Smart Motorways Programme

Environmental Assessment Report

Tranche 5 – A1(M) J6 to 8 (Preliminary Design – PCF Stage 3)

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Introduction

Highways England has commissioned WSP to design and assess a proposed Smart Motorway - Motorway - All Lane Running scheme on the A1(M) between junction 6 at Welwyn and junction 8 north of Stevenage, referred to in this report as the 'Proposed Scheme' at Project Control Framework Stage 3. The Proposed Scheme lies within the county of Hertfordshire (see Figure 1.1 for a location plan). Highways England expects to commence construction of the Proposed Scheme in 2020 and it is expected to take approximately two years to construct, including commissioning.

The Proposed Scheme would provide three permanent running lanes, by converting the hard shoulder into a running lane (lane1), between junction 6 and 8. Through junction running will be provided at junction 6 (northbound only) and junctions 7 and 8. The All Lane Running will be supported through the installation of technology to monitor conditions and inform drivers. A full description of the Proposed Scheme is provided in Chapter 2: The Proposed Scheme, with a summary below:

- Thirty overhead gantries (including 28 new gantries, 2 retained gantries where existing foundations would be reused). Five of the new gantries will be fitted with advanced motorway indicators and all 28 will include variable messaging signs. These will display variable speed limits based on traffic conditions.
- Twelve emergency areas, 2 places of relative safety and 4 new short sections of hard shoulder will be installed. Six emergency areas, 1 place of relative safety and 2 new short sections of hard shoulder on the northbound carriageway and 6 emergency areas, 1 place of relative safety and 2 new short sections of hard shoulder on the southbound carriageway. They will be constructed to provide a safe area for vehicles to stop in an emergency without interrupting the flow of traffic.
- Cameras and loop detectors will provide information to support the technology, where through junction running will be introduced.
- Hardening of the central reserve and installation of a rigid concrete barrier along the majority of the Proposed Scheme between junction 6 and 8 (excluding a section of soft verge that has been proposed north of junction 7).

This Environmental Assessment Report presents the findings of the non-statutory environmental assessment undertaken to identify and assess potential environmental effects that could arise from the Proposed Scheme and proposes mitigation measures to minimise these effects in order to inform the planning, design and construction process and satisfy legal obligations.

Overview of study area

The A1(M) is a strategic route that carries an annual average daily traffic of 7 to 8% of heavy goods connecting London, the East Midlands, Yorkshire and the North East as well as connecting to the wider Strategic Road Network. The A1(M) between junction 6 and 8 is a busy section of the London to Leeds (East) route with existing capacity problems. Every junction is close to existing or possible future housing sites with the potential to accommodate up to 13,000 additional new homes by 2030.

Air quality

A detailed air quality assessment has been undertaken to establish the potential effects of the Proposed Scheme with the core scenario of base year 2017.

In addition to this core scenario, the following additional scenarios were examined in order to ensure the avoidance of any adverse air quality effects:

- Projected base year 2022 (and 2037 for regional air quality assessment only);
- Opening year Do Minimum 2022 (and 2037 for regional air quality assessment only); and
- Opening year 'Cumulative Worst Case' Do Something 2022 (and 2037 for regional air quality assessment only.

The following schemes were taken into consideration in the air quality modelling:

- A14 Cambridge to Huntingdon;
- M1 Junction 13 to 16 Smart Motorway;
- A5/M1 J11a Link;
- M25 Junction 25 improvement;
- M25 Junction 28 improvement;
- A428 Black Cat to Caxton Gibbet; and
- M11 Junction 7a

Construction impacts were scoped out in the Environmental Scoping Report, May 2018 (Highways England – document reference MP0135-HEX-EGN-ZZ-AS-KK-0001) and so have not been considered in this assessment.

The detailed assessment of local air quality has focused on the impacts of the air pollutant nitrogen dioxide, as the air quality criteria for this pollutant are those most likely to be exceeded in the air quality assessment study area.

The air quality assessment for the 'core' scenario indicates that there are no significant adverse air quality effects.

Beyond the Proposed Scheme there are no potentially significant adverse air quality effects predicted for any other geographical area for the core scenario.

There are no design or mitigation measures required for the Proposed Scheme after opening, as no significant air quality effects are predicted.

In terms of regional emissions, there is a predicted increase in all pollutant emissions of between 0.8-4.0% in the opening year (2022) and between 2.6-5.5% in the design year (2037). This is due to the 4.1% (opening year) and 5.7% (design year) predicted increase in vehicle kilometres travelled compared to without the Proposed Scheme.

Knebworth Woods Site of Special Scientific Interest and Sherrardspark Wood Site of Special Scientific Interest experience an increase in annual mean oxides of nitrogen concentration and nitrogen deposition levels. The potential for significant adverse effects on these sites is considered within Chapter 6: Biodiversity, however no significant effects are predicted.

Overall, no significant air quality effects are predicted as a result of the construction or operation of the Proposed Scheme and it can progress without the need for mitigation.

Biodiversity

Designated sites for nature conservation included within the Habitats Regulations Assessment screening comprise:

- Everden and Wimpole Woods Special Area of Conservation;
- Lee Valley Special Protection Area; and
- Lee Valley Ramsar site.

As a result of the distance of the designated sites from the Proposed Scheme and the lack of potential impact pathways, the Habitats Regulations Assessment screening process did not identify any potential for the Proposed Scheme to cause an adverse effect on the integrity of any of the European Sites listed above.

Knebworth Woods Site of Special Scientific Interest and Sherrardspark Wood Site of Special Scientific Interest, three areas of ancient woodland and 14 Local Wildlife Sites lie within the zone of influence of the Proposed Scheme (i.e. 200m from the affected road network). Surveys undertaken have recorded the presence of, or suitable habitats to support, roosting bats, great crested newts, badger, otter, water vole and breeding birds. Additional survey work to support any potential licence works for protected species will be undertaken pre-construction.

Construction will involve temporary loss of habitats within soft estate, which will have temporary effects on resource availability for the aforementioned notable and/or legally protected species, but these effects are not considered to be significant with respect to the favourable conservation status of these species. Nevertheless, mitigation and compensation measures will be required, such as appropriate timing of site clearance and enabling works as detailed in the Outline Environmental Management Plan.

The biodiversity assessment concludes that there are no significant effects anticipated on any international, national or locally designated sites for nature conservation or on the favourable conservation status of notable and/or legally protected species as a result of the construction or operation of the Proposed Scheme.

Landscape and cultural heritage

The landscape is not covered by any national designation. The landscape to the west of the A1(M) is characterised by open farmland or woodland, interspersed with small scale settlement patterns in the north and larger urban areas in the south. To the east, urban influences are more apparent due to the presence of larger settlements at Stevenage, Knebworth and Oaklands. These consist of a range of built elements, including residential properties, commercial and industrial buildings. These are commonly set back or screened by fencing treatments or established belts of vegetation present within narrow verges.

Insofar as cultural heritage is concerned, the following assets are located within the zone of influence of the Proposed Scheme:

- Dicket Mead Roman Villa Scheduled Monument;
- Lockleys Roman Villa Scheduled Monument;
- Knebworth Grade II Registered Park and Garden;
- Homewood Grade II Registered Park and Garden;
- Thatched Cottage Grade II listed building; and
- The Dairy, the Old Farmhouse and the Tudor House at Stebbing Farm Grade II* listed building.

The removal of sections of existing mature vegetation, along with additional gantries, signs and noise barriers, will increase the dominance of the motorway as a locally prominent feature. This will not result in significant effects on the landscape character both with and without established mitigation planting. Although additional gantries and signs would slightly exacerbate the prominence of the motorway, the residual effects on the setting of the local landscape character areas with mitigation are considered to be not significant.

There would be localised visual intrusion on sensitive visual receptors as a result of construction works, vegetation clearance and the addition of new infrastructure. However, gantries, emergency areas and cabinet sites have been located to reduce potentially significant visual effects. The mitigation strategy includes the reinstatement of vegetation lost as a result of the Proposed Scheme, where feasible. The assessment concludes that in the long term following establishment of the mitigation planting, there would be no permanent significant effects on landscape, visual amenity or the setting of cultural heritage assets.

During construction, potentially significant localised effects have been identified for 1 key visual location, this does not reduce at year 1 of operation, although reduces to not significant by the design year (15 years following opening). Due to the very localised and relatively temporary nature of each impact, it is concluded that the overall residual effects of the Proposed Scheme on visual amenity would not be significant.

In terms of heritage assets, effects on setting during construction would be not significant, and would generally reduce at year 1 and year 15 of operation. Due to the very localised and relatively temporary nature of each impact, it is concluded that the overall residual effects of the Proposed Scheme on the setting of heritage assets would not be significant.

Noise and vibration

There are 12 noise Important Areas within the wider calculation area, with 10 occurring along the Proposed Scheme. There are 5 existing noise barriers along the length of the Proposed Scheme at the following locations:

- Near the Avenue Underbridge;
- Near the Brambles, Oaklands;
- Near Normans Lane;
- Near the Meadway Underbridge; and
- Near Symonds Green.

During the operational phase, no significant effects are predicted as an overall beneficial effect is anticipated when compared to the situation without the Proposed Scheme in the opening year (2022). This outcome is as a result of the Proposed Scheme providing 5 new noise barriers and low noise surfacing on all lanes.

In the short term (Do Minimum 2022 vs Do Something 2022), approximately 3% of residential properties are expected to experience a negligible increase in noise level, whilst 4 residential properties are expected to experience a minor increase of less than 3 decibels. These properties are located approximately 1km to the west of junction 8, along Stevenage Road and are not located within a noise Important Area. The majority of the remaining residential properties are expected to experience no change or a negligible decrease in noise levels. A total of 1,044 properties in Fishers Green, Symonds Green, Pottersheath, Oaklands, Danesbury and Welwyn are expected to experience minor noise decreases of less than 3 decibels with a further 96 properties in Fishers Green, Pottersheath, Oaklands, Danesbury and Welwyn expected to experience a moderate or major reduction in noise.

In the long term (Do Minimum 2022 vs Do Something 2037), the motorway would have been provided with low noise surfacing across all lanes of both carriageways. Nevertheless, as a result of a growth in traffic, a total of 1,426 residential properties are expected to experience a negligible increase in noise levels. The vast majority of residential properties (approximately 65% of the total) are expected to experience no change or negligible decreases in noise levels for the daytime period, along with 9 properties which are expected to experience minor or moderate noise decreases.

In the long term, 124 residential properties are expected to experience noise increases during the night-time, all of which are negligible. The vast majority of residential properties (approximately 85% of the total) are expected to experience no change or negligible decreases in noise levels for the night-time period. A total of 8 properties in Fishers Green, Pottersheath, Oaklands, Danesbury and Welwyn are expected to experience a minor or moderate noise decrease in noise.

There are no significant adverse effects predicted as a result of the operation of the Proposed Scheme with or without the proposed noise barriers. In terms of addressing the Noise Policy Statement for England, Aim 1 (to avoid) has been addressed by consideration of the 5 proposed noise barriers and new low noise surfacing to reduce the number of properties exposed to noise levels above the Significant Observed Adverse Effect Level SOAEL. Similarly, for Aim 2 (to mitigate and minimise) consideration has been given to the 5 proposed noise barriers and the new low noise surfacing to reduce the number of properties exposed to noise levels between the Lowest Observed Adverse Effect Level LOAEL and Significant Observed Adverse Effect Level. With regard to Aim 3 (contribute to the improvement of health and quality of life) there are no further measures which are not listed against Aim 1 or 2.

During construction, as motorway traffic would be under traffic management and on occasions be further away from receptors, so a noticeable reduction in noise levels is anticipated which on occasions would be interrupted by construction noise that could give rise to localised temporary (non-significant) adverse impacts.

Construction noise and vibration is anticipated to require high levels of management to avoid undue disturbance at locations where noise barriers are to be temporarily removed (Oaklands and Symonds Green), where piling works may be required (Todds Green, Fishers Green, Symonds Green, Norton Green, Knebworth, Rabley Heath, Potters Heath, Oaklands, Danesbury and Welwyn) or where night-time vegetation clearance may be required (Rabley Heath, Old Knebworth, Norton Green, Symonds Green, Oaklands, and Welwyn).

Of the available diversion routes, a total of 872 residential receptors are located within 50m of the routes, with the following communities having a potential to be adversely affected by the diverted traffic which would most frequently be at night:

- Woolmer Green;
- Knebworth Village;
- Oaklands;
- Fishers Green; and
- Symonds Green

The Construction Environmental Management Plan will set out the measures to be taken to ensure that noise and vibration levels are reduced to the lowest levels and durations possible.

Road drainage and the water environment

The drainage system does not discharge to any surface water features that flow directly into any designated sites for nature conservation or water abstraction point. The drainage system infiltrates surface water to ground within Zones 2 and 3 of a designated Source Protection Zone protected for public water supply.

The Proposed Scheme will result in no residual effect on surface water flow and flood risk. While the Proposed Scheme includes the provision of 12 emergency areas, 2 places of relative safety and 4 new short sections of hard shoulder and paved central reserves, giving rise to a small increase in the impermeable area, the drainage system will provide for no increase in the rate of discharge from the baseline situation. Attenuation, most likely by oversize pipes, will include a 20% allowance for climate change for the additional impermeable area.

There are not anticipated to be any significant effects on flooding resulting from the Proposed Scheme. Emergency areas and gantries are located within the low risk Flood Zone 1.

As a result of the Proposed Scheme, traffic flows are predicted to increase by more than 20% in certain links along the mainline. The application of the HAWRAT assessment methods has indicated there would be no significant residual effects when compared to the assessment of baseline conditions.

Following a review of the Highways Agency Drainage Data Management System, there are no Priority ‘A’ and no Not Determined Priority Outfalls along the length of the Proposed Scheme. However, the cumulative HAWRAT assessment of discharge to the Ash Brook indicates the potential for a Priority B outfall, both in the Do mimimum and Do Something scenario, which would need ratification prior to formal designation as a Priority Outfall.

A Construction Environmental Management Plan will provide protection of watercourses and floodplains during construction. Where works are being undertaken near to watercourses, then a Water Framework Directive compliance statement may be required.

Population and health

As the Proposed Scheme does not give rise to significant adverse operational noise or air quality effects, so these key environmental determinants of health would not contribute to an adverse effect upon population and health. Temporary construction activities have the potential to give rise to localised sleep disturbance of nearby residents, but such effects would be of insufficient duration to contribute towards an adverse health outcome for most of the population. As some residents may have existing health conditions that increase their sensitivity to construction disturbance, an elevated level of engagement with local residents will ensure that adequate notification of the works, as well as mitigation measures, are in place to avoid contributing to an adverse health outcome for a small number of residents.

In terms of the works that may adversely affect levels of stress, the removal of screening vegetation or the introduction of a new source of visual intrusion (new gantry or sign) may give rise to heightened anxiety. Indeed, the removal of screening vegetation may lead to a perception that noise levels have been made worse, again on a highly localised basis. While efforts will be taken to retain screening vegetation, some loss is inevitable. In those situations, an elevated level of engagement with local residents will ensure that adequate notification of the works, as well as mitigation measures where practicable, are in place to avoid contributing to an adverse health outcome for a few residents.

The Proposed Scheme does not involve any substantive change to the design of junctions and hence there would be no physical effect on the movement of non-motorised users. Increased motorway traffic however, is anticipated to affect the ability of the non-motorised users to cross the slip roads, potentially increasing severance. Chapter 2: The Proposed Scheme records measures (if any) to be undertaken at junctions to improve safety and potentially reduce severance.

The Proposed Scheme does not involve the demolition of structures used by non-motorised users and thus no adverse effect would result on the ability of people to exercise or impose increased risks to personal safety.

For the above reasons, no health effects assessment has been considered necessary.

Cumulative effects

The cumulative effects assessment considers two types of cumulative effects:

- **Intra-project cumulative effects:** Those caused only by the Proposed Scheme occurring when an individual receptor or group of receptors would experience multiple effects; for example, a community experiencing noise, air quality and visual amenity effects.
- **Inter-project cumulative effects:** Those caused by a combination of the Proposed Scheme with other relevant developments.

Intra-project cumulative effects

Whilst the topic assessments have, in many cases, considered the same receptors, it is considered that there would be no combined effects that would be considered significant.

During construction, it is considered that mitigation measures would be sufficient to mitigate any single effects to such a level that no significant combined effects would arise. Loss of vegetation will be temporary and be replaced by mitigation planting where possible, and therefore it is concluded that there is no potential for cumulative landscape and ecological effects.

Inter-project cumulative effects

The traffic model takes account of consented developments and road schemes in the wider region around the Proposed Scheme, including development projects at a greater distance than 1km and consequently, the air quality, noise and road drainage and water environment assessments are inherently cumulative assessments.

Other relevant projects as up to January 2019 were identified using a selection criteria methodology including scale, distance from the Proposed Scheme and development type. A total of 2 land use developments were identified, but no transport schemes were identified in addition to those already identified in the traffic model. Each identified development was examined to determine the potential for interactions with the Proposed Scheme that may result in significant cumulative effects. It is considered that there would be no significant cumulative effects, mainly due to distance of receptors and the proposed nature of the works.

Monitoring

The environmental assessment of SMP schemes that are delivered without recourse to the Development Consent Order process, conclude that significant effects are not expected due to the deployment of standard construction management or operational practices.

Also, measures identified during the design and assessment and recorded in the Outline Environment Management Plan are intended to avoid significant adverse effects.

Some situations may arise where there is uncertainty in the outcome or the effectiveness of a mitigation measure for which it may be appropriate to consider the adoption of targeted monitoring to enable corrective measures to be taken and also to demonstrate effectiveness for the benefit of other schemes. In this context, the Outline Environmental Management Plan has identified that there are approximately 3 locations where monitoring of the mitigation measure and/or its effectiveness is required.

Conclusion

As described above, no significant adverse environmental effects have been identified. The Proposed Scheme includes design measures to avoid and/or reduce effects as well as address existing environmental issues. Also, a spatially specific risk based approach has been taken towards the specification of the environmental management measures to be implemented during the delivery and operation of the Proposed Scheme. This is supported by mapping that highlights where specific environmental management clauses across the environmental topics occur.

An overview of the environmental management measures is provided in each topic chapter, with details being provided in the Outline Environmental Management Plan.

1. Introduction

1.1 Background to the Smart Motorway Programme

1.1.1 Highways England has commenced a programme to introduce Smart Motorways to actively manage traffic and improve journeys on their motorway network. Smart Motorways are managed by Regional Control Centres (RCC), using technology to deploy Highways England traffic officers to incidents and to help keep traffic moving.

1.1.2 Early schemes used a combination of variable mandatory speed limits and extra capacity through the use of the hard shoulder as a running lane during peak traffic periods. The current schemes (those that started design development from 2013 onwards) will be built to a new design standard in accordance with Interim Advice Note (IAN) 161/15: Smart Motorways.

1.1.3 Smart Motorways have the following key features:

- Mandatory speed control, using variable speed limits displayed on special Advanced Motorway Indicators (AMIs) equipped with 'Red Rings', mounted above each lane on standard gantries (installed at nominal 1km intervals);
- Automatic signal setting in response to traffic conditions, with additional driver information displayed on Variable Message Signs (VMS); and
- Speed enforcement using automatic camera technology.

1.1.4 The new design provides additional capacity by making the hard shoulder available for use as a traffic lane at all times.

1.1.5 Smart Motorways are being delivered as a programme to support the achievement of the following national objectives:

- The Treasury's Business Plan 2011-2015 to secure an economy that is growing sustainably, is more resilient, and is more balanced between public and private sectors and between regions through developing a more effective transport network that facilitates movement of people, goods and services between places;
- The Government's priority to invest in the Strategic Road Network (SRN) to promote growth and address the congestion that affects people and businesses, and continue to improve road safety as set out in the Department for Transport (DfT) Business Plan 2011-15;
- Delivering a Sustainable Transport System, implementing the recommendations of the Eddington Transport Study 2006, through enhancing national networks to tackle congestion, capacity constraints and unreliability in particular on key inter-urban corridors and international gateways; and
- Support continued enhancements to the Trans European Road Network and secure the benefits it gives in terms of maintaining international connectivity for road users.

1.1.6 The programme also supports the Strategic Outcomes of Highways England, as defined in its Delivery Plan 1, directly contributing to the following outcomes:

- Supporting economic growth; and
- Achieving a freer flowing network.

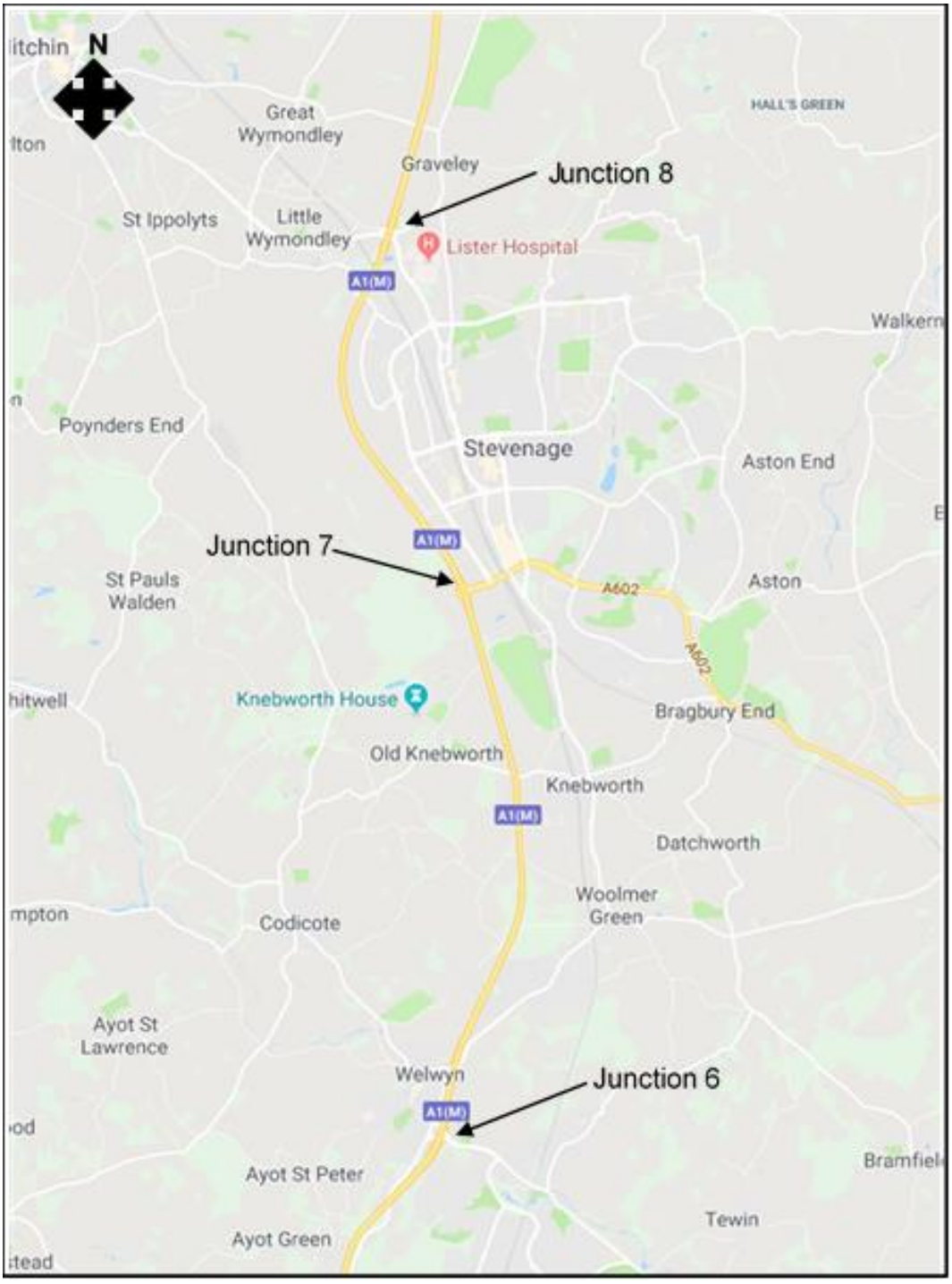
1.1.7 In addition to these direct contributions, the Smart Motorways Programme supports the Strategic Outcomes of 'A Safe and Serviceable Network', 'Improved Environment' and an 'Accessible and Integrated Network'. Support of these outcomes should support an improvement in user satisfaction.

[1] Highways England. (2015). *Highways England Delivery Plan 2015-2020*.

1.2 The Proposed Scheme

1.2.1 Highways England is proposing to upgrade the A1(M) Motorway between junction 6 at Welwyn and junction 8 to the north of Stevenage to a Smart Motorway, referred to in this report as the 'Proposed Scheme'. The Proposed Scheme lies within the county of Hertfordshire (see Figure 1.1 for a location plan). Highways England expects to commence construction of the Proposed Scheme in 2020 and is expected to take approximately 2 years to construct, including commissioning.

Figure 1.1 - Proposed Scheme location plan[2]



[2] Google Maps, 2018. *Map of Hertfordshire, Stevenage and Welwyn A1(M) J6-8.* 27 September 2018. (https://www.google.com/maps/@51.8488477,-0.1807754,11.03z).

1.2.2 The Proposed Scheme would provide three permanent running lanes, by converting the hard shoulder into a running lane (lane1), between Junction 6 and 8. Through junction running will be provided at junctions 6, 7 and 8. All lane running (ALR) will be supported through the installation of technology to monitor conditions and inform drivers. A full description of the Proposed Scheme is provided in Chapter 2: The Proposed Scheme.

1.2.3 Smart Motorways use active traffic management (ATM) techniques to increase capacity by use of variable speed limits and hard shoulder running. The Proposed Scheme will include all lane running along 16.7km (10.4 miles) by permanently converting the hard shoulder into a lane for traffic to use. This will relieve congestion, improve journey times and reliability, maintain safety levels and support the economic development.

1.2.4 Highways England is proposing to upgrade the motorway as an improvement scheme under the Highways Act 1980. As an improvement scheme with no permanent works beyond the existing highway boundary, the Proposed Scheme falls under Highways England's permitted development rights.

1.3 Purpose of this Environmental Assessment Report

1.3.1 Highways England has commissioned WSP to design and assess the Proposed Scheme at Project Control Framework (PCF) Stage 3.

1.3.2 This Environmental Assessment Report (EAR) presents the findings of the non-statutory environmental assessment undertaken to identify and assess the likelihood of potential significant environmental effects that could arise from the Proposed Scheme. It recommends mitigation, rectification and enhancement measures, which aim to fulfil the environmental objectives noted within the Roads Investment Strategy (RIS) and Highways England's Licence.

1.3.3 While no significant residual effects are predicted, the conclusions of the environmental assessment process are recorded and summarised in a separate Environmental Impact Assessment (EIA) Screening (Determination) document and then published in a formal public Notice of Determination (NoD), as required by IAN 126/15[3].

1.3.4 The purpose of this non-statutory EAR is to:

- Describe the Proposed Scheme;
- Describe the baseline environment;
- Assess any likely significant effects on environmental receptors in line with the recommendations of the Environmental Scoping Report[4];
- Assess likely cumulative effects on environmental receptors;
- Describe mitigation and rectification measures to minimise potentially significant effects;
- Identify potential enhancement opportunities for the Proposed Scheme; and
- Aid preparation of an Outline Environmental Management Plan (OEMP).

1.3.5 For the purposes of this EAR, the assessment of the Proposed Scheme has been undertaken using a Design Fix 2 (DF2) layout and developed as the design has changed.

1.3.6 As a result of the Environmental Scoping Report, various topics were scoped out of consideration in the EAR but may require measures to be identified within the OEMP. These are detailed in Section 4.2 of this EAR.

1.3.7 This EAR is supported by other related documents produced at PCF Stage 3, including:

- The OEMP (HE551539-WSP-EGN-SG-RP-LE-00014); and
- A Habitats Regulations Assessment (HRA) Screening Report (HE551539-WSP-EBD-SG-RP-LE-0001).

[3] Interim Advice Note 126/15 - Environmental Assessment Screening and Determination
http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian126r2.pdf
[4] Highways England 2018: A1(M) J6 to J8 Smart Motorway Scoping Report, MP0135-HEX-EGN-ZZ-AS-KK-0001

1.3.8 An OEMP has been developed at this stage of the programme, based on a Register of Environmental Actions and Commitments (REAC), and will be developed further to form the basis for the Delivery Partner's Construction Environmental Management Plan (CEMP).

1.3.9 Any subsequent design change through to DF4 / DF5 (detailed design) and beyond are unlikely to lead to a change in the significance of the effects of the Proposed Scheme, but may have an influence on the definition of measures to be reported within the OEMP. Any such changes would be recorded and assessed in the Evaluation of Change Register.

1.4 Reporting

1.4.1 This EAR has been structured in the following manner.

Table 1.1 - Report structure

Chapter	Title	Description
1	Introduction	Introduces the Proposed Scheme, indicates the background to and purpose of this EAR, summarises the applicable regulatory framework, and structure of the Report.
2	The Proposed Scheme	Provides a detailed description of the Proposed Scheme.
3	Alternatives for Consideration	Discusses the alternatives considered for the Proposed Scheme.
4	Approach to Assessment	Outlines the scoping report outcomes and EIA methodology including the approach to significance, mitigation and enhancement.
5 to 9	Topics 'Scoped in'	The technical topics for which the environmental assessment has been undertaken (i.e. those that have the potential to experience significant environmental effects arising from the Proposed Scheme). Each topic chapters covers study area and baseline, limitations to the assessment, applicable regulatory framework, mitigation, impact magnitude, environmental management and residual effects.
10	Assessment of Combined and Cumulative Effects	Details the assessment of cumulative effects undertaken for the Proposed Scheme.
Appendices		
1.1	Professional Competency	Details of the competent experts that have undertaken the assessments for each topic.
2.1	General Arrangement Drawings	-
5.1 to 5.7	Air Quality	-
6.1	A1(M) Junction 6 to 8 Smart Motorway Ecological Survey Report	-
7.1	Visual Effects Schedule	-
8.1 to 8.5	Noise and Vibration	-
9.1	HAWRAT Assessment Summary	-
10.1	Relevant Development Proposals for the Cumulative Effects Assessment	-

1.5 Regulation and guidance

Environmental Impact Assessment Directive

1.5.1 The EIA Directive 2011/92/EU was amended by the EIA Directive 2014/52/EU which was transposed into English legislation in June 2017[5]. Highways England issued guidance in May 2017, and revised it in May 2018, to ensure that all projects are considered in accordance with the Directive. Table 1.2 details how this EAR meets those requirements.

Table 1.2 - Fulfilment of the amended EIA Directive (2014/52/EU)

EIA Directive Requirement	
Consideration of the demolition phase.	The demolition works for the Proposed Scheme is described in Chapter 2: The Proposed Scheme, Section 2.5.14. Demolition is 'scoped out' of assessment in the EAR, however mitigation measures will be included in the OEMP as appropriate.
Evolution of the environment 'without the Scheme'	The approach to assessing the 'Future Baseline' is described in Chapter 4: Approach to Assessment, Section 4.3.3 with each topic providing details of how that aspect would evolve without the Proposed Scheme.
Biodiversity	The topic has been re-titled by the directive as Biodiversity.
Population & human health	Health effects are generally scoped out of Smart Motorways Programme schemes since the intention is to avoid a deterioration in air quality and also to reduce noise levels as part of the scheme design. Where a health risk has been identified, then the topic is reported in Chapter 10: Assessment of Combined and Cumulative effects. For this Proposed Scheme, no health risk was identified and therefore the assessment of population and human health was scoped out (for further details see Chapter 4: Approach to assessment).
Land	Smart Motorways Programme schemes (delivered outside of the Development Consent Order (DCO) process) do not involve the use of land not in public ownership. As a result, it is not intended to report land further (for further details see Chapter 4: Approach to assessment).
Climate	The approach to the assessment of climate, which is scoped out is described in Chapter 4: Approach to Assessment, Section 4.2.
Major Accidents and Disasters	The assessment of this topic was 'scoped out'. Further detail is provided in the Scoping Report.
Heat and Radiation	The assessment of this topic was 'scoped out'. Further detail is provided in the Scoping Report (see Section 4.2).
Monitoring	The approach to monitoring is described in Chapter 4: Approach to Assessment, Section – 4.3.15.
Expertise for EIA	The expertise used in the assessment of each topic is presented in Appendix 1.1.

1.5.2 Under the Directive 2014/52/EU and current EIA regulations in England, those developments listed under Annex II may need to be subject to statutory EIA depending on whether the Proposed Scheme qualifies as a 'relevant project' (that is if it meets certain criteria and thresholds defined in Annex II) and gives rise to significant effects (see Annex III of the EIA Directive). A modification to a motorway is identified as an Annex II project.

[5] The Town and Country Planning (Environmental Impact Assessment) Regulations 2017 http://www.legislation.gov.uk/uksi/2017/571/contents/made

1.5.3 In England and Wales, the requirements of the EIA Directive with regards to road projects is enacted through the Highways Act 1980, as amended by the EIA (Miscellaneous Amendments Relating to Harbours, Highways and Transport) Regulations 2017. Screening procedures that accord with the requirements of the EIA Regulations exist within Highways England to determine whether trunk road and motorway developments require statutory EIA. This process is known as Determination with this EAR informing that process.

1.5.4 Where significant effects are anticipated, a statutory EIA would be prepared under the Planning Act 2008 and the Infrastructure Planning (EIA Regulations 2017). In the event of no significant effects being predicted, the conclusions of the EAR are recorded in an EIA Screening (Determination) and published in a Notice of Determination.

Guidance documents

1.5.5 The EAR has been produced in accordance with Design Manual for Roads and Bridges (DMRB) Volume 11: Environmental Assessment[6] and the following associated IANs:

- IAN 161/15 – Smart Motorways[7];
- IAN 183/14 – Environmental Management Plans[8];
- IAN 125/15 – Supplementary guidance for users of DMRB Volume 11 'Environmental Assessment Update'[9];
- IAN 184/15 – Updated Traffic, Air Quality and Noise Advice on the Assessment of Link Speeds and Generation of Traffic Data into Speed-Bands for Users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA207/07) and Volume 11, Section 3. Part 7 Noise (HD213/11); and
- IAN 126/15 – Environmental Assessment, Screening and Determination[10].

1.5.6 For the Smart Motorways Programme, the above guidance is tempered by consideration that it was principally developed for application on green-field, new strategic highway routes, whereas Smart Motorways Programme schemes are delivered within the existing highway estate. Specific advice is set out in the Smart Motorways Programme Design Guide Environmental Annex[11] which address the following topics:

- E5.01 – Site Clearance
- E5.02 – Soft Estate;
- E5.03 – Assessment of existing noise barriers (EnvTN08);
- E5.04 – Noise assessment methodology (EnvTN09);
- E5.05 – Cost Benefit Ratio analysis of noise barriers (EnvTN10)
- E5.06 – Construction noise and vibration assessment (EnvTN11);
- E5.07 – Noise Surveys (EnvTN13);
- E5.08 – Candidate Construction Compound Site Tool;
- E5.09 – Ecological Survey Report Template;
- E5.10 – Environmental Data (Specification and Reporting) to Smart Motorways Programme Geographical Information Systems (GIS); and
- E5.11 – Dynamic Reporting of Environmental Risk.

1.5.7 Additional guidance is listed for each topic specific assessment in the Chapters 5 to 10.

1.5.8 The scope and content of this EAR have been informed by the A1(M) Junction 6 to 8 Scoping Report.

[6] The Design Manual for Roads and Bridges (DMRB) Volume 11: Environmental Assessment: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/index.htm
[7] IAN 161/15 – Smart Motorways: http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/IAN161_15.pdf
[8] IAN 183/14 - Environmental Management Plans: http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian183.pdf
[9] Supplementary guidance for users of DMRB Volume 11 'Environmental Assessment Update': http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian125r2.pdf
[10] IAN 126/15 - Environmental Assessment, Screening and Determination: http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian126r2.pdf
[11] Environmental Annexes of the Design Guide are available on request.

Highways England Licence requirements

1.5.9 It is the responsibility of Highways England to comply with (or have due regard to) the conditions set out in the Highways England Licence (April 2015)[12], which constitute statutory directions and guidance issued by the Secretary of State for Transport to the Licence holder, as provided for in section 6 of the Infrastructure Act 2015[13].

1.5.10 The relevant Licence requirements that this EAR must consider, on behalf of the Licence holder, are 4.2 g and h, as follows:

- (g) Minimise the environmental impacts of operating, maintaining and improving its network and seek to protect and enhance the quality of the surrounding environment; and
- (h) Conform to the principles of sustainable development.

Roads Investment Strategy

1.5.11 The RIS was published in December 2014[14], setting out a long-term strategic plan for investment in the Strategic Road Network between 2015 and 2020. Smart Motorway Programme schemes consider the RIS Objectives and seek to:

- Reduce noise levels within noise Important Areas (see Chapter 8: Noise and Vibration);
- Deliver no net loss in biodiversity (see Chapter 6: Biodiversity);
- Enhance landscape setting (See Chapter 7: Landscape and Cultural Heritage); and
- Improve the quality of runoff at priority outfalls (see Chapter 2: The Proposed Scheme, section 2.4).

1.5.12 The RIS objectives are considered within each relevant discipline chapter in which the enhancement measures, where applicable, proposed to deliver the Licence requirements and RIS objectives are summarised.

1.6 Expertise used to undertake the assessment

1.6.1 All environmental reports and other technical reports must be provided with details of the competent experts that have undertaken the assessments. This is to include individual lead topic specialists, the Environmental Coordinator and those responsible for assuring the quality of the report. This expectation is to fulfil requirements of EU Directive 2014/52/EU.

1.6.2 The Environment Coordinator and Quality Assurance Lead for this EAR are detailed in Table 1.3 below. The expertise of the specialist topic leads can be found in Appendix 1.1.

Table 1.3 - Professional competency

Name and Role	Grade and Company	Expertise and Professional Qualification
Catherine Sugden BSc (Hons) MSc MIEMA, CEnv Environmental Coordinator	Associate, WSP	Coordination of numerous EIAs including: • Drax Repower DCO EIA • High Speed 2 Phase 2b Crewe to Manchester Draft Environmental Statement • East West Rail Transport and Works Act Order EIA • Hirwaun Power Project DCO EIA.
		Bsc (Hons) Environmental Science Msc Carbon Capture and Storage Full and Chartered Member of the Institute of Environmental Management and Assessment (IEMA)

[12] Highways England License: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/431389/strategic-highways-licence.pdf
[13] Infrastructure Act (2015): http://www.legislation.gov.uk/ukpga/2015/7/pdfs/ukpga_20150007_en.pdf
[14] Road Investment Strategy (2014): https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/408514/ris-for-2015-16-road-period-web-version.pdf

Name and Role	Grade and Company	Expertise and Professional Qualification
Leon Bailey Bsc (Hons) GradIEMA Environmental Coordinator	Assistant Environmental Consultant, WSP	Input and coordination of the preparation of the EAR for ongoing Highways England projects, including M62 J20-25 Smart Motorway and Norcross Roundabout (Blackpool). In addition to input to the M62 J10-12 Evaluation of Change Register.
		BSc (Hons) Environmental Science Graduate Member of the Institute of Environmental Management and Assessment (IEMA)
Andrew Thornhill BSc (Hons) MPhil Technical Assurance	Technical Manager, WSP	Coordination and/ or technical assurance of numerous EARs for Smart Motorway and other major technology and highways schemes including: • M42 ATM Pilot • Birmingham Box Managed Motorways 1 and 2 • Birmingham Box Phase 3 Managed Motorways • M1 Smart Motorways J28-31 and J32-35a Andrew has also provided technical input to Highways England IAN 161/15: Smart Motorways and other IANs.
		BSc (Hons) Agricultural Zoology MPhil Landscape Design Chartered Member – Landscape Institute
David Hoare BSc (Hons), MSc, CEnv, MCIEEM, PIEMA Technical Assurance	Associate Director, WSP	Coordination and technical assurance of numerous EIAs, including: • M4 J3-12 Smart Motorway • Trans-Pennine Upgrade • M62 J20-25 Smart Motorway • Preesall Underground Gas Storage Facility
		BSc (Hons) Geography MSc Ecology and Environmental Management Chartered Member of the Society for the Environment Full Member of the Chartered Institute of Ecology and Environmental Management Practitioner Member of the Institute of Environmental Management and Assessment

1.7 Stakeholder engagement

1.7.1 As a non-statutory scheme, no formal consultation has been undertaken in the production of the EAR. However, liaison has been undertaken with the following stakeholders to gather baseline information to inform this assessment:

- Historic England – contacted 08 November 2018, response received 13 November 2018;
- Environment Agency – contacted 04 October 2018, response received 12 November 2018;
- Hertfordshire County Council – contacted 04 October 2018, response received 17 October 2018; and
- Kier Highways – for further information refer to Chapter 7: Landscape and Cultural Heritage.

2. The Proposed Scheme

2.1 Need for the Proposed Scheme

2.1.1 The A1(M) is a strategic route that carries an annual average daily traffic (AADT) of 7 to 8% of heavy goods connecting London, the East Midlands, Yorkshire and the North East as well as connecting to the wider Strategic Road Network (SRN). The A1(M) between junction 6 and 8 is a busy section of the London to Leeds (East) route with existing capacity problems. Every junction is close to existing or possible future housing sites with the potential to accommodate up to 13,000 additional new homes by 2030.

2.1.2 The motorway is within a rural and urban setting. Congestion and unreliable journey times are experienced at busy periods and traffic is predicted to continue to grow. Weekday flow profiles show similar trends, although it is noted that the Friday afternoon period flows tend to be higher. There is a regular fluctuation in traffic flows with southbound flows highest in the morning peak as traffic commutes towards London, while northbound flows are highest in the evening peak.

2.1.3 The Highways England baseline traffic data reported the following:

Northbound

- At an average speed of 113km/hr (70mph), the northbound journey time should take 7.0 minutes between junction 6 to 8 for weekdays;
- The average northbound journey time in a typical morning period (7am to 10am) was 8.2 minutes between junction 6 to 8, which is an average delay of 1.2 minutes for every light vehicle;
- In the inter-peak period (10am to 4pm) this journey time is similar at 8.2 minutes between junction 6 to 8, although this still represents an average delay of 1.2 minutes for every car travelling northbound; and
- PM peak period (4pm to 7pm) in a northbound direction, the average journey time is 11.1 minutes between junction 6 to 8, equivalent to a delay of 4.0 minutes for each light vehicle.

Southbound

- At an average speed of 113km/hr (70mph), the southbound journey time should take 7.0 minutes between junction 6 to 8 for weekdays;
- The average southbound journey time in a typical morning period (7am to 10am) was 11.0 minutes between junction 6 to 8, which is an average delay of 4.0 minutes for every light vehicle;
- In the inter-peak period (10am to 4pm) this journey time improves to 7.8 minutes between junction 6 to 8, although this still represents an average delay of 0.8 minutes for every car travelling southbound; and
- PM peak period (4pm to 7pm) in a southbound direction, the average journey time is 7.6 minutes between junction 6 to 8, equivalent to a delay of 0.6 minutes for each light vehicle.

2.1.4 These delays are the result of intensive traffic flows, with network stress particularly high between junction 6 to junction 8, due to reduction in number of lanes from three to two. This leads to slow journey speeds and frequent incidents of flow-breakdown, resulting in physical queues and delays and road safety issues.

2.1.5 For the northbound direction, there is currently one significant location of congestion at the junction 6 merge with moderate congestion during the morning (AM) peak and severe congestion in the evening (PM) period.

2.1.6 One significant location of daily seed point congestion occurs southbound at junction 7 where traffic merges from Stevenage with queues extending back on the main carriageway to junction 8 during the morning AM period[15].

2.1.7 The Proposed Scheme is 16.7km in length and would contribute towards the improvement of this strategic route as well as provide improvements to traffic management and travel times on a local scale.

2.2 Existing motorway

2.2.1 The A1(M) between junction 6 to junction 8 is a two-lane motorway with hard shoulders built in the late 1960s and early 1980s. Its key features include:

- Junction 6 links to Welwyn Garden City;
- One crossing of the River Mimram;
- Crossing of the East Coast Mainline at Todd's Green Lane underbridge; and
- Six underbridges with sealed lightwells in the central reservation.

Climbing lanes

2.2.2 There are no climbing lanes between junction 6 and junction 8 on the A1(M).

Pavement

2.2.3 The motorway is predominantly thin surface course with indicative ages of between 11 and 13 years old.

Structures and other infrastructure

2.2.4 The number of existing structures, retaining walls and closed-circuit television (CCTV) masts within the Proposed Scheme extent are detailed in Table 2.1 below.

Table 2.1 - Existing structures and other infrastructure

Structure	Number
Overbridge	6
Underbridge	14
Footbridge	0
Culverts	4
Gantries	3
Retaining Walls	2
CCTV Masts	1

2.2.5 A total of 5 structures have been identified as having failed a pier impact assessment (proposed works are detailed in Table 2.7):

- Pottersheath Overbridge (SK5015);
- Langley Sidings South Overbridge (SK5020);
- Gipsy Lane Overbridge (SK1517);
- Langley Sidings North Overbridge (SK5021); and
- Fishers Green Overbridge (SK5026).

Lighting

2.2.6 The motorway is unlit on the main carriageway through junction 6 to 8. The following junctions are lit: junctions 6, 7 and 8 and on all the slip roads at junction 6. Current lighting consists of 150w high pressure sodium lanterns on 10m columns.

Abnormal load bays

2.2.7 No abnormal load bay facilities are located between junction 6 and junction 8.

[15] A1(M) J6-8 Smart Motorway Scheme. Combined Operations Report (SGAR3). (February 2019). HE551539-WSP-GEN-SG-RP-CH-00016

Police observation platforms

2.2.8 Two existing police observation platforms are located between junction 6 and junction 8. One is located on the northbound carriageway approximately at marker post (MP) 49/3 and the other southbound at approximately MP46/2.

Turnaround points

2.2.9 No turnaround points are located between junction 6 and junction 8.

Transmission stations

2.2.10 There are currently no Transmission Stations (TS) located between junction 6 and junction 8.

Motorway drainage and pollution control

2.2.11 The current drainage system comprises the following:

- Predominantly filter drains, but also includes ditches, surface water channels & gullies;
- Twenty-five outfalls, none of which are 'priority' outfalls or 'not-determined' outfalls;
- Twelve drainage ponds/ sustainable drainage systems (SuDs); and
- Four culverts, none of which are identified as 'priority' culverts.

Geotechnics

2.2.12 The published geological information and historical exploratory holes show the superficial deposits underlying the Proposed Scheme are:

- Anthropogenic Deposits;
- Head Deposits;
- Alluvium;
- Glacial Till (Lowestoft Formation);
- Glaciofluvial Deposits;
- Glacial Sands and Gravels (Kesgrave Formation); and
- Clay with Flints Formation.

2.2.13 The underlying solid deposits are formed of the Lewes Nodular Chalk Formation, Seaford Chalk Formation, Holywell Nodular Chalk Formation and New Pit Chalk Formation. The Anthropogenic Deposits present generally relate to the construction of the A1(M). The existing ground information has been used to produce 5 representative ground models for the Proposed Scheme. Further details can be found in the combined Preliminary Sources Study Report (PSSR)/Ground Investigations Report(GIR)[16].

2.2.14 The main geotechnical risks identified, as reported in the Statement of Intent, are:

- Insufficient ground investigation information;
- Instability of existing earthworks;
- Dissolution features causing instability of earthworks;
- Potential for compressible / collapsible ground; and
- Potential for shrink / swell.

2.2.15 These geotechnical risks are currently being reviewed as part of the production of the combined PSSR /GIR and proposals are anticipated to be undertaken for ground investigation at DF5/6.

2.3 Description of the Proposed Scheme

2.3.1 The Proposed Scheme provides All Lane Running (ALR) between junction 6 and junction 8 comprising:

[16] Tranche 5 – A1(M) J6-8 (Preliminary Design – PCF Stage 3) Smart Motorways Programme. Combined Preliminary Sources Study Report (PSSR) and Ground Investigation Report (GIR) HE551539-WSP-HGT-RP-CE-00004

- Permanent removal of the hard shoulder facility on the mainline and conversion to a running lane to create extra capacity necessary to support economic growth;
- A rigid concrete barrier (RCB) component requiring the hardening of the central reserve and installation of RCB between junction 6 and junction 8 (excluding a section of soft verge, that has been proposed north of junction 7);
- Emergency areas to provide safe stopping areas in case of emergency;
- Overhead gantries fitted with Advanced Motorway Indicators (AMIs), new Variable Message Signs (VMS) and/ or Advanced Directional Signs (ADS);
- Incident detection systems, speed enforcement cameras and comprehensive CCTV coverage;
- A Stop Vehicle Detection (SVD) system;
- Additional noise barriers amounting to approximately 2.3km in length to be provided for Symonds Green Ward, Fishers Green, Oakland and Danesbury; and
- Through-Junction Running (TJR) – the conversion of the hard shoulder into a running lane within the extent of the junction and associated merge and diverge lining modifications (Where applicable and appropriate with reference to traffic flow requirements and space availability). This is implemented at junction 6 (northbound only), and junctions 7 and 8 (see Table 2.2).

2.3.2 Smart motorways also have the following key features:

- **Variable mandatory speed limits (VMSL)** enabled using a combination of verge and cantilever gantry-mounted variable message signs and lane-specific signalling, with variable speed limits displayed on Advanced Motorway Indicators mounted above each lane on portal gantries;
- **Verge mast mounted radar vehicle detection systems** provided to support incident detection, queue protection, VMSL and congestion management. At calculated thresholds, the mandatory speed limit displayed to drivers is reduced or increased as required, managed through the Motorway Incident Detection and Automated Signs (MIDAS) system;
- **Emergency roadside telephones** provided in emergency areas and possibly adjacent to hard shoulders on slip roads;
- **Earthwork modifications** at some gantry, cabinet/ chamber and emergency area locations;
- **Speed enforcement** using Highways Agency Digital Enforcement Camera System 3 (HADECS3), supported by External Aspect Verification (EAV) cameras;
- **CCTV camera** coverage supported by infra-red lighting units mounted as necessary; and
- **Remotely Operated Temporary Traffic Management (ROTTM) Signs** verge mounted electronic signs to facilitate access for the maintenance service providers.

2.3.3 An indicative layout required by an all lane running scheme is presented in Figure 2.1.

Carriageway

2.3.4 Where the existing dual two-lane carriageway (motorway) with hard shoulder (D2M) is to be upgraded to three-lane all lane running (D3-ALR), the proposed layout will be accommodated within the existing carriageway footprint and highway boundary. Nearside pavement widening is required at the majority of diverge and merge layouts within the Proposed Scheme extents.

2.3.5 The physical design elements of the Proposed Scheme include:

- Conversion of the hard shoulder to a permanent traffic lane making three lanes of 11.35m[17] overall width. The operational width of the road would be 3.2m wider than existing;

[17] This is made up of 3 lanes 3.65m, 3.5m, 3.4m and offside hard strip width 0.3m and nearside width of 0.5m

- There are a number of proposed carriageway widths across the Proposed Scheme length to accommodate restricted space across structures whereby the minimum of 10.95m compared to the standard 11.35m; and
- Re-configure junction layouts to accommodate all lane running cross section.

Table 2.2 - Proposed carriageway configurations

Location	Northbound	Southbound
Junction 6 to 7	D3-ALR	D3-ALR
Junction 7 to 8	D3-ALR	D3-ALR
Junction 6, 7 & 8	TJR	TJR (Excluding junction 6)

2.3.6 The General Arrangement of the Proposed Scheme, including the location of new and existing gantries, other signs and emergency areas is presented in Appendix 2.1.

2.3.7 Where space within the highway boundary is limited and surrounding ground levels require, retaining walls may be required to accommodate emergency areas, communications cabinet sites and gantries.

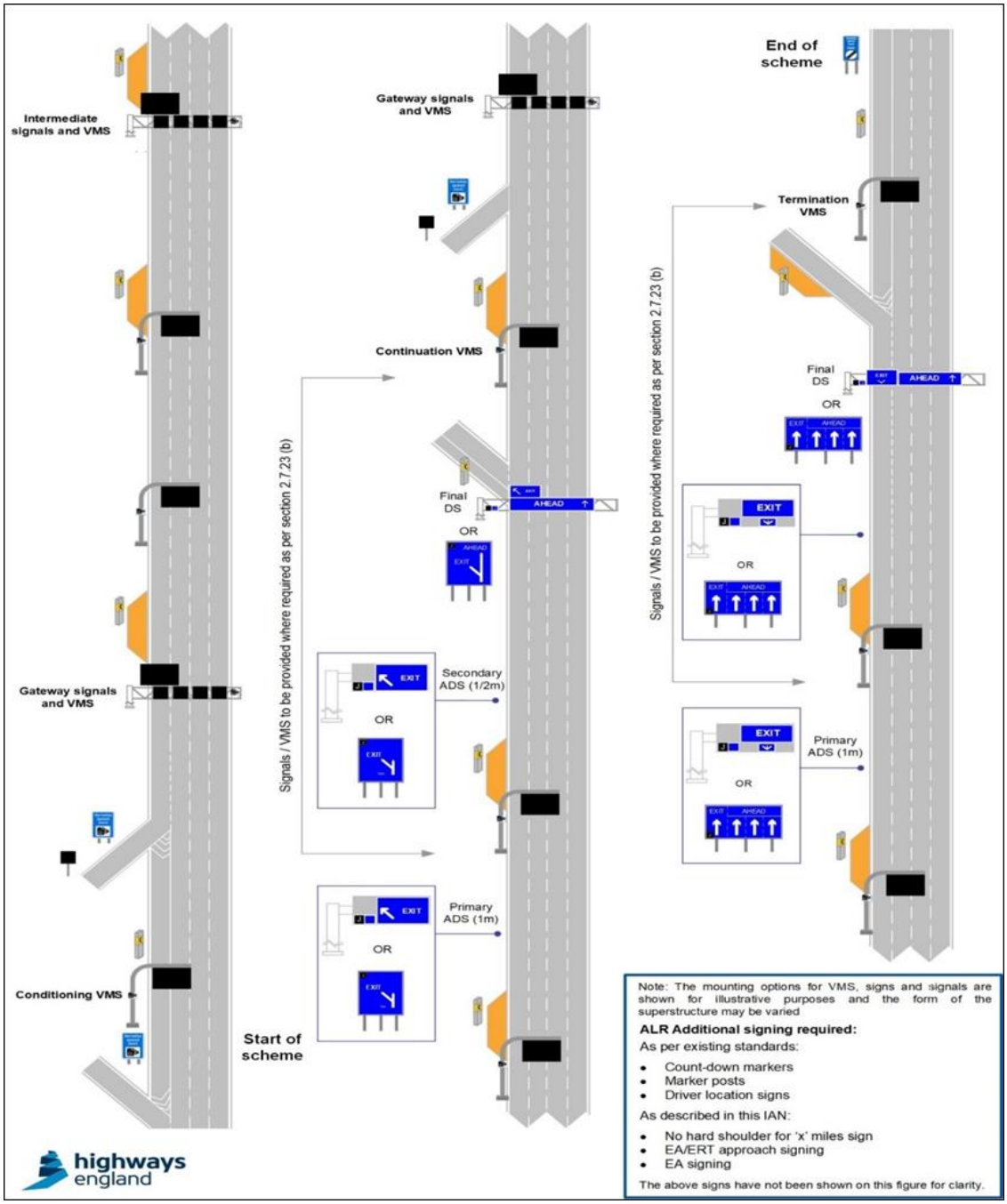
2.3.8 The mainline horizontal and vertical alignment will not be changed as part of the Proposed Scheme and as such is not expected to have any operational impact.

Pavement

2.3.9 All lanes of the carriageway within the Proposed Scheme limits will be resurfaced, with low noise surfacing in the opening year between junctions 6 and 8.

2.3.10 The junction layouts will be realigned to accommodate the third lane by re-configuration of slip road merge and diverges.

Figure 2.2 - Illustrative drawing of an all lane running (ALR) layout



Source: IAN 161/15: Smart Motorways (as updated 02/05/2018)

Central reserve works

2.3.11 The A1(M) between junction 6 and 8 central reserve currently comprises sections of steel barrier vehicle restraint system to separate the carriageways. The Proposed Scheme will replace the steel barriers with rigid concrete barrier, which will allow the central reserve to be narrowed, where required, to accommodate the proposed all lane running cross section. A hard surface will be introduced for the majority of the central reserve to minimise the need for future maintenance work. A soft verge is proposed north of junction 7, for a length of approximately 2.9km (between an approximate chainage[18] 9920 – 12800).

2.3.12 The central reserve works comprises the following components:

[18] Chainage is the numerical referencing system used through the scheme length and determines where the scheme starts and finishes. It the case of the A1(M) Junction 6 to 8, it starts at the southern end of the Proposed Scheme and finishes just north of Junction 8. The system is measured in metres.

- Replacement of steel vehicle restraint system (VRS) with a Rigid Concrete Barrier (RCB), totalling approximately 16.6km. RCB will be installed between the following approximate chainages:
  - Chainage 3431 – chainage 5623
  - Chainage 5643 – chainage 12098
  - Chainage 12118 – chainage 15880;
- In the following approximate locations, the central reserve will be provided with emergency crossing points (ECP);
  - Chainage 5623 – chainage 5643
  - Chainage 12098 – chainage12118;
- Central reserve pavement throughout, with narrowing to 2.6m minimum but typically 4m to 4.5m (approximately 3.4km of the central reserve is currently paved);
- Encapsulation of central reserve piers to provide impact protection to overbridges; and
- Central reserve drainage works to replace existing drains and provide attenuation as required.

Verge works

2.3.13 The overhead lane signalling and Variable Message Signs (VMS) component of the Proposed Scheme provides enhanced signalling to the existing carriageway cross section.

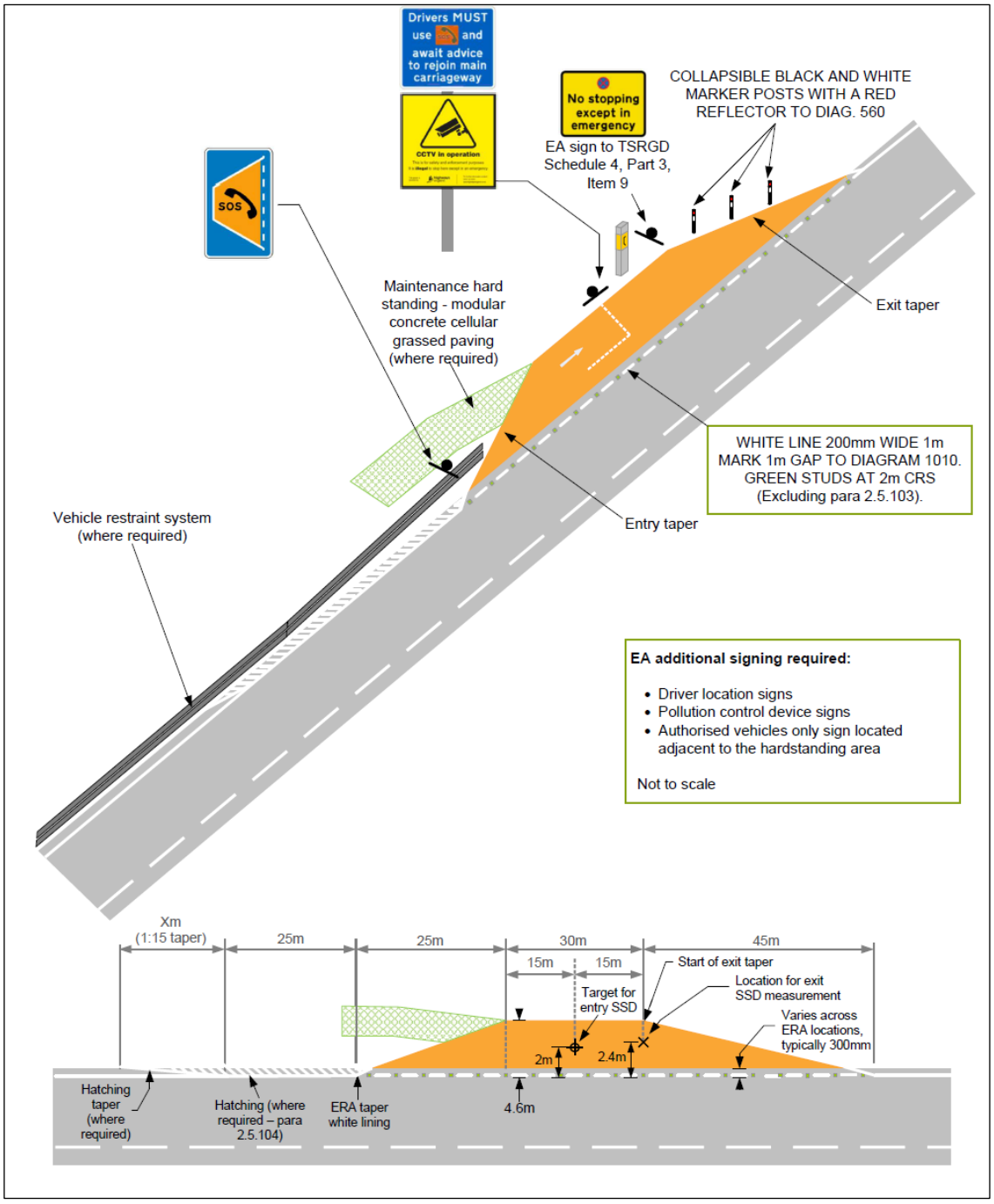
2.3.14 The Proposed Scheme comprises the following components:

- On all lane running sections a nearside hard strip of (normally) 500mm width with enhanced edge drainage will be introduced, while the existing surface drainage system will be retained on the controlled motorway sections.
- There are 2 existing gantries;
- Removal of 1 existing gantry (located chainage 15575/ MP53/0B);
- Provision of 12 new emergency areas, 2 places of relative safety and 4 new short section of hard shoulders;
- New longitudinal communication ducting along the Proposed Scheme length;
- New vehicle restraint system at specific locations generally associated with new infrastructure such as gantries;
- New retaining structures to accommodate emergency areas, communication cabinet sites, gantries and other verge infrastructure;
- Two proposed noise barriers located within the verge of the northbound and 3 proposed noise barriers located within the verge of the southbound carriageway. These are detailed in Table 2.10;
- Details of new and existing technology roadside devices are detailed in Table 2.5; and
- New signing.

Emergency areas

2.3.15 Emergency areas are provided along all lane running sections and are required to provide a safe area for vehicles to stop in an emergency. They are 4.6m wide and extend for 100m. Barrier setback will increase from 1.2m at 25m from the start of the emergency area to 1.6m at the end of the area (see Figure 2.2). Places of relative safety/new short section of hard shoulder are a minimum length of 100m.

Figure 3.2 - Illustrative drawing of an emergency area



2.3.16 It is proposed to provide 6 emergency areas, 1 place of relative safety and 2 new short section of hard shoulder for the northbound carriageway and 6 emergency areas, 1 place of relative safety and 2 new short section of hard shoulder for southbound traffic as set out in Table 2.3.

2.3.17 Emergency roadside telephones will be provided in all dedicated emergency areas. Existing emergency roadside telephones elsewhere along the extent of the Proposed Scheme will be removed.

2.3.18 To enhance the conspicuousness of an emergency area to motorway users, these areas are to be provided with an orange coloured surface (see Plate 2.1).

Table 2.3 - Proposed emergency area locations

Northbound Carriageway		Southbound Carriageway	
Emergency Area Id	**Approx. Location[19] (Chainage/MP)**	**Emergency Area Id**	**Approx. Location[20] (Chainage/MP)**
PRS NB1	2107 – 3488 (MP39/6A)	NSSH SB 1	14878 – 14778 (MP52/2B)
EA NB 1	4770 – 4870 (MP42/3A)	EA SB 1	12917 – 12817 (MP50/4B)
EA NB 2	6335 – 6435 (MP43/8A)	EA SB 2	11317 – 11217 (MP48/7B)
EA NB 3	7760 – 7860 (MP45/3A)	NSSH SB 2	9744 – 9644 (MP47/1B)
NSSH NB1	9361 – 9461 (MP46/9A)	EA SB 3	8342 – 8242 (MP45/8B)
EA NB 4	10725 – 10825 (MP48/2A)	EA SB 4	7335 – 7235 (MP44/8B)
EA NB 5	11710 – 11810 (MP49/2A)	EA SB 5	6350 – 6250 (MP43/7B)
EA NB 6	12970 – 13070 (MP50/5A)	EA SB 6	5210 – 5110 (MP42/7B)
NSSH NB 2	14390 – 14490 (MP51/9A)	PRS SB 1	3730 – 2964 (MP41/3B)

Plate 2.1 - Indicative emergency area

2.3.19 Consideration will be given to the provision of maintenance hard standing areas at the upstream end of emergency areas prior to DF4. This arrangement will reduce the requirement for temporary traffic management (lane closures) during maintenance.

[19] Defined as the centre of the emergency area.
[20] Defined as the centre of the emergency area.

Signs, gantries and roadside devices

2.3.20 Operation of the Proposed Scheme will be controlled by light-emitting diode (LED) signals, which will be mounted on overhead portal or cantilever gantries, or pole mounted in the verge. The location of proposed and retained gantries is provided in Table 2.4.

2.3.21 There are 3 main types of LED signals included in the Proposed Scheme, which are described below:

- Advanced Motorway Indicators are used to display variable mandatory speed limits for each lane using programmable high resolution LEDs;
- Message Sign Mark 4 (MS4) are a type of variable message sign used to provide driver information in the form of text and pictograms; and
- Remotely operated temporary traffic management (ROTTM) signs pole mounted in the verge, deployed at set intervals to facilitate maintenance service provider access to the network.

Table 2.4 - Gantry and signing provision

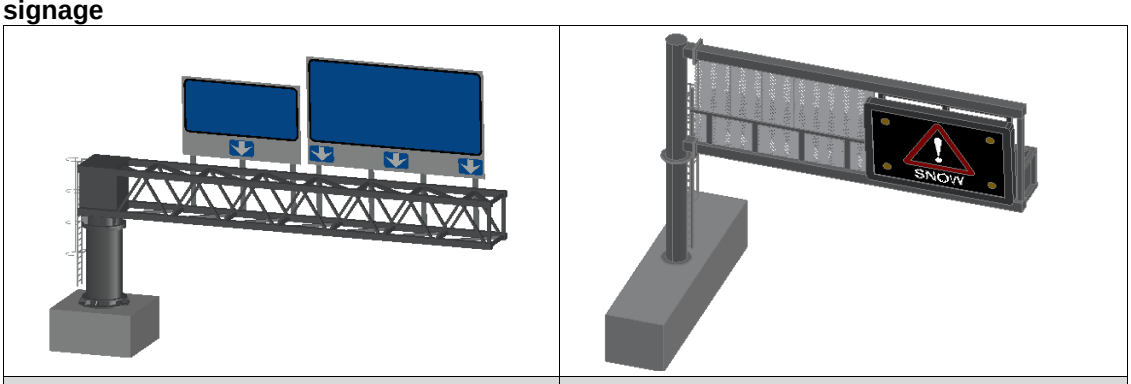
Link	Gantry Id	Indicative Location (Chainage/MP)	Carriage-way Northbound (NB)/ Southbound (SB)	Gantry history (New/ retained/ existing foundations re-used)	Type	Northbound gantry equipment	Southbound gantry equipment
Within J6	/A1(M)//39.30/S/	945	NB	Retained	Portal Gantry	Fixed ADS only	
	/A1(M)//38.50/S/	1746	NB	Retained	Portal Gantry	Fixed ADS only	
	G-A1(M) 01	2280 (MP39/8A)	NB	New	MS4	Conditioning VMS	
	G-A1(M) 28	2410 (MP39/9B)	SB	New	MS4		Terminations VMS
J6-7	G-A1(M) 02	3375 (MP40/9A)	NB	New	MS4	Intra Junction VMS	
	G-A1(M) 27	3750 (MP41/2B)	SB	New	MS4		Secondary ADS VMS
	G-A1(M) 26	4437 (MP41/9B)	SB	New	MS4		Primary ADS VMS/ EA VMS
	G-A1(M) 03	4467 (MP42/0A)	NB	New	MS4 + AMI	Gateway Signals and VMS/EA VMS	
	G-A1(M) 04	5266 (MP42/8A)	NB	New	MS4	Link VMS	
	G-A1(M) 25	5450 (MP43/0B)	SB	New	MS4 + AMI		Intermediate signal/EA VMS
	G-A1(M) 05	6035 (MP43/5A)	NB	New	MS4	EA VMS	
	G-A1(M) 24	6500 (MP44/0B)	SB	New	MS4		EA VMS
	G-A1(M) 06	7104 (MP44/6A)	NB	New	MS4	Primary ADS VMS/ EA VMS	
	G-A1(M) 23	7485 (MP44/8B)	SB	New	MS4		EA VMS
	G-A1(M) 07	7974 (MP45/5A)	NB	New	MS4	Secondary ADS VMS	
	G-A1(M) 22	8426 (MP45/9B)	SB	New	MS4 + AMI		Gateway Signals and VMS/ EA VMS
	G-A1(M) 08	9425 (MP46/9A)	NB	New	MS4	Continuation VMS	
J7-8	G-A1(M) 21	9670 (MP47/1B)	SB	New	MS4		Continuation VMS
	G-A1(M) 09	10625 (MP48/1A)	NB	New	MS4 + AMI	Gateway Signals and VMS/EA VMS	
	G-A1(M) 20	10971 (MP48/4B)	SB	New	MS4		Secondary ADS VMS
	G-A1(M) 10	11510 (MP49/0A)	NB	New	MS4	EA VMS	
	G-A1(M) 19	11668 (MP49/1B)	SB	New	MS4		Primary ADS VMS/ EA VMS
	G-A1(M) 11	12163 (MP49/6A)	NB	New	MS4	Primary ADS VMS	
	G-A1(M) 18	12467 (MP49/9B)	SB	New	MS4		Link VMS
	G-A1(M) 12	12867 (MP50/4A)	NB	New	MS4	Secondary ADS VMS/ EA VMS	
	G-A1(M) 17	13117 (MP50/6B)	SB	New	MS4		EA VMS
	G-A1(M) 13	13660 (MP51/2A)	NB	New	MS4	Link VMS	
	G-A1(M) 16	13810 (MP51/3B)	SB	New	MS4 + AMI		Gateway Signals and VMS
Within J8	G-A1(M) 14	14710 (MP51/1A)	NB	New	MS4	Termination VMS	
	G-A1(M) 15	14810 (MP52/2B)	SB	New	MS4		Conditioning VMS

2.3.22 The roadside devices to be included as part of the Proposed Scheme are detailed in Table 2.5 below. Figure 2.3 illustrates typical views of a Superspan Cantilever Gantry and MS4 Cantilevers, Directional Signs and Advanced Motorway Indicator signage. Indicative information for verge located advanced directional signs and other large driver information signs (see Table 2.6).

2.3.23 The base height to the underside of the gantries is approximately 6m, but with the addition of an MS4 sign (3.2m high), the most prominent proposed infrastructure would be approximately 9m. Advanced Motorway Indicators are mounted onto the face of the gantry and would not protrude above the gantry top, as shown below. ADS (fixed directional signs) may extend approximately 4m and hence may have a total height of 12m.

2.3.24 As recorded in Table 2.4, the Proposed Scheme would require the removal/ installation of super cantilever gantries potentially leading to a total of 17 carriageway closures.

Figure 2.4 - Typical views of a superspan cantilever gantry with advanced directional sign (ADS) and MS4 cantilevers, directional signs and advanced motorway indicators signage



Superspan Cantilever Gantry with Advanced Directional Sign (ADS)	MS4 Cantilever

Source: representations taken from M62 J10 to J12 Federated Model (HE549341-ACM-GEN-M62_SW_ZZ_ZZ-m3-IM-0001).

Table 2.5 - Roadside devices

Roadside device	New	Existing
AMI (gantry mounted)	12	0
AMI (post mounted)	8	0
MS1	0	10
MS4	28	0
MS3 / MS4-L	0	0
ERT	18	22
HADECS enforcement cameras (ENF) (live sites)	2	0
HADECS enforcement cameras (ENF) (non-live sites)	3	0
MIDAS outstation	42	13
MIDAS Radar sites	30	0
MIDAS Mainline loops	4	13
Midlink Loops	4	0
Pan, tilt and zoom (PTZ) CCTV camera	36	2
Stopped Vehicle Detection (SVD)	49	0
Remotely operated temporary traffic management (ROTTM) signs	43	0
Entry Stop Signals	8	0
Speed Equalisation Signals	0	0
Electrical Interface (EI) cabinets	6	9

Table 2.6 - Proposed signs and signals

Proposed Assets	Type	Estimated Asset Quantities[21]	
		New	Remove
Cantilevered Signs/Signals	MS4	23	0
	MS4 + AMI	5	0
Overhead Gantry	ADS	0	1

Lighting

2.3.25 There is no replacement lighting proposed as part of the Proposed Scheme. Existing lighting is present on the slips roads.

2.3.26 Where replacement lighting is required, this should be provided by efficient LED type lanterns that would be capable of being managed centrally allowing them to be dimmed or even switched off to minimise the environmental effects at low flow times in the middle of the night. These LED lanterns offer more directional lighting with full-cut off lanterns which do not emit any ultra violet output, thus having a lower impact than the existing low pressure and high pressure sodium lamps and should be less intrusive to neighbouring residents. They also are compliant with the recommendations in the IPL document – Bats and Lighting in the UK[22].

Demolition and new structures

2.3.27 No new structures (i.e. overbridges and underbridges) are currently indicated within the Proposed Scheme and no existing structures are planned for demolition.

Overbridges and underbridges

2.3.28 Significant repairs or replacement of components are needed at 12 structures, described below.

2.3.29 The proposed works to the overbridges are outlined in Table 2.7 below and have been assessed within the relevant topic chapters.

Table 2.7 - Proposed works to overbridges

Structure Name	Structure Number	Location (Chainage/ MP)	Works to Structure	Located in Flood Zone (2/3)	Located within the River Channel
Potters-heath	SK5015	4950 (MP42/5A)	Reinforced concrete strengthening to overbridge piers in the form of encapsulation. 1.5m encapsulation at central reserve piers rigid concrete barrier at verges northbound and southbound	No	No
Gipsy Lane	SK5017	6130 (MP43/6A)		No	No
Langley Sidings South	SK5020	9480 (MP46/9A)		No	No
Langley Sidings North	SK5021	9600 (MP47/1A)		No	No
Fishers Green	SK5026	13720 (MP51/2A)		No	No

2.3.30 No proposed works are in Flood Zone 2/3 or within the river channel.

2.3.31 The proposed works to the underbridges are outlined in Table 2.8.

[21] Quantities may vary.
[22] Bat Conversation Trust. Institute of Lighting Professionals (2018) Guidance Note 08/18. *Bats and artificial lighting in the UK. Bats and the Built Environment series.*

Table 2.8 - Proposed works to underbridges

Structure Name	Structure Number	Location (Chainage/MP)	Works to Structure
Avenue	5014	4150 (MP41/4B)	Central Reserve Strengthening work
Ninning's Wood Subway	5016	5540 (MP43/0A)	Light well Strengthening/replacement
Norton Green Subway	5022	10590 (MP48/1A)	Light well Strengthening/replacement
Chadwell Road	5023	11130 (MP48/6A)	Lightwell Strengthening works
Kitching Lane	5024	12015 (MP49/5A)	Light well Strengthening/replacement
Symonds Green	5025	12570 (MP50/0A)	Light well Strengthening/replacement
Todds Green railway	5027	14105 (MP51/6A)	Light well Strengthening/replacement

Communication cabling and ducting

2.3.32 Longitudinal ducting will be required to replace existing cables buried in the ground along the Proposed Scheme where the carriageway arrangement will be changed. Typically, the longitudinal ducts will only be provided in one verge a minimum of 2.0m from the edge of the existing carriageway.

2.3.33 Ducts and cabling will be situated along the northbound carriageway for the majority of the Proposed Scheme. An indicative crossing to the southbound carriageway, via a cross carriageway duct (CCD), is proposed at chainage 10055 where cabling will then be routed through ducting in the verge of the southbound carriageway, before crossing back over to the northbound carriageway at chainage 10515, to avoid Watery Grove ancient woodland.

2.3.34 Other ducts will be required to connect to cabinets near the gantries and other communications equipment, and for power supply connections between the electricity feeder pillars (normally placed at various locations at the motorway fence line) and the communications equipment.

2.3.35 The installation of new ducts will require localised vegetation clearance from the hard shoulder, but the width and installation method will be varied where it is important to maintain screening.

2.3.36 New cross carriageway ducts are to be provided spanning both carriageways. Once surveys have been concluded and ducts proved, there may be opportunities to re-use existing cross carriageway ducts, thereby minimising any impacts. The detailed design will be developed in PCF Stage 5 to confirm vegetation clearance and retention.

Proposed power supply

2.3.37 Existing and new Distribution Network Operator (DNO) supplies would be used to power the roadside technology, with the locations of additional or upgrade sites being presented in Table 2.9 below.

Table 2.9 - Potential locations for new or upgrade power supply (EI)

Existing		New	
ID	**Location (Chainage/MP)**	**ID**	**Location (Chainage/MP)**
EI 01	2521 (MP40/1A)	EI 04	5099 (MP42/6A)
EI 02	3557 (MP41/1B)	EI 05	6368 (MP43/9B)
EI 03	4174 (MP41/7A)	EI 10	12039 (MP49/5A)
EI 06	7163 (MP44/6A)	EI 11	13029 (MP50/4B)
EI 07	8929 (MP46/4A)	EI 14	7961 (MP45/5B)
EI 08	9523 (MP47/0B)	EI 15	8575 (MP46/1B)
EI 09	10582 (MP48/1A)	EI 16	11140 (MP48/6B)
EI 12	13831 (MP51/3A)	EI 17	11306 (MP48/8A)
EI 13	14532 (MP52/0B)		

Turnarounds

2.3.38 No turnarounds points for use by authorised vehicles including emergency services and highways maintenance are proposed for the Proposed Scheme.

Police observation platforms

2.3.39 The existing police observation platforms will be removed and not replaced. This has been agreed at a core responders meeting and endorsed at Project Safety Control Review Group (PSCRG).

Drainage strategy

2.3.40 Treatments for drainage will be determined during DF3 as part of the drainage strategy. Where the carriageway is balanced, there will be no requirement for any drainage within the central reserve; any existing drainage can be abandoned or removed.

2.3.41 As the carriageway is super elevated between junctions 6 and 8, a surface water collection system will be required within the central reserve; this is likely to be a 0.9m wide surface water channel in accordance with the SMP design guide drainage hierarchy.

2.3.42 The drainage system will be designed to accommodate a 1-year design storm without surcharge and a 5-year storm with surcharge with 20% allowance for climate change, as per IAN 161/15. However, it should be noted that drainage will be for new paving only e.g. emergency areas only.

2.3.43 Existing chambers within the hard shoulder would be covered over and connected to adjacent verge side chambers or replaced with larger chambers, to allow for maintenance, flow control and attenuation requirements in accordance with Interim Advice Note (IAN) 196/17.

Land take

2.3.44 There is no requirement for permanent additional land take as part of the Proposed Scheme.

2.3.45 The Proposed Scheme would require temporary land-take for compound areas, material storage and temporary breakdown vehicles. Details of the temporary land-take will be reported within the Construction Environmental Management Plan (CEMP) following environmental surveys and assessments.

2.3.46 Following the removal of topsoil, soil stabilisation and installation of drainage some levelling may be required. All existing material would stay on site with imported material being required for hardstanding areas such as a carpark, material compounds and office foundations.

2.3.47 Temporary sites would be required for the duration of the construction period and would be returned to its previous state upon completion of the main works.

Maintenance access

2.3.48 In order to achieve a safe working environment, pedestrian access to the motorway assets will be sought from the local road network at underbridges and overbridges where possible, and will involve the construction of new footways to these assets.

2.3.49 The viability of maintenance vehicle parking, including the construction of new maintenance laybys on the local road network, will require consideration and detailed liaison with the maintenance teams. As design information concerning maintenance access cannot be completed until gantry locations are confirmed at DF3, the following assumptions have been made:

- Where existing steps and footways are present at structures, it has been assumed that these routes will be acceptable for use in the future; and
- Parking bays on the local road network can be provided within the highway boundary on the local road network and would not require any additional land take.

Outstanding elements of scheme design

2.3.50 The following elements of the Proposed Scheme have not yet been designed:

- Geotechnical interventions e.g. retaining walls – have yet to be finalised/agreed with the Highways England Geotechnical team and thus have not been assessed within the topic chapters.

2.4 Rectification, mitigation and enhancement

Scheme evolution from operational concept

2.4.1 The location of 3 design elements have been changed in order to reduce the potential for adverse environmental effects:

- **Emergency area (EA NB 2)** was previously located in close proximity to ancient woodland, Ninning's Wood (approximate chainage 5800, northbound). This emergency area has been relocated further north (chainage 6335-6435, northbound) to avoid potential significant adverse effects on the ancient woodland;
- **Gantry (G-A1(M) 25)** was previously located in close proximity to ancient woodland, Ninning's Wood (chainage 5,360, southbound). The gantry has now been relocated further north (chainage 5,450, southbound), where the ancient woodland is farther away from the highway boundary. This is to avoid potential significant adverse effects on the ancient woodland; and
- **Emergency area (EA NB 1)** was previously proposed adjacent to residential properties on Danesbury Park (chainage 4735, northbound). The emergency area has been moved further north, to reduce the visual impact upon these properties (chainage 4770, northbound).

2.4.2 There are 2 design elements where re-positioning was not possible:

- **Gantry (G-A1(M) 04)** proposed the northbound carriageway, is located in close proximity to Ancient Woodland, Ninning's Wood (chainage 5,321, northbound). Repositioning was not possible because of the following:
  - It is the maximum distance away from the previous gantry (799m), therefore must achieve the minimum visibility of 350m.
  - If the gantry moved further upstream, the visibility line would be obstructed by Pottersheath Overbridge (5015) structure (approximately 355m away).
  - If the gantry moved further downstream the visibility will fall outside the highway boundary, due to the left hand bend (approximately between chainage 5,300 – 5,800); and

- **Gantry (G-A1(M) 09)** proposed along the northbound carriageway (chainage 10,625) is likely to have adverse visual effects to recreational and residential receptors at Norton Green Cottage. Repositioning was not possible because of the following:
  - The gantry achieves 600m visibility. If it was to move any further downstream, the gantry would not achieve the minimum ½ distance from previous gantry for visibility required by IAN 161/15.
  - The gantry achieves the maximum non-visibility of 600m.

Rectification of outfalls and culverts

2.4.3 The Proposed Scheme contributes to the objectives of the Water Framework Directive[23] through installation of:

- New carrier drains and attenuation for verge drainage as required;
- No upgraded runoff outfalls with enhanced pollution control measures; and
- No priority outfalls and culverts

2.4.4 There are 19 recorded flood events, including 4 high impact events and 5 events with a flood severity index ranging from 7 to 10. There are no drainage improvements for the Proposed Scheme Design as a result of a review of the Category A flooding hotspots.

2.4.5 Following a review, there are no outfalls classified as 'not-determined' in Highways Agency Drainage Data Management System (HADDMS) and no additional outfalls that discharge into watercourses targeted for water quality improvement, which are connected to sensitive habitats or discharge into Flood Zone 2 or 3.

Noise barriers (new/renewal and temporary removals)

2.4.6 To address the Highways England Licence and Roads Investment Programme objectives, 12 candidate new noise barriers were identified in the Environmental Scoping Report[24].

2.4.7 Following the review of their suitability and value for money assessment, the Proposed Scheme is to provide 5 new barriers over approximately 2.3km. Also, approximately 50m of existing noise barrier is to be replaced. The proposed noise barriers are detailed in Table 2.10.

2.4.8 Approximately 100m of existing noise barriers is likely to be removed temporarily during construction to allow works in the verge to be carried out safely. However, they would be dismantled and reinstated in series. The construction work would be programmed to allow completion of all works affecting each section of noise barrier within approximately 8 weeks. Table 2.10 below records those noise barriers that are to be removed on a temporary basis and new noise barriers.

[23] European Commission. Environment (2000) *EU Water Framework Directive. Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy.*
[24] Highways England, 2018: A1(M) Junction 6-8 Environmental Scoping Report, MP0135-HEX-EGN-ZZ-AS-KK-0001

Table 2.10 - Works to noise barriers

Noise Barrier ID	Start (Chainage/MP)	End (Chainage/MP)	Approx Length (m)	Height (m)	New/ Renewal/ Temporary removal
NNB1 (NB)	2709 (MP40/2A)	3226 (MP40/8A)	537	3	New
NNB3 (SB)	4151 (MP41/7B)	4250 (MP41/8B)	99	3	New
NNB4 (SB)	4662 (MP42/1B)	4864 (MP42/4B)	202	3	New
NNB5 (NB)	4327 (MP41/8A)	4828 (MP42/3A)	501	3	New
NNB10 (SB)	12715 (MP50/1B)	13706 (MP51/1B)	991	4	New
ENB5 (SB)	12442 (MP49/9B)	12492 (MP49/9B)	50	3	Temporary removal
ENB2 (SB)	4412 (MP41/9B)	4462 (MP42/0B)	50	2	Temporary removal

Walking, cycling, horse riding assessment and review (WCHAR) movements at junctions

2.4.9 In accordance with HD 42/17 WCHAR[25], the potential presence of pedestrians, cyclists and equestrians within the extents of the Proposed Scheme and any potential user impact outside the Proposed Scheme extents as a direct consequence of the Proposed Scheme implementation has been examined. The Proposed Scheme is considered to be exempt from the WCHAR process at this stage, as detailed in the WCHAR Exemption File Note[26], for the following reasons:

- The entirety of the Proposed Scheme is located within the existing motorway extents and will comprise changes to the mainline (motorway) carriageway and the road markings on the slip roads, where pedestrians, cyclists and equestrians are not permitted to access;
- Junctions 6 to 8 of the A1(M) will not be subjected to any changes (in relation to the Proposed Scheme) where there could be potential impact on users;
- Proposed slip road infrastructure will be positioned such that there will be no impact on existing Walking, Cycling and Horse riding (WCH) crossings; and
- No other underpasses and bridges will be affected as a result of the Proposed Scheme, other than potential temporary works to strengthen lightwells at underpasses; the impact of any temporary situation will be reviewed at DF4 when the design solution and construction sequence will be more developed.

Ecological and landscape measures

2.4.10 Three proposed areas for landscape and ecological enhancement beyond the soft estate have been identified. Where such measures are considered to merit further investigation, discussions would be held with landowners to establish the practicalities of a management agreement being established post DF3. The proposed enhancement areas have been identified at:

- **Norton Green -** Infill gaps and/or improve, existing planting to screen visual receptors and aid integration of the motorway into the local landscape through new planting within the highway estate. To tie into the existing landscape framework and reduce views from open areas to the west. Screening visual receptors and aide integration of the motorway into the local landscape; and

[25] Design Manual For Roads and Bridges (DMRB) (2017) *Volume 5 Assessment and preparation of road schemes Section 2 Preparation and implementation. Part 5 HD42/17 Walking, cycling and horse-riding assessment and review.*
[26] A1(M) J6-8 Smart Motorway (07/11/18) *WCHAR Exemption File Note HE551539-WSP-HGN-SG-RP-CH-00004*

- **Local Public Rights of Way's (Shangri-La Farm/ Lucas Wood & Fishers Green) and open access land (Fishers Green)** - Enhance/improve the existing species mix/habitat typology in otherwise poor quality areas to improve biodiversity and connectivity along the route taking the opportunity to tie into the local landscape through which the road passes, particularly adjacent woodlands, scrub, field boundary hedgerows and flight lines.

2.4.11 The following opportunities have been identified where the Proposed Scheme design will endeavour to retain a "sense of place" and to provide for an enhanced landscape setting. The selection of soft landscape earthwork solutions or existing hard standing areas have been used where possible:

- The planting strategy will aim to retain a 'sense of place' by using plants which reflect the local landscape character and reinforce traditional features and patterns that offer habitat enhancement;
- Use of native tree and shrub planting to create woodlands, copses and shelterbelts to screen structures, traffic and lighting and help integrate the Proposed Scheme into the existing landscape pattern; and
- Use of planting on the highway boundary, where appropriate, to link into existing field boundary planting to provide screening and integration into the local pattern, as well as connection of existing wildlife corridors, in locations where other planting is not proposed.

2.5 Construction works

2.5.1 All construction works on the carriageway will be undertaken within the existing highway boundary. Haul routes for materials and equipment will be routed along the existing motorway carriageways. The new gantries and emergency areas will be installed from the hard shoulder with new cabling installed within the verge to connect the new signage.

2.5.2 The actual construction methods and equipment, locations of compounds and access routes will be developed by the Delivery Partner. The key activities are expected to be:

- Replace steel vehicle restraint system in the central reservation with rigid concrete barrier with associated hardening of the reserve and any drainage modifications;
- Harden central reserve (where not already hardened) and install rigid concrete barrier in the central reserve;
- Resurface and/or strengthen the hard shoulder of both carriageways to provide a running lane with low noise surfacing being used;
- Resurface all lanes of both carriageways with low noise surfacing where rigid concrete barrier works are required;
- Install traffic signs and signals, some located in the verge on stand post foundations and others on new gantries, with associated earthworks or retaining systems;
- Install emergency areas using appropriate earthworks/ retaining systems;
- Install all supplementary all lane running infrastructure with any associated earthworks or retaining systems including, pan-tilt-zoom (PTZ) CCTV mast, Radar motorway incident detection and automated sign masts, external aspect verification masts, standalone stop vehicle detection site (post, chamber and cabinet), chamber cluster and cabinets;
- Improve slip road arrangements;
- Install remotely operated temporary traffic management signs at designated fixed taper points;
- Install a surface water channel/ linear drainage in the verge and associated drainage works. The main attenuation tanks for emergency areas are generally located immediately adjacent to or beneath the emergency areas footprint;
- Install 'remote', buried surface water attenuation and Pollution Control Devices (PCDs);
- Installation of noise barriers within the verge;

- Install vehicle restraint system in the verge to protect gantries and other SM infrastructure; and
- Install power supplies at the highway boundary.

2.5.3 Temporary works will include compound areas housing the contractor's facilities and material storage. The Proposed Scheme is envisaged to involve the following general work and sequencing:

- **Site mobilisation and site clearance:** Establishment of temporary fencing, utility relocations and establishment of construction compound sites and access and vegetation clearing and stripping, stockpiling and management of topsoil and unsuitable material;
- **Main works:** Establishing the ground levels and undertaking ground works including drainage systems and installing the gantries and rigid concrete barrier construction. Resurfacing of the existing surface and other pavement works; and
- **Landscaping and decommissioning:** Vegetation planting, installation of safety barriers, fencing, pavement marking and removal of site compound and site tidy up.

2.5.4 All works on site will be undertaken in compliance with a CEMP, which will be based on the (OEMP).

Construction compounds

2.5.5 The Delivery Partner would require mobilisation time to establish site offices and services ahead of the start of construction. Typically, this process takes 12 weeks. This may be concurrent with a period of site clearance operations, prior to commencement of construction.

2.5.6 The location of the construction compounds will be outside of the highway boundary and will be assessed for environmental effects separately by the Delivery Partner to support any licences or consents that may be required such as for protected species. The CEMP would demonstrate how the construction compounds would be located and operated in such a manner so as not to give rise to potentially significant environmental effects.

2.5.7 A main office compound (approximately 2ha) and several smaller section compounds (approximately 0.5ha each) to accept material deliveries, provide distribution of plant and equipment including batching plant and provide office and welfare facilities for workers is anticipated. These locations will need to be adjacent to the motorway or motorway junctions to allow easy access and egress from site.

2.5.8 It is envisaged that compounds would be utilised for the following activities:

- Storage of materials (stockpiles);
- Concrete batching plant;
- Storage of general plant;
- Blacktop plant;
- Earthworks reprocessing;
- Site office and welfare; and
- Site car parking.

2.5.9 Details of the approximate number of heavy goods vehicle (HGVs) that would access the compound(s) per day during peak construction periods would be recorded in the CEMP. Larger items, such as bridge beams and gantries, will require delivery via special transporters.

Site clearance

2.5.10 Typically, vegetation clearance from within the soft estate will be required for the following:

- A 4m width is envisaged from the edge of the existing hard shoulder throughout the Proposed Scheme consists mostly of existing drainage equipment with approximately 0.5m of grass verge. Within this, some localised areas of vegetation removal may be needed.
- A 1m strip along the highway boundary fence line to permit the safe access to install the surface laid duct and the interrupter cable. Any existing canopy would be retained. Periodic maintenance will be required to maintain safe access.

- Installation of new infrastructure will require a clearance area extending around proposed infrastructure sites. This would include: gantries, emergency areas, retaining walls and electricity cabinet.
- Site clearance is also required associated with the construction of drainage features and the improvement of existing drainage.
- Vegetation clearance may be required in areas along the Proposed Scheme to achieve visibility lines for new infrastructure, including emergency areas, gantries, remotely operated temporary traffic management signs and highways agency digital enforcement camera systems.

2.5.11 A total area of approximately 20 ha is to be cleared. Indicative temporary and permanent works footprints are presented in Table 2.12. Based upon these assumptions, Table 2.11 details the estimated vegetation clearance that would be required to construct and operate the Proposed Scheme.

Table 2.11 - Estimated vegetation clearance requirements

Land Use	Estimated Area of Vegetation Clearance (ha)
Ancient woodland	0 ha[27]
Deciduous woodland	11.8 ha
Scrub	0.9 ha
Waterbody	0 ha
Grassland	1.5 ha
Bare ground	0.02 ha
Other habitat	5.1 ha
No Data	0.9 ha

2.5.12 Clearance works are similar to maintenance activities when managing landscaped areas, with most of the greenery and branches being chipped on site and left on the verge slopes. Larger branches or trunks of trees would be removed from site and taken to a timber yard of the Delivery Partners choice.

2.5.13 Detailed requirements for site clearance will be developed through PCF Stage 5 (Construction Preparation), where PCF product, the 'Evaluation of Change Register' will record changes to the design and assumptions assessed at PCF Stage 3. The change register will include an evaluation of the effects of these changes on the outcomes of the assessment and mitigation defined at PCF Stage 3 (as detailed within this EAR and accompanying OEMP) and outline any further actions to be undertaken. A worst case scenario has been adopted within this assessment in relation to site clearance, and therefore it is not expected that any changes to site clearance requirements at PCF Stage 5 would give rise to significant environmental effects

[27] It is assumed that there is no ancient woodland within the highway boundary, see Chapter 6: Biodiversity for further details.

Table 2.12 - Site clearance assumptions

Component	Assumption	At grade		Cutting		Embankment	
General	Stands of key screening vegetation identified for retention have been captured within the design. Appropriate alternative permanent and temporary works solutions will be required where these clash with gantry sites. Similarly, alternative provision will be required if the highway boundary restricts the site.			It is assumed that typical batter slopes in cuttings are graded at 1v:3h. A maximum temporary works batter of 1v:2h is assumed.		It is assumed that typical batter slopes on embankments are graded at 1v:2.5h. A maximum temporary works batter of 1v:1.5h is assumed.	
		Temporary footprint	**Permanent footprint**	**Temporary footprint**	**Permanent footprint**	**Temporary footprint**	**Permanent footprint**
Gantry and MS4 sites	The permanent works footprint, excluding earthworks, of a typical site for a gantry leg with cabinets will be 5m wide and 27m long. The assumptions for cutting and when on embankments are to accommodate temporary working areas such as piling platforms for plant (where stands of screening vegetation for retention are identified adjacent to site these have been captured within the design and where appropriate requirements for alternative retaining solutions included).	6m wide, 40m long.		9m wide, 40m long.	9m wide, 40m long.	up to highway boundary wide, 40m long.	up to highway boundary wide, 40m long.
Emergency area site	The permanent works footprint, excluding earthworks, of a typical EA site will be 6m wide and 100m long. Where retention of existing essential screening vegetation is required then this has been considered within the design with requirements for alternative retaining solutions.	7m wide, 110m long.	6m wide, 100m long.	9m wide, 120m long.	7m wide, 120m long.	up to highway boundary wide, 120m long.	up to highway boundary wide, 120m long.
CCTV and stopped vehicle detection (SVD) sites	The permanent works footprint, excluding earthworks, of a typical CCTV site with associated cabinets will be 3.7m (into verge, measured from front face of safety barrier) wide and 12m long. Where existing essential screening vegetation is required then this has been considered within the design within requirements for alternative retaining solutions	5m wide, 20m long.	3.7m wide, 20m long.	9m wide, 20m long.	7m wide, 20m long.	up to highway boundary wide, 20m long.	up to highway boundary wide, 20m long.
CCD sites	It is assumed that the permanent works remaining at CCD locations will consist of no more than an A chamber. The pit floor dimensions of a launch pit are expected to be 15m wide and 10m long and 10m x 5m on the opposite side whether in cutting or on embankment. It is assumed that the launch pit and reception pit dimensions are identical.	15m wide, 10m long.	As A chamber	15m wide, 10m long.	As A chamber	15m wide, 10m long	As A chamber
Longitudinal cables	A 4m strip from the edge of the white line marking of each carriageway along the entire length of the Proposed Scheme will be cleared to install longitudinal cables. The cables will be buried and so would have no permanent footprint.	4m wide across verge over entire Proposed Scheme length.	No permanent footprint	4m wide across verge over entire Proposed Scheme length.	No permanent footprint	4m wide across verge over entire Proposed Scheme length.	No permanent footprint

Component	Assumption	At grade		Cutting		Embankment	
ROTTM signs	The permanent footprint, excluding earthworks, of each ROTTM signs is expected to be 4m (TMS site only) wide by 11m long.	4m wide, 16 m long	4m wide, 16m long	5m wide, 16m long	4m wide, 16m long	4m wide, 16m long	4m wide, 16m long
PI MIDAS Side Fire Radar	The permanent works footprint, excluding earthworks, of a typical MIDAS Side Fire Radar site with associated cabinets will be 2.5m wide (into verge) and 4m long.	2.5m wide, 4m long.	3m wide, 4m long.	5m wide, 4m long.	5m wide, 4m long.	5m wide, 4m long.	5m wide, 4m long.
Electrical interface cabinet	The permanent works footprint, excluding earthworks, of a typical electrical interface cabinet site will be 4m (into verge) wide. (access steps up to the highway boundary)	Up to the highway boundary wide, 4m long.	Up to the highway boundary wide, 4m long.	Up to the highway boundary wide, 4m long.	Up to the highway boundary wide, 4m long.	Up to the highway boundary wide, 4m long.	Up to the highway boundary wide, 4m long.
A chamber	The permanent works footprint, excluding earthworks, of a standard A chamber will be 4m (into verge, measured from rear of safety barrier) wide and 3m long.	5m wide, 5m long.	4m wide, 3m long	5m wide, 5m long.	4m wide, 3m long	5m wide, 5m long.	4m wide, 3m long
External Aspect Verification (EAV) Camera and chamber site	The permanent works footprint, excluding earthworks, of a typical EAV site with associated cabinets will be 3.3m (into verge measured from front face of safety barrier) wide and 7m long. The visual operational working area of the EAV units requires that all other infrastructure and vegetation is to be removed or relocated from a specified area.	5m wide, 7m long.	3.3m wide, 7m long	9m wide, 15m long.	7m wide, 15m long.	Up to the highway boundary wide, 15m long.	Up to the highway boundary wide, 15m long.
Abnormal load bays	There are no abnormal load bays on the Proposed Scheme	N/A	N/A	N/A	N/A	N/A	N/A
Note: Depending on the detailed design earthwork solution the permanent footprint may be able to accommodate planting.							

Demolition and removals

2.5.14 There is no requirement to demolish any bridges, however 1 existing gantry is to be demolished. The environmental effects of demolition works are identified within and controlled via the OEMP.

2.5.15 Those bridges unaffected by the Proposed Scheme would typically have a residual design life of over 60 years by when the nature of demolition technologies and any consequential environmental effects may well change. In addition, future land use development proposals and other transport projects may require the demolition of bridges. In such cases, the impact of such works would be considered as part of the consenting regime for the specific land use or transport project.

2.5.16 SMP schemes will generally require the removal of gantries and signs typically involving the separation of electronic components for specialist recycling and the removal of steel components again for recycling. Above ground foundations would be removed to just below ground level with the soil been re-seeded as appropriate. Over a 10-20-year period it is envisaged that a programme of gantry and sign removal would take place as in-car communications become established. A similar removal strategy is currently envisaged.

2.5.17 As part of the Proposed Scheme, the road surface of all lanes would be resurfaced. Within a 5-12-year period the current road surface would be replaced using conventional techniques.

2.5.18 Lighting columns have a 25-30-year design life with integrity testing typically commencing after 15 years. A decision to replace existing columns will be taken according to their residual life and whether there is a need to reposition the lighting. In such instances the columns would be removed for recycling.

2.5.19 SON luminaire lamps require replacement every three years. It is anticipated that LED lighting is likely to be introduced as part of the SMP scheme thereby removing the need such frequent replacements since LED lights typically require replacing every 25 years. As a result, this would reduce the quantities of hazardous materials to be disposed via specialist recycling companies as well as use less energy.

Temporary removal of existing noise barriers

2.5.20 It is anticipated that there is a requirement to temporarily remove existing noise barriers at 2 locations (see Table 2.10) in order to allow works in the verge to be undertaken safely. An assessment of the impact arising from the removal of such barriers is reported in section 8.5 with the proposed environmental management requirements being documented in the OEMP. This will set out a requirement for the Delivery Partner to demonstrate in a method statement for the temporary removal of noise barriers that:

- The acoustic, ecological and vegetation impacts have been minimised after consideration of alternative construction techniques;
- When and where temporary barriers would be used; and
- The elevated level of stakeholder engagement that would be afforded to the affected residents.

2.5.21 The acoustic assessment detailed in Chapter 8: Noise and Vibration assesses whether there are any significant effects during the temporary removal of existing noise barriers.

Retaining walls

2.5.22 Retaining walls have not yet been agreed with Highways England, and therefore an assumption has been made that retaining walls will be located in a cutting or embankment for emergency areas and gantries. Small walls are built by traditional concrete construction or gabion walling. In some areas, steel sheet piles are required. Initially a piling platform is formed using imported stone and roller compaction. The piles will then be installed using specialist rigs and vibratory drivers.

Piling for structures

2.5.23 At this design stage, 11 gantries are anticipated to require piling works for their foundations. Where piling is required, a piling platform will be created and specialist rotary or flight auger rigs used to install the piles. Piling operations for gantries are therefore expected to take approximately 22 days[28]. Due to the timing of the availability of this information, a worst case assumption has been used for the assessment (i.e. all gantries will require piling works).

Gantry construction

2.5.24 The method in which concrete foundations will be constructed is to be confirmed following the preliminary assessment of foundation types.

2.5.25 The superstructures will have masts erected with a small crane or crane-lorry in normal working hours. Cantilever gantries will be similarly erected, but this will be at night with traffic management measures confining the traffic to single-lane running. For larger and full-span gantries, the motorway will be closed and the gantries erected by hydraulic cranes. Gantries are assumed to be erected in batches between junctions to minimise the number of closures required.

Drainage and ducting

2.5.26 Alterations to the drainage and new communications ducting will be carried out with wheeled excavators for deeper drains and mini excavators for shallower drains. Materials will be brought to the work area just-in-time for installation, having been previously stored in the nearest suitable construction compound. Chambers and pits are generally preformed rings or plastic units and are installed with the pipework. Trench filling is done with a small roller and plate compactors.

2.5.27 For some drainage or ducting works, the size of verge slot drain or concrete channel will suit a slip-form process. The specialist slip-forming machine to be used is the same as the one for central reserve rigid concrete barrier. This can achieve 200m to 300m per day.

Paving

2.5.28 The existing pavement will be planed out using large rotary planers. HGVs would then transport the arising directly off-site to the main compound for temporary stock piling. Any local widening and strengthening for the sub-base stone layers will then be carried out using imported stone and rollers. This latter operation may be carried out in conjunction with the drainage and ducting works.

2.5.29 The resurfacing of the new lanes is often carried out as a night time operation. The old surface will be planed off and the new surface re-laid in a continuous process. Road finishes and white lining will be undertaken in the same night shift as the paving operation.

Replacement planting

2.5.30 Areas of vegetation lost to construction activities will, where possible, be re-planted using local species that are considered appropriate to the nature of the soil and with due regard to ecological requirements. In the medium to long-term this planting will mature to provide habitats and visual screening, which will replace the vegetation removed.

2.5.31 As the soft estate is a stressful location, the species selected would be capable of surviving and so would also be capable of surviving changing conditions induced by climate change.

[28] This is under the assumption that 20 linear metres of piling is completed per day (440m of piling required for gantries).

Construction traffic management

2.5.32 It is currently anticipated that the Proposed Scheme would be constructed mainly under a 50mph enforceable variable speed limit with traffic management between junction 6 and 8, extending beyond the junctions of the Proposed Scheme extent. A detailed TM strategy will be developed for SGAR3.

2.5.33 Subject to safety and road alignment considerations, the 50mph limit may be locally increased to 60mph. The existing 2 lane motorway capacity would be maintained during the daytime; reducing outside of peak periods.

2.5.34 There will be no daytime closures. An estimated total of 17 night time northbound or southbound carriageway closures, could be required for the removal of existing gantries and the erection of the new superspan cantilever or cantilever gantries. Traffic management through the use of contraflow, narrow lanes and rolling road blocks may be used rather than full motorway closures. To avoid impact on ancient woodland, cross carriageway cabling works in the verge will be under a hard shoulder closure behind rigid barrier traffic management. Protection of ancient woodland will be secured in the outline environmental management plan in clauses such as Nat066.

2.5.35 Overnight lane closures will be required for the removal of equipment and any sign faces on the existing gantries and their subsequent replacement later in the construction sequence.

2.5.36 During overnight or weekend carriageway closures traffic, which tends to be dominated by HGVs, will be diverted onto alternative routes. The A1(M) has a defined series of Emergency Diversion Routes, which would be evaluated for their suitability for the planned diversion of motorway traffic during construction works. Discussions would be held with the Local Highway Authority to confirm the routes to be used along with any traffic control or minor works that would reduce disturbance to local residents.

2.5.37 Details of carriageway and any motorway closures will be confirmed as part of the activities to prepare the CEMP at DF5.

2.5.38 It is envisaged that all construction works would be undertaken within the existing highway boundary. Haul routes for materials and equipment would be routed along the existing motorway carriageways.

Timing of construction works

2.5.39 At the time of writing, construction of the Proposed Scheme is scheduled to commence in Spring 2020, and is expected to take approximately 2 years to construct, including commissioning.

2.5.40 The working hours and permissible noise levels for construction will be determined on the basis of an assessment of the expected impacts of certain types of construction work and the proximity of noise sensitive areas. Works to replace signs and signals on existing gantries, to lift new gantries into place and for the resurfacing of the carriageway will require lane of full carriageway closures and are likely to be undertaken at night.

2.5.41 The Delivery Partner will determine the hours of construction for the Proposed Scheme, which are likely to include both daytime and night time and weekend working and agree these with the Local Authority. Works are to be programmed so as that the requirement for working outside normal working hours is minimised and so noisy works are undertaken during the daytime where possible.

Construction Environmental Management Plan

2.5.42 All works on site and within construction compounds would be undertaken in compliance with a CEMP to be developed by the Delivery Partner. The CEMP will address the risk based and spatially focused environmental management clauses presented in the Register of Environmental Actions and Commitments, as recorded in the OEMP.

2.5.43 Where advanced works are to be undertaken, such as for vegetation clearance, then an initial CEMP will be prepared specifically focusing upon those operations.

2.5.44 Method statements prepared by the Delivery Partner to support the CEMP will demonstrate alignment with the OEMP requirements and thus specify a risk based approach to how the works are to be undertaken. Consequently, where noise barriers are to be removed, it will not be appropriate to rely upon generic method statements. Instead, they should be shown to be applicable to the circumstances of the Proposed Scheme and specifically those red risk areas and actions defined in the OEMP.

2.6 Forecast traffic characteristics

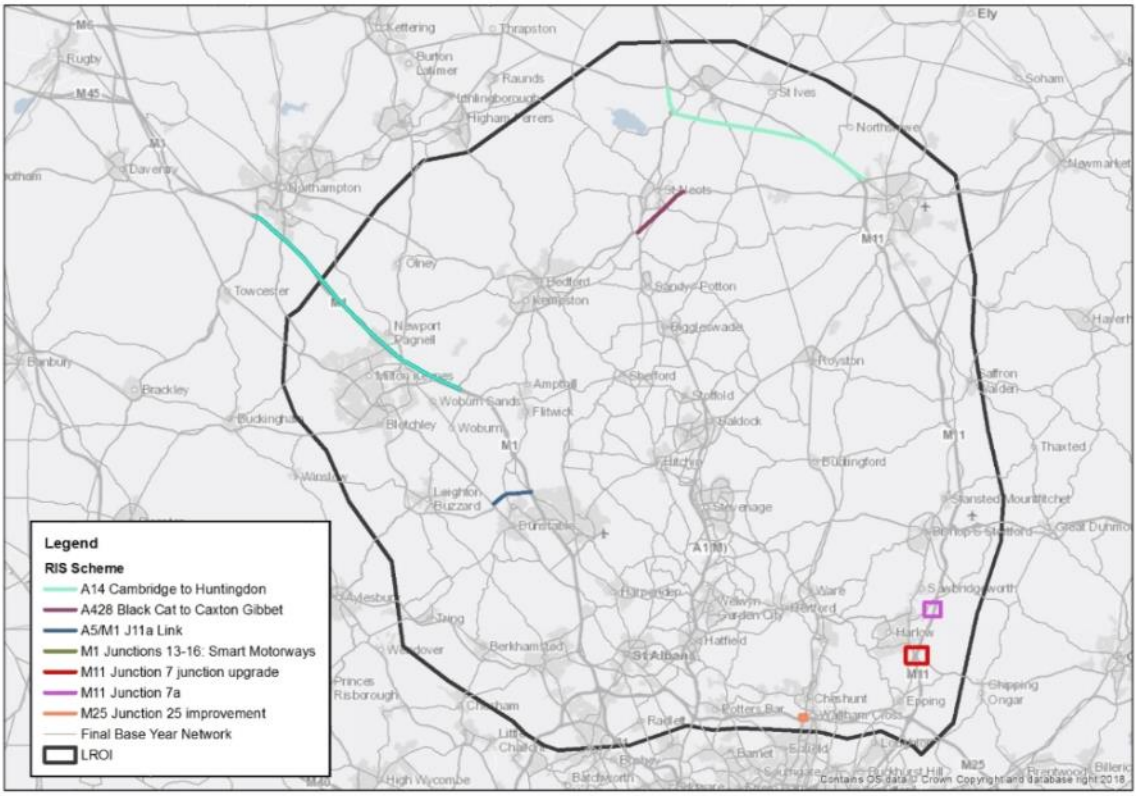
Other transport schemes

2.6.1 Apart from the Proposed Scheme, the following other Highways England schemes are anticipated to be delivered in accordance with the relevant Road Investment Strategy (RIS). The RIS1 schemes in each forecast scenario (i.e. Do Minimum and Do Something) are dependent on their PCF stage. Only those schemes which are classified as 'Near Certain' or 'More than likely' as of February 2018 have been included within the Core Strategy model. RIS2 schemes were not included in the forecast modelling. It is noted that the status of some of the RIS schemes has changed from the status that was specified in the South East Regional Transport Model (SERTM) Uncertainty Log. The RIS schemes included in the Uncertainty Log by scenario are presented in Table 2.13 below and presented in Figure 2.4.

Table 2.13 - RIS schemes – likely region of influence

Scheme name	Opening Year	Status	Uncertainty Status (February 18)	Scenario	SERTM Include File	Model Year
RIS1 Schemes (Single Design Option)						
A14 Cambridge to Huntingdon	2021	Under Construction	Near Certain	Core	Yes	2022
M1 Junctions 13-16: Smart Motorways	2022	Advance Works	More than Likely	Core	Yes	2022
A5/M1 J11a Link	2017	Open	Near Certain	Core	Yes	2022
RIS1 Schemes (Multiple Design Options)						
M25 Junction 25 improvement	2022	Consultation	More than Likely	Core	Yes	2022
M25 Junction 28 improvement	2022	Consultation	More than Likely	Core	Yes	2022
M11 Junction 7 junction upgrade	2021	Consultation	Hypothetical	No	Yes	2022
A428 Black Cat to Caxton Gibbet	2024	Route to be announced	More than Likely	Core	Yes	2037
Other Schemes						
M11 Junction 7a*	2021	Planning Permission granted	More than Likely	Core	New	2021
*Creation of a new motorway junction east of Harlow called junction 7a. Will involve widening of the B183 Gilden Way and open land ready for the development of 15,000 houses						

Figure 2.5 - Scheme locations - RIS schemes[29]



2.6.2 Local authority schemes were initially selected from the SERTM Uncertainty Log. In addition, a review was undertaken of the network assumptions specified by Hertfordshire County Council (February 2018), if they were likely to have an appreciable impact on the Proposed Scheme (i.e. material change in vehicle trips, speed etc.). The following non-Highways England schemes expected to be delivered are shown in Table 2.14 below and Figure 2.5.

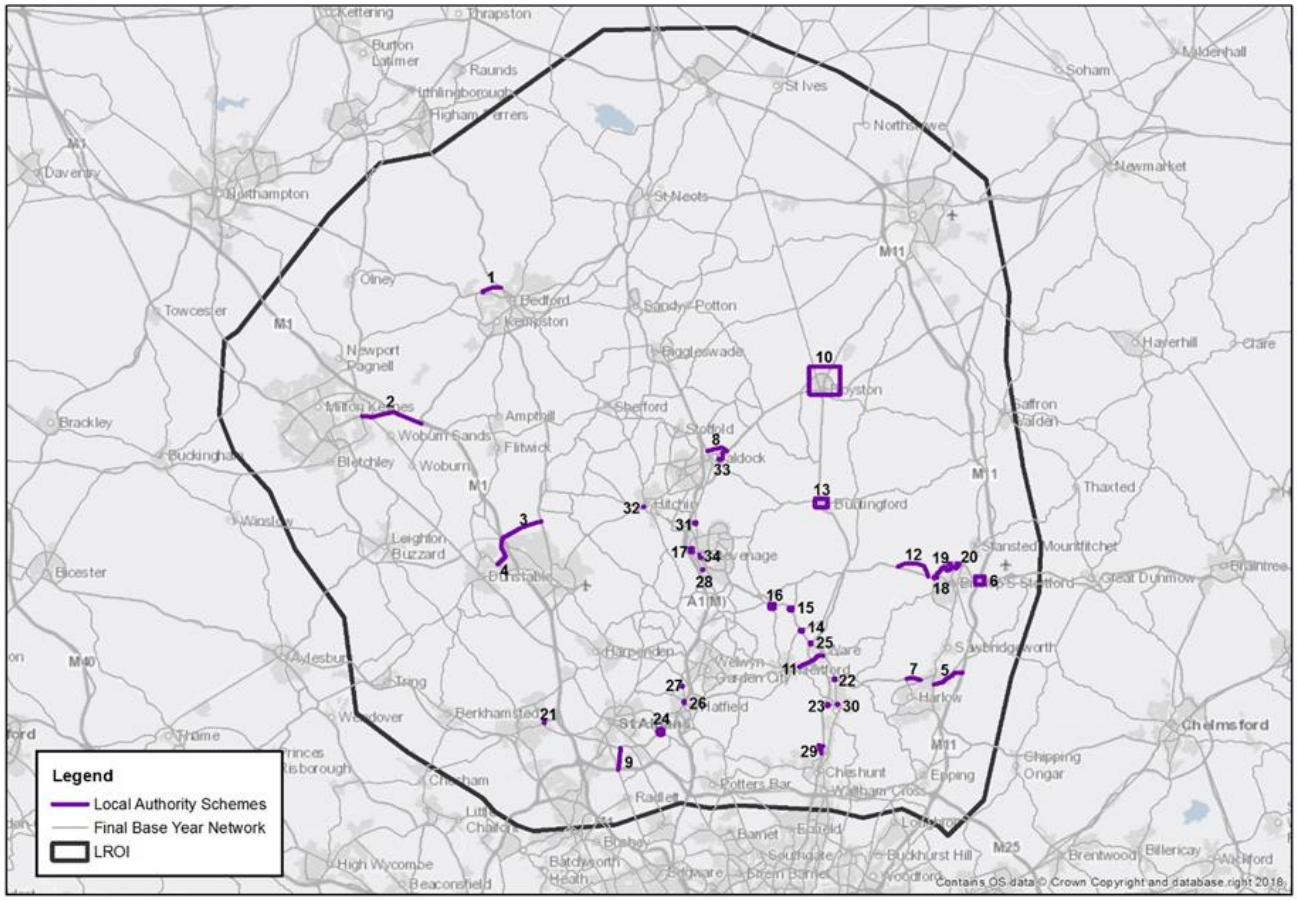
[29] M25 Junction 28 Improvement is not displayed on Figure 2.4, as it is located out of the area shown.

Table 2.14 - Local authority schemes – likely region of influence

ID	Scheme name	Local Authority	Opening Year	Status	Uncertainty Status (as at Feb 2018)	Scenario	Model Year
1	Bedford Western Bypass	Bedford Borough Council	2016	Open	Near Certain	Core	2022
2	A421: Junction 13 to Milton Keynes dualling	Central Bedfordshire Council/ Milton Keynes Council	2020	Advance Works	Near Certain	Core	2022
3	M1 jnc 11a - A6 link road	Central Bedfordshire Council	2022* SEMLEP website, CBC no date given	Funding Secured	More Than Likely	Core	2037
4	Woodside Link	Central Bedfordshire Council	2017	Open	Near Certain	Core	2022
5	B183 Gilden Way Link (Harlow)	Essex County Council	By 2022	Planning Permission granted	More Than Likely	Core	2022
6	M11 Junction 8 Slip road improvement	Essex County Council	By 2022	Improvement LEP funding approved	Near Certain	Core	2022
17	Stevenage Costco access/ Gunnells Wood Road	Hertfordshire County Council	2018	Implemented	Near Certain	Core	2022
16	A602 Improvements -Hertford Road signalization	Hertfordshire County Council	2018-2019	Under Construction	Near Certain	Core	2022
16	A602 Improvements - A119 roundabout,	Hertfordshire County Council	2018-2019	Under Construction	Near Certain	Core	2022
15	A602 Improvements - Sacombe Pound junction,	Hertfordshire County Council	2018-2019	Under Construction	Near Certain	Core	2022
14	A602 Improvements Anchor Lane roundabout	Hertfordshire County Council	2018-2019	Under Construction	Near Certain	Core	2022
25	A602 Improvements A10 junction Ware	Hertfordshire County Council	2018-2019	Under Construction	Near Certain	Core	2022
24	A414 Colney Heath longabout safety scheme	Hertfordshire County Council	2018	Proposed	More Than Likely	Core	2022
23	A10 Hoddesdon_Dumbell Roundabout - Dinant Link Road	Hertfordshire County Council/ Developer	By 2022	Planned	Near Certain	Core	2022
30	Dinant Link Road / Amwell Street (Sun Roundabout)	Hertfordshire County Council/ Developer	By 2022	Planned	Near Certain	Core	2022
18 19 20	Capacity improvements associated with Bishops Stortford North development (various locations)	Hertfordshire County Council/ Developer)	By 2022	Planning Permission granted	Near Certain	Core	2022
22	Remove the existing Bus Ln on Ware Rd approach to A10 Amwell Rbt	Hertfordshire County Council	By 2022	Planned	More than likely	Core	2022
28	Upgrade of A602 / Gunnels Wood Road / GSK junction to hamburger layout	Hertfordshire County Council	By 2022	Linked to planning permission for GSK expansion	More than likely	Core	2022

ID	Scheme name	Local Authority	Opening Year	Status	Uncertainty Status (as at Feb 2018)	Scenario	Model Year
21	A414 Breakspear Way / Maylands Lane Reallocation, Hemel Hempstead	Hertfordshire County Council	By 2022	Agreed through S106	More than likely	Core	2022
13	Upgrade to A10/London Road roundabout Buntingford	Hertfordshire County Council	By 2022	Funding Secured	Near Certain	Core	2022
12	A120 Little Hadham Bypass	Hertfordshire County Council	2019	Funding Secured	Near certain	Core	2022
29	Turnford Link Road	Hertfordshire County Council	Post 2022	Linked to development. Subject to Planning Consent	Near Certain	Core	2037
11	Hertford Road / Ware Road Broxbourne Improvement	Hertfordshire County Council	-	Planned	More than likely	Core	2037
32	A505 /A10 Roundabout; A505 /A1198 Roundabout; A10/Newmarket Road / Melbourn Street Roundabout Royston	Hertfordshire County Council	Pre 2022	Linked to development. Subject to Planning Consent	More Than Likely	Core	2022
9	Radlett Railfreight, new access junction onto A414 and new spine road connecting to A5183 Radlett Road (south of Frogmore)	Hertfordshire County Council	Pre 2022	Planning Consent Granted for Development	More Than Likely	Core	2022
8	New link road connecting North Baldock development to North Road and Royston Road	Hertfordshire County Council	Pre 2022	Linked to development. Subject to Planning Consent	More than Likely	Core	2037
7	Second Stort Crossing (Gilston)	Hertfordshire County Council	-	Linked to long term development. Subject to Planning Consent	Reasonably Foreseeable	Optimistic	2037
32	Pirton Road / A505 / Upper Tilehouse St/ Wratten Rd , Hitchin & Upper Tilehouse St / A602/ Paynes Park	Hertfordshire County Council	-	Planned	Reasonably Foreseeable	Optimistic	2037
33	Baldock Southern link road	Hertfordshire County Council	-	Linked to long term development. Subject to Planning Consent	Reasonably Foreseeable	Optimistic	2037
31	B197 Graveley Rd / North road	Hertfordshire County Council	-	Linked to development	Reasonably Foreseeable	Optimistic	2037
34	Lytton Way redesign (town centre)	Hertfordshire County Council	By 2031	Linked to development	Reasonably Foreseeable	Optimistic	2037
26	Wellfield Road/Comet Way Roundabout & Coopers Green Lane Roundabout Hatfield	Hertfordshire County Council	By 2031	Linked to development	Reasonably Foreseeable	Optimistic	2037

Figure 2.6 - Scheme locations – local authority schemes



2.6.3 Traffic modelling for the Proposed Scheme has taken account of schemes that have and uncertainty status of 'near certain' and 'more than likely' as part of the baseline forecasting for the Proposed Scheme.

Land use development proposals

2.6.4 Major development sites within 1km[30] of the Proposed Scheme have been captured through a review of the Local Planning Authority's Planning Register and other sources[31] over the period August 2013 to January 2019[32] using the following criteria:

- Schemes recorded between August 2013 and January 2019;
- Employment developments (B1, B2 and B8 only) within 1km of the Proposed Scheme (criteria for selecting developments are specified in Chapter 10: Assessment of Combined and Cumulative Effects);
- Residential: 200 + dwellings within 1km of the Proposed Scheme;
- Residential: 10 + dwellings within 300m of the Proposed Scheme;
- Major Minerals and Waste applications within 1km of the Proposed Scheme;
- Nationally Significant Infrastructure Projects within 1km of the Proposed Scheme;
- Transport infrastructure proposals within 1km of the Proposed Scheme (trunk roads or motorways only).

[30] This study area reflects the study area generally adopted for the specialist topics. It is noted some study areas are greater than 1km, for example European Designated Sites within 30km of the Proposed Scheme. However, this is considered a deviation from the general sudy area considered for the Porposed Scheme across specialist topics.
[31] A review of major development allocations from Development Plans, Growth Fund Projects, Strategic Housing Land Availability Assessments and Employment Land Availability Assessments has been undertaken on those plans published as of November 2017. A review of all Nationally Significant Infrastrucuture Projects (NSIP) detailed in the register of applications as of January 2019. Major development sites such as sustainable urban extensions are then captured within the transport modelling uncertainty log.
[32] A review of the planning register from August 2013 to November 2017 was provided by Highways England in May 2018. A review of the Planning Register will be updated up to January 2019.

2.6.5 Following the above criteria, sufficient environmental data and assessments for the development in question would need to be readily available for any cumulative assessment to be conducted with any confidence. Should such information not be available for any given development, then that development has not been taken into account in the assessment of cumulative effects; and

2.6.6 Following the above criteria, developments located greater than 300m from the Proposed Scheme will only be assessed where a valid planning permission has been secured, and for which formal environmental impact assessment or non-statutory environmental impact assessment has been undertaken.

2.6.7 There are 2 proposals for residential development involving approximately 26 dwellings within 300m of the Proposed Scheme. The closest proposed site is at The Avenue, Welwyn and would be 35m from the motorway carriageway. No proposals for industrial/commercial development were identified within 300m of the Proposed Scheme.

2.6.8 A summary of these developments, including those which have been included in the traffic model, are included in Table 2.15**.**

Table 2.15 - Summary of land use development proposals

Development	Description	Included in the Traffic Model (Y/N)
22 The Avenue, Welwyn AL6 0PP	Outline planning permission for 12 dwellings, at the time of writing this application is under appeal	N
Land at Chadwell Road, Norton Green, Stevenage, Hertfordshire	14 dwellings	N
Housing Development - North of Stevenage	800 Dwellings by 2021	Y
Housing Development - The Oval neighbourhood centre	275 Dwellings between 2021 – 2026	Y
Housing Development - Stevenage West	1,350 Dwellings by 2021	Y
Housing Development - South East of Stevenage 1	550 Dwellings by 2021	Y
Housing Development - S of WGC (Birchall W)	1,200 Dwellings between 2021 – 2031	Y
Housing Development - North West of Hatfield	1,550 Dwellings between 2021 – 2036	Y
Housing Development - East of Stevenage	600 Dwellings by 2021	Y
Housing Development - Land East of Welwyn Garden City	1,350 Dwellings between 2021 – 2031	Y
Housing Development - The Gilston Area	3,050 Dwellings 2021 – 2031	Y
Housing Development - Symondshyde	1,000 Dwellings between 2021 – 2031	Y
Housing Development - North of Baldock	2,500 Dwellings between 2021 – 2031	Y
Housing Development - North of Stevenage	900 Dwellings between 2021 – 2031	Y
Housing Development - North of Great Ashby	930 Dwellings between 2021 – 2031	Y
Housing Development - Land East of Luton	2,100 Dwellings between 2021 - 2031	Y

Development	Description	Included in the Traffic Model (Y/N)
Housing Development - Land at Highover Farm	700 Dwellings between 2021 – 2031	Y
Housing Development - Land north of Letchworth	900 Dwellings between 2026 - 2031	Y
Housing Development - Land North and East of Ware	1,000 Dwellings between 2026 – 2031	Y
Housing Development - Land south of Little Wymondley	300 Dwellings between 2021 – 2026	Y
Housing Development - North of Luton	3,100 Dwellings between 2026 – 2031	Y
Employment Development - Proposed Rail Freight Interchange, Public Open Space and Community Forest Sites, North Orbital Road, St Albans	The total employment floorspace (sqm) by 2031 – 331,665. Providing a total of 4,095 jobs by 2031.	Y
Employment Development - The Wine Society, Gunnels Wood Road, Stevenage, SG1 2BG	The total employment floorspace (sqm) by 2031 – 7,204. Providing a total of 87 jobs by 2031.	Y
Units 1-5, 8-25, A-Q & Comark House, Gunnels Wood Park, Gunnels Wood Road, Stevenage, SG1 2BH	The total employment floorspace (sqm) by 2031 – 29,522. Providing a total of 1,379 jobs by 2031.	Y
AVC, Bessemer Drive, Stevenage, SG1 2DT	The total employment floorspace (sqm) by 2031 – 12,282. Providing a total of 574 jobs by 2031.	Y
Broadwater Rd West (Spen HIll Tesco dev), Welwyn Hatfield	The total employment floorspace (sqm) by 2031 – 20,150. Providing a total of 2,001 jobs by 2031.	Y
North West Hatfield, Welwyn Hatfield	The total employment floorspace (sqm) by 2031 – 17,375. Providing a total of 1,583 jobs by 2031.	Y
Unit 1 Quadrant Park, Mundells, Welwyn Garden City, AL7 1FS	The total employment floorspace (sqm) by 2031 – 2,469. Providing a total of 69 jobs by 2031.	Y

Traffic modelling

2.6.9 The traffic modelling has been derived from a base year of 2015 and has employed the South East Regional Transport Model (SERTM). An A1(M) version of the model has been derived with additional network and zoning within the A1(M) corridor. The A1(M) model will be used for the development and assessment of the Proposed Scheme, economic as well as environmental. The calibration of the model has been updated using additional traffic count data provided by Hertfordshire County Council to derive forecasts for the opening year (2022) and design year (2037) for situations with and without the Proposed Scheme.

Reliability of traffic model

2.6.10 Having examined the model outputs, it is identified that the model is suitable for assessing the Proposed Scheme. The traffic flows have been validated to WebTAG criteria, while the demand model also meets TAG criteria. The model outputs have been used to define a Traffic Reliability Area (TRA). This covers much of Hertfordshire and a large area of Bedfordshire, with particular focus on the Strategic Road Network including the A1, A1(M), M1, M11 and M25 inter-urban routes such as the A602 and a series of cordons around the urban areas including Stevenage, Welwyn, Hatfield, Hitchin, St Albans and Luton. Checks have also been made to ensure the model is satisfactory on Pollution Climate Mapping links on the Strategic Road Network. It is noted that the Traffic Reliability Area excludes the centres of the urban areas as the main focus was on the Strategic Road Network corridors and access routes to these.

Affected road network

2.6.11 The affected road networks (ARNs) for the opening and design year for the Proposed Scheme are presented in Figures 2.6 and 2.7. As a result of the Proposed Scheme, 119 one way links are expected to have a reduction in traffic[33], whereas 212 one way links are expected to increase in traffic[34][35]. The largest traffic changes are on the A1(M) corridor through the Proposed Scheme while there are local reductions on routes between Welwyn, Knebworth and Stevenage. Traffic flows are increased along the A1 corridor between Biggleswade and South Mymms (M25 junction). In addition, the forecasts show an increase on the A505 between Royston and Baldock as well as local changes approaching the A1(M) junctions. In the wider area there are reductions on the M1 and M11 as longer distance traffic diverts to the A1(M).

2.6.12 In Design Year 2037, the Proposed Scheme is envisaged to generate an increase in traffic of up to 24% at junction 6 to junction 7 northbound, an increase of up to 22% at junction 7 to junction 8 northbound and an increase of up to 21% at junction 7 to junction 6 southbound compared to the 'do minimum' scenario. The increases in Annual Average Daily Traffic (AADT) for light vehicles are due to the following reasons:

- Junction 6 to 7 northbound: through the release of queued traffic in the do-minimum at junction 6 northbound, as well as traffic diverting from parallel local roads through Knebworth and Codicote as well as long distance traffic being attracted to the corridor;
- Junction 7 to 8 northbound: through the release of queued traffic from the previous section in the do-minimum at junction 6, as well as traffic diverting from parallel local roads through Knebworth and Codicote as well as long distance traffic being attracted to the corridor; and
- Junction 7 to 6 southbound: through the release of queued traffic in the do-minimum at junction 7 southbound as well as local routing changes from the north of Stevenage as well as longer distance diversions.

2.6.13 In Design Year 2037, the percentage of HGVs is envisaged to increase by 12% in the northbound direction and 11% in the southbound direction due to the following reasons:

- Junction 6 to 7: diversions from other corridors such as the M1 and M11 and local re-routing; and
- Junction 7 to 8: diversions from other corridors such as the M1 and M11 and local re-routing.

[33] Of the 119 one way links which have a reduction that meet the AADT change, 2 links are motorway links (A1(M)) and 117 are other links which provide access (such as the A505, the A1 north of Baldock and routes near Stevenage).
[34] Of the 212 links which have an increase that meet the AADT change criteria, 68 are motorway links (A1(M)) and 144 are other links which provide access links (such as the A505, the A1 north of Baldock and routes near Stevenage).
35 These results, detailing the links that increase and decrease in traffic flow, are based on one way SATURN links from the traffic model for the Proposed Scheme.

2.6.14 In Design Year 2037, each of the sections between junctions 6 and junction 8 along the motorway are forecast to experience an increase in traffic volume in the region of 20%. South of the Proposed Scheme between junctions 4 and 6, flows are increased by 11%. Similarly, to the north of the Proposed Scheme, flows are increased by 10% between junctions 8 and 9.

2.6.15 In Design Year 2037, in terms of a change in movements at junctions, none of the Proposed Scheme's junctions involve an increase in excess of 10% in the ADDT flows. However, it is noted in the wider area, traffic will increase by more than 10% the following:

- Black Cat roundabout: increase of 14% due to strategic re-routing to the A1 corridor

Figure 2.7 - Opening Year affected road network

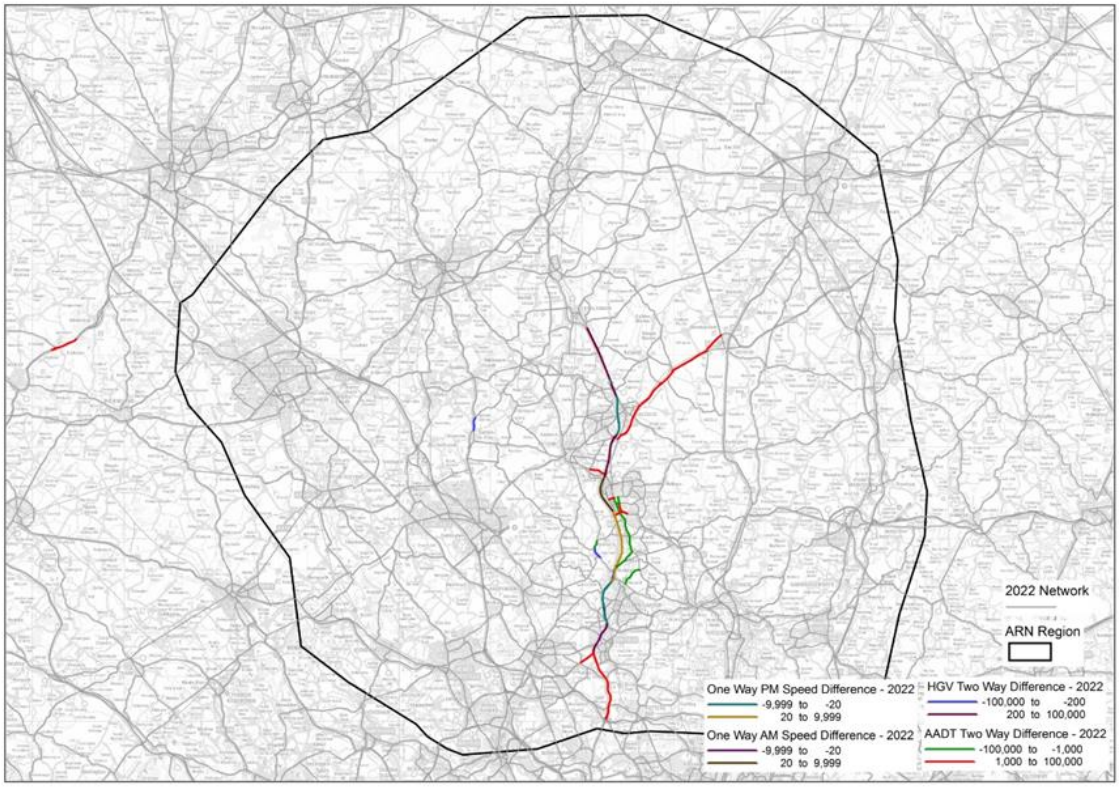
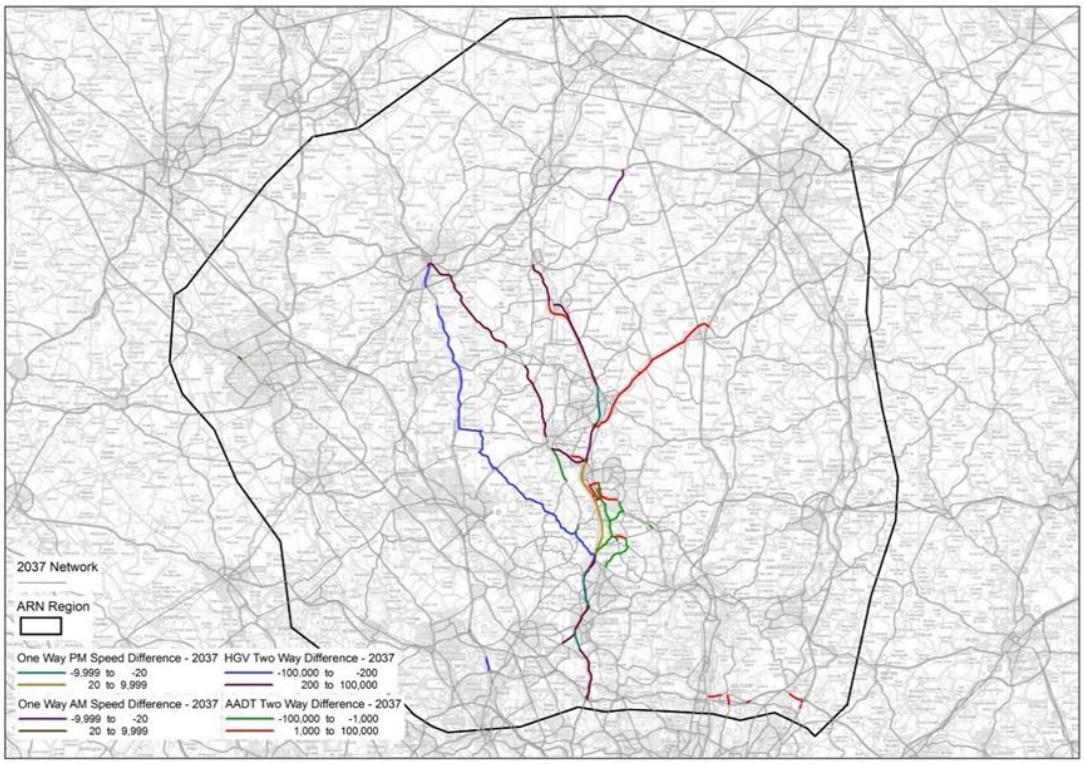


Figure 2.8 - Design Year affected road network



3. Alternatives Considered

3.1 Programme level alternatives

3.1.1 In October 2007, following the success of a Hard Shoulder running trial on the M42, the Transport Secretary Ruth Kelly announced that a comprehensive review of the roads build programme was to be undertaken. As part of this announcement the Managed Motorways concept was born, recognising that an innovative mix of road widening, opening up the hard shoulder and junction improvements, was required to provide cost effective and sustainable solutions to highways congestion.

3.1.2 The development of proposals led to the announcement in July 2008 of a £6bn programme to fund improvements to national strategic roads in England in the period up to 2014. The DfT Command paper 'Roads – Delivering Choice and Reliability' considered the latest roads build programme, and initiated a nationwide study into whether alternatives to widening through the Dynamic Use of Hard Shoulder (DHS) and other innovative regimes could provide workable and cost-effective solutions. Using Managed Motorways DHS design guidance developed by the Highways Agency (now Highways England), an initial 29 schemes were identified for review encompassing over 400km of motorway network.

3.1.3 For each scheme, an Options Identification Report was to be produced, considering how to best address the specific local problems, be that through DHS, traditional widening or alternative solutions. Experience from these schemes suggested that there was scope to further reduce both the capital and operating costs, whilst continuing to meet the congestion and safety objectives. This led to the introduction of the All Lane Running (ALR) design, described in Interim Advice Note (IAN) 161/15.

3.2 Scheme specific alternatives

3.2.1 As the Smart Motorways Programme (SMP) schemes are located within the existing Highways England road estate, there are minimal scheme-specific design alternatives available for consideration.

3.2.2 Such alternatives relate primarily to the locations of gantries, emergency areas, communications equipment and noise barriers; the positions of some of these being dictated by various design rules.

3.2.3 In terms of the Proposed Scheme, a total of 20 gantries and emergency area locations proposed in at Design Fix (DF) 1 have been repositioned primarily for operational, safety or environmental reasons. Operational traffic and safety factors are a key driver in identifying and deciding upon an option. Environmental constraints are also considered to minimise the risk of significant environmental effects while also seeking to deliver the environmental enhancements called for under the Highways England Licence and Road Investment Strategy.

3.2.4 The relocation of gantries and emergency areas from DF1 to DF2 mainly relate to the change in guidance from the Overseeing Organisation, detailing the updated requirements to IAN 161/15, but also relate to a change in junction arrangements resulting from updated traffic data being provided at DF2.

3.2.5 A summary of significant changes to the Proposed Scheme between DF1 and DF3 are summarised in Table 3.1 below**.**

Table 3.1 - Principal design changes between DF1 to DF3

Approximate Chainage	Northbound(NB)/ Southbound(SB)	Proposed Scheme Link	Details	Reason
4770-4870	NB	J6-J7	EA NB1 relocated further north between DF1- DF2	Moved to meet guidance from the Overseeing Organisation, but inadvertently avoided opening views of the motorway due to vegetation clearance. This reduced the visual impact upon properties located on Danesbury Park.
6335 - 6435	NB	J6-J7	EA NB2 relocated further north between DF1- DF2	Relocated to meet guidance from the Overseeing Guidance, but inadvertently avoided an adverse impact to an irreplaceable habitat (Ninning's Wood, ancient woodland).
5460	SB	J6-J7	G-A1(M) 25 relocated further north between DF1- DF2	Since DF1, the gantry type has changed from a superspan gantry to a super cantilever. This allowed greater flexibility in locating the gantry and thus was relocated further north, to avoid an adverse impact to an irreplaceable habitat (Ninning's Wood, ancient woodland).
5321	NB	J6-J7	G-A1(M) 04 repositioned between DF1- DF2 (no repositioning between DF2-DF3)	GA-1(M) 04 moved between DF1 and DF2 due to a change in guidance. It was relocated in close proximity to ancient woodland; however, further repositioning was not possible between DF2 and DF3 for the following reasons: Maximum distance away from previous gantry, therefore must achieve the minimum visibility. If the gantry moved southbound, the visibility line would be obstructed by Pottersheath Overbridge (5015) structure. If the gantry moved northbound the visibility will fall outside the highway boundary, due to the left hand bend in the motorway.
10625	NB	J7-J8	GA1(M) 09 repositioned between DF1-DF3	GA1(M) 09 moved between DF1 and DF2 due to change in guidance. This gantry is a gateway gantry, therefore it was repositioned further northbound between DF2 and DF3 to enable GA1(M) 10 to be placed far enough away from the gantry, so that it is in advance of the sweeping right hand bend which reduces visibility to GA1(M) 11. Consequently, this location is likely to have an adverse visual impact to recreation and residential receptors at Norton Green Cottage. Further repositioning was not possible for the following reasons: If the gantry moved any further northbound, the gantry would not achieve the minimum half distance from the gantry for visibility requirements. The gantry achieves the maximum non-visibility of 600m; if the gantry was relocated further southbound, it would not achieve the minimum visibility.

4. Approach to Assessment

4.1 Introduction

4.1.1 The main stages of the environmental assessment process that have been undertaken are set out below.

4.2 Screening

4.2.1 The Proposed Scheme is classified as a relevant EIA Directive project within Annex II as it is a change to an Annex I project, namely a motorway. Whether a statutory environmental assessment is required is dependent upon what are termed Annex III criteria which include: the sensitivity of the receiving environment; the likelihood of significant effects and the project characteristics.

4.2.2 A screening checklist, completed using the template provided in Interim Advice Note (IAN) 125/15 - Environmental Assessment Update (Annex B)[36], identified that it was considered unlikely that significant environmental effects would result from the Proposed Scheme. However, there was some uncertainty because of the level of information available at that time and further scoping and desk study was required. This was to ensure effects could be avoided or managed below significant levels.

4.2.3 A scoping exercise for the Proposed Scheme was undertaken in line with established guidance[37]. This report concluded that there were unlikely to be significant environmental effects[38]. It identified potential impacts and detailed information to be gathered to gain further certainty regarding potential environmental effects and defined the scope of any further assessment identified as required. Scoping conclusions, taken from Table 3.1 of the Environmental Scoping Report, are detailed in Table 4.1 below.

Table 4.1 - Scoping conclusions

Topic	Scoped in / out of EAR		Scoped in / out of Outline Environmental Management Plan
	Construction	Operation	
Air quality	Out	In	In
Noise and vibration	In	In	In
Biodiversity	In	In	In
Cultural heritage	In	In	In
Landscape character	In	In	In
Landscape and visual effects	In	In	In
Road drainage and the water environment	Out	Out	In
Geology and soils	Out	Out	Out
Materials & waste	Out	Out	Out
Population and human health*	Out	Out	Out
Cumulative environmental effects	In	In	Out
Climate change	Out	Out	Out
Major accidents & disasters	Out	Out	Out
Heat and radiation	Out	Out	Out
Demolition	Out	Out	Out
Land take	Out	Out	Out
*To be addressed under air quality, noise and vibration and cumulative effects			

[36] IAN 125/15 - Environmental Assessment Update: http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian125r2.pdf
[37] DMRB, Volume 11, Section 2 (Part 4): http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section2/ha20408.pdf
[38] Highways England, 2018: A1(M) Junction 6-8 Environmental Scoping Report, MP0135-HEX-EGN-ZZ-AS-KK-0001

4.2.4 For the purpose of this EAR, the assessment of the Proposed Scheme has been undertaken using the latest developed design which has been advanced from the Design Fix 2 (DF2) design. Topics scoped into the EAR have been subject to further assessment, the result of which is described in Chapters 5 to 10 of this report. The cultural heritage assessment of construction and operational effects is assessed and reported within Chapter 7: Landscape and Cultural Heritage since the potential impact due to SMP schemes is generally limited to that of a change to the setting of a heritage asset. For some schemes, there is a risk that construction activities could affect buried archaeology as is the case for the Proposed Scheme, although the works are not expected to be deep enough to impact any preserved buried remains present underneath the A1(M).

4.2.5 Topics scoped out are excluded from further environmental assessment, although they have been considered to determine whether the Outline Environmental Management Plan (OEMP) needs to include measures to ensure the absence of significant effects. The reasoning behind the decision to scope topics out is described in the Environmental Scoping Report.

4.2.6 Due to progression of the Proposed Scheme design and field based surveys, the scoping decisions have been reviewed within this EAR. This has resulted some changes to the scope of this EAR. Justification of these changes is provided in the following text.

Road Drainage and The Water Environment

4.2.7 Pollutant loading and impacts to ground water is scoped in for operational effects, due to a change in traffic flow greater than 20% in the following locations along the Proposed Scheme:

- Junction 6 northbound through road;
- Junction 6 northbound on-slip;
- Junction 6 southbound off-slip;
- Between Junction 6 and Junction 7 northbound and southbound;
- Junction 7 northbound through road;
- Between Junction 7 and Junction 8 northbound; and
- Junction 8 northbound off-slip.

4.2.8 Given the sensitivity of underlying groundwater resources, risks to groundwater during construction has been scoped in.

Population and Human Health

4.2.9 Population and human health has been scoped out of Chapter 10: Assessment of Combined and Cumulative Effects.

4.2.10 The Environmental Scoping Report stated that population and human health had the potential to be scoped out of the cumulative assessment. This was on the basis of the low accidents rates on motorways and the low likelihood of an adverse noise or severance impacts on local health. However, the decision on whether to include population and human health was deferred at the scoping stage, pending the results of the noise and air quality assessments.

4.2.11 No significant effects on human health receptors have been identified in the noise or air quality assessments, therefore it is not evident that there would be significant cumulative effects on human health receptors. Furthermore, it is considered that effects on populations (for example; Oaklands, Symonds Green, Todds Green, Fishers Green, Norton Green, Rabley Heath, Potters Heath, Danesbury and Welwyn) through closures of the motorway would be low. Gantries are assumed to be erected in batches between junctions to minimise the number of closures required with an estimated total of 17 night time northbound or southbound carriageway closures. All closures will take place overnight or at weekends and will be short term in nature, therefore having a limited impact on journeys. As such, population and human health has been scoped out of the cumulative assessment.

4.3 Methodology

4.3.1 The structure of each technical topic broadly follows the structure for non-statutory environmental impact assessment as indicated in DMRB Volume 11, Section 2, Part 6 – Reporting of Environmental Impact Assessments[39].

Study areas

4.3.2 The individual study areas for each environmental topic are defined in Chapters 5 to 10. These are based on the geographical scope of the potential effects relevant to the topic and topic specific guidance provided in DMRB and other best practice guidance referenced in the individual topic chapters.

Future baseline conditions

4.3.3 For the assessment of environmental effects, the baseline needs to reflect the conditions that would exist in the absence of the Proposed Scheme. The soft estate and wider environment, within which the Proposed Scheme resides, is expected to experience little change from its current state. Future baseline conditions are set out in each topic chapter of this report.

4.3.4 In the case of acoustics and air quality, alongside the current situation, the opening year do minimum situations are presented. In the case of acoustics, the assessment goes further to detail the do minimum for the design year (opening year +15 years).

4.3.5 Developments that have the potential to generate additional traffic have been considered within the uncertainty log for the traffic model. See Table 2.13 and 2.14 of Chapter 2: The Proposed Scheme for details. Only those schemes which are classified with a likelihood of 'Near certain' or 'More than likely' as of February 2018 have been included in the traffic model.

4.3.6 Development proposals with consent and located within 300m of the Proposed Scheme have been considered to determine whether they would either introduce new receptors for visual, air quality and/or noise.

4.3.7 It is also possible that development could introduce screening that reduces the impact of the Proposed Scheme. The location of such development is considered in each topic chapter and located on Figure 10.1.

4.3.8 Section 2.6 provides in more detail the criteria used to identify land use and development proposals. A summary of these developments, including those which have been included in the traffic model, are included in Table 2.15 of Chapter 2: The Proposed Scheme.

4.3.9 Beyond the potential for change in land use, other potential for change in the soft estate is associated with the natural growth of the vegetation and the ongoing management of wider environment by others. No significant change is anticipated in the year preceding the start of construction, the opening year or the design year.

4.3.10 The 'future baseline' i.e. changes that would occur in the absence of the Proposed Scheme, have been identified in Chapters 5 to 10, providing consideration of trends as appropriate.

Impact avoidance and mitigation

4.3.11 The first premise of good design is the avoidance of impacts and in this regard a SMP is no different to any other. However, the importance of road safety and the associated design rules can restrict the flexibility in locating some of the works. The evolution of the Proposed Scheme design, along with those aspects where design rules prevent a preferred environmental location from being selected, are presented in Section 2.4.

[39] DMRB, Volume 11, Section 2 (Part 6): http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section2/hd4808.pdf

4.3.12 An OEMP has been produced as part of the EAR (Document reference: HE551539-WSP-EGN-SG-RP-LE-00014). The OEMP sets mitigation and enhancement measures to be delivered during the construction and/or operation of the Proposed Scheme. The structure of the OEMP follows IAN 183/14.

Assessment of effects

4.3.13 Policy and guidance relevant to each specific environmental topic are identified within the topic chapters of this EAR.

4.3.14 In accordance with DMRB, the assessments focus on the likely potential significant environmental effects arising from the permanent and temporary, direct, indirect, secondary, cumulative, short, medium and long-term, positive and negative impacts of the Proposed Scheme.

Monitoring

4.3.15 The environmental assessment of SMP schemes that are delivered without recourse to the Development Concent Order (DCO) process, conclude that significant effects are not expected due to the deployment of standard construction management or operational practices. Also, measures identified during the design and assessment and recorded in the OEMP are intended to avoid significant adverse effects.

4.3.16 Some situations may arise where there is uncertainty in the outcome or the effectiveness of a mitigation measure for which it may be appropriate to consider the adoption of targeted monitoring to enable corrective measures to be taken and also to demonstrate effectiveness for the benefit of other schemes. In this context, the OEMP has identified that there are approximately 3 locations where monitoring of the mitigation measure and/or its effectiveness is required.

Traffic forecasting

4.3.17 The Appraisal Specification Report sets out the approach taken towards traffic forecasting, but insofar as the environmental assessment is concerned speed pivoting is applied only to links within affected road network only (worst case of Opening or Design Year) and within 200m of the affected road network. In addition, those links outside the Traffic Model Reliability area are not assessed.

4.3.18 As link speeds vary within the traffic model (i.e. mid-link speeds can often be different from speeds approaching the junction), so both noise and air quality forecasts are based on average speed links inclusive of junction delay.

4.3.19 Where the speed of traffic changes bands of less than 5kph, then the Speed Band of the scenario with the greatest difference is used, for example:

- Base Year (BY) = 20.3kph, Do Minimum (DM) = 19.6kph, Do Something (DS) = 21kph. Speed band of the DS would be taken for all.
- BY = 19.2kph, DM = 19.5kph, DS = 22.5kph. Speed band of the DS would be taken for all.

4.3.20 A base year of 2017 traffic model has been used for the environmental assessments.

4.3.21 Calculation of 18 hr annual average weekday traffic (AAWT) speeds is taken from an average of 18hr AAWT speeds, and others such as morning peak speeds, i.e. they take no account of flow weighting.

Significance criteria

4.3.22 The significance of identified environmental effects is determined by considering the changes with and without construction and operation of the Proposed Scheme. Volume 11, Section 2, Part 5 of DMRB (specifically Tables 2.1 and 2.2) provides advice on typical descriptors of environmental value, magnitude of impact and significance of effects. This has formed the basis for assessment in this EAR together with specific advice contained within DMRB Volume 11 Section 3 and IAN 125/09, where appropriate.

4.3.23 Certain impacts will be avoided as a result of management actions undertaken prior and during construction. Such commitments and actions are documented in the OEMP with sufficient spatial precision to be delivered by the organisation constructing the Proposed Scheme. The OEMP will also clearly identify the structures and processes that will be used to manage and control these aspects. Such actions also form part of the Works Instructions as necessary.

4.3.24 Effects, whether beneficial or adverse, are expressed in terms of their significance. Significance is derived through consideration of the sensitivity of a receptor (sometimes referred to as its value or importance) and the magnitude of the impact, as defined by the amount of change from the baseline. Therefore, the significance of an effect is influenced by both of these variables. The significance of effect has been assigned after consideration of the effectiveness of 'impact avoidance measures', committed in the Proposed Scheme design (refer to Chapter 2: The Proposed Scheme) and the OEMP.

4.3.25 Further details of the topic specific significance criteria used in this EAR are discussed in Chapters 5 to 10.

Cumulative and human health effects

4.3.26 Two types of cumulative effects have been considered within this EAR:

- **Combined effects** are those caused only by the Proposed Scheme which arise when an individual receptor or group of receptors would experience multiple effects as a result of the Proposed Scheme; for example, an individual property experiencing combined noise, air quality and visual amenity effects. These are also referred to as intra-project effects; and
- **Cumulative effects** are those caused by the Proposed Scheme acting with other relevant schemes. These are also referred to as inter-project effects.

Assumptions and risks

4.3.27 This EAR is based on construction and design information, which is subject to change. Further detailed design information and construction methods will be developed as the Proposed Scheme progresses beyond SGAR3. Any changes will be assessed using the Evaluation of Change Register to ensure that no significant effects arise from the Proposed Scheme.

4.3.28 Information presented within the EAR is based on readily available online databases and mapping data. Site surveys have been undertaken in a targeted way, which is considered to be proportionate to the Proposed Scheme. For health and safety reasons, access to the verge was restricted to areas behind permanent barriers and avoiding access from the live carriageway. Other areas were not accessible due to existing site constraints.

4.3.29 Topic specific assumptions and limitations are identified in Chapters 5 to 10.

5. Air Quality

Key features for this topic:

- Two designated ecological sites (Knebworth Woods Site of Special Scientific Interest (SSSI) and Sherrardspark Wood SSSI) breach acceptable nitrogen deposition rates, although do not result in a significant overall effect - the impacts are documented in Chapter 6: Biodiversity;
- There are no Air Quality Management Areas affected by the Proposed Scheme;
- The maximum modelled concentration within the Proposed Scheme, in the opening year, was 38.6µg/m^3 (R029, northern entrance/exit to the Welwyn Tunnels);
- No modelled exceedances of the annual mean objective for nitrogen dioxide (NO_2) or the European Union (EU) limit value, with or without the Proposed Scheme;
- Seventeen receptors (R004-7, R015-19, R021-25, R027, R029, and R031) experience an imperceptible worsening in air quality with the Proposed Scheme in the opening year; and
- Nine receptors (R044, R045, and R053-59) experience an imperceptible improvement in air quality with the Proposed Scheme in the opening year.
- Overall, the impact of the Scheme on air quality is not significant.

5.1 Introduction

5.1.1 Air quality is a consideration for any scheme proposal involving material changes in the nature and location of emissions to air. Any changes to traffic volumes, speed and composition associated with the Proposed Scheme have potential subsequent impacts on emissions to air and thus ambient air quality at nearby receptors.

5.1.2 This chapter describes the detailed assessment of the local and regional operational effects arising from the Proposed Scheme, a summary of the current baseline conditions, the potential impacts of the Proposed Scheme.

5.1.3 The assessment includes:

- Determination of the air quality assessment study area;
- Determination of existing baseline conditions and constraints; and
- Estimation and consideration of effects on local air quality (human and ecological receptors) and regional emissions.

5.1.4 The local air quality assessment has focused on the impacts of the air pollutant nitrogen dioxide (NO_2) as the air quality criteria for this pollutant are those most likely to be exceeded in the air quality assessment study area. The regional assessment of emissions considers oxides of nitrogen (NO_x), carbon dioxide (CO_2) and particulate matter.

5.1.5 The scope of the assessment is in line with that set out in the Environmental Scoping Report (P01.1 – May 2018)[40]. On this basis, construction impacts were scoped out as they are highly localised and temporary. However, best practice measures/controls will be adopted during construction for works near to sensitive receptors, which are outlined in the Outline Environmental Management Plan (OEMP).

5.1.6 This chapter is supported by:

[40] MP0135-HEX-EGN-ZZ-AS-KK-0001

- Appendix 5.1 – Air quality assessment strategy and methodology papers;
- Appendix 5.2 – Regulatory and policy framework;
- Appendix 5.3 – Baseline, opportunities and constraints;
- Appendix 5.4 – Traffic data;
- Appendix 5.5 – Model verification;
- Appendix 5.6 – Impact assessment; and
- Appendix 5.7 – Compliance risk assessment.

5.1.7 The following figures also support this chapter.

- Figure 5.1 – Affected road network;
- Figure 5.2 – Air quality constraints map including monitoring locations;
- Figure 5.3 – Predicted nitrogen dioxide concentrations with Proposed Scheme in 2022; and
- Figure 5.4 – Predicted change in nitrogen dioxide concentrations with Proposed Scheme in 2022.

5.1.8 The professional competency of the Topic Lead for this Air Quality Chapter is detailed in Appendix 1.1. This information is provided to fulfil the requirement of EU Directive 2014/52/EU.

5.2 Methodology

5.2.1 This section summarises the following:

- The study area;
- Legislation, policy and guidance;
- Operational air quality scenarios;
- Baseline information & data sources;
- Constraints mapping;
- Traffic data;
- Local air quality assessment;
- Verification;
- Regional air quality assessment;
- Receptors;
- Magnitude of change;
- Significance of effect; and
- Stakeholder engagement.

Study Area

5.2.2 The air quality assessment presented for the Proposed Scheme considers a study area of the roads affected (the affected road network (ARN)) and is illustrated in Figure 5.1.

5.2.3 The air quality study area has been determined in accordance with traffic change criteria set out in DMRB Volume 11, Section 3, Part 1 (HA207/07), and specifically (paragraph 3.12) which defines the affected road network for local air quality assessments.

5.2.4 The affected road network, for the purposes of a local air quality assessment, is defined as those roads within a defined traffic reliability area (TRA) (i.e. the area of the traffic model considered to provide reliable estimates of traffic when the base traffic model is compared to observed traffic) that meet any of the traffic change criteria (based on the two-way flow on all roads), whereby:

- Road alignment will change by 5 metres (m) or more, or
- Daily traffic flows will change by 1,000 Annual Average Daily Traffic (AADT) or more,
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more, or
- Daily average speed will change by 10 kilometres per hour (km/hr) or more, or
- Peak hour speed will change by 20km/hr or more.

5.2.5 The air quality study area has been defined, based on the affected road network, or those links which have relevant receptors within 200m of either side of road carriageways[41]. In practice, the assessment is undertaken by identifying where relevant receptors are located adjacent to the affected road network as well as all road sources within 200m of that receptor, whether in the affected road network or not.

[41] This distance of 200m from roads is industry best practice guidance specified in DMRB HA207/07, which has been derived from calculations using atmospheric dispersion modelling of dispersion profiles that have been confirmed through field measurements.

5.2.6 For the purposes of the regional air quality assessment, the study area has been defined as all road links within the traffic reliability area.

5.2.7 For ease of modelling and comparison, impacts have been predicted at selected representative receptors (see paragraph 5.2.35) within this area for all scenarios.

5.2.8 The locations of the various monitoring sites included are shown in Figure 5.2.

Legislation, Policy and Guidance

5.2.9 Relevant air quality legislation, policy and guidance, including relevant Air Quality Strategy objectives, are detailed in Appendix 5.2.

5.2.10 Relevant guidance documents used for the air quality assessment are listed below:

- DMRB Volume 11, Section 3, Part 1 HA207/07, May 2007;
- Interim Advice Note (IAN) 114/08 Highways Agency Carbon Calculation and Reporting Requirements, September 2008;
- IAN 170/12 v3 Updated air quality advice on the assessment of future NO_x and NO2 projections for users for DMRB Volume 11, Section 3, Part 1 Air Quality, November 2013;
- IAN 174/13 Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA207/07), June 2013;
- IAN 175/13 Updated advice on risk assessment related to compliance with the EU Directive on ambient air quality and on the production of Scheme Air Quality Action Plans for users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA207/07), June 2013;
- IAN 185/15 Updated traffic, air quality and noise advice on the assessment of link speed and generation of vehicle data into 'speed-bands' for users of DMRB Volume 11, Section 3, Part 1 'Air Quality and Volume 11, January 2015;
- Note on Highways Agency's Interim Alternative Long Term Annual Projection Factors (LTTE6) for Annual Mean NO_2 and NO_x Concentrations between 2008 and 2030, draft, October 2013;
- Guidance from the overseeing authority on determining the correct base year traffic model to support air quality assessments (August 2014);
- Guidance from the overseeing authority on 'One-Team' delivery approach for Traffic and Environmental Teams (August 2014); and
- Department for the Environment, Food and Rural Affairs (Defra) Local Air Quality Management Technical Guidance (LAQM.TG(16))[42] , where appropriate.

Operational Air Quality Scenarios

5.2.11 A detailed assessment has been carried out for local air quality, which takes into account diurnal changes in traffic flows using ADMS Roads v4.1.1 to determine potential impacts on NO_2 concentrations at human health receptors, and NO_x concentrations at designated ecological sites in the expected opening year. A simple level of assessment has been undertaken for regional emissions of NO_x, PM_{10} and CO_2 for the opening and design years.

5.2.12 The following scenarios have been considered within the local and regional air quality assessment:

- Base year 2017;
- Projected base year 2022 (and 2037 for regional air quality assessment only);
- Opening year Do-Minimum 2022 (and 2037 for regional air quality assessment only);
- Opening year 'Cumulative Worst Case' Do Something 2022 (and 2037 for regional air quality assessment only).

5.2.13 As discussed previously, predictions in the majority of the air quality study area have used the traffic flow increases associated with the Proposed Scheme.

[42] Department for Environment Food & Rural Affairs (February 2018) Part IV of the Environment Act 1995. Environment (Northern Ireland) Order 2002 Part III. *Local Air Quality Management: Technical Guidance (TG16).*

Baseline Information and Data Sources

5.2.14 Information on existing baseline air quality conditions within the study area was obtained from the following sources:

- Local Air Quality Management Reports undertaken by Stevenage Borough Council, North Hertfordshire District Council, Hertsmere Borough Council, Bedford Borough Council, St Albans City and District Council and Welwyn Hatfield Borough Council;
- Highways England monitoring;
- National modelling undertaken by Defra using the Pollution Climate Mapping (PCM) model; and
- Designated ecological site information from the Multi-Agency Geographic Information for the Countryside (MAGIC) website (www.magic.gov.uk) and Natural England.

5.2.15 A summary of existing air quality conditions within the study area has been based on information collected as part of the Smart Motorways Programme (SMP) Advanced Environmental Desk Studies (AEDS) process, supplemented with more recent air quality monitoring data, where available, and data from the wider study area within the affected road network. The baseline air quality is discussed further in Section 5.4 and in Appendix 5.3.

5.2.16 Analysis of measured trends in annual mean NO_2 has been undertaken using the Finnish Meteorological Institute MAKESENS (v1) spreadsheet and the annual mean time series data for relevant continuous monitoring site. The analysis identifies if and where there are statistically significant trends in measured annual mean NO_2, thus informing the selection of suitable long-term trend factors. Further details are presented in Appendix 5.3.

Constraints Mapping

5.2.17 A constraints map for the Proposed Scheme air quality study area is shown in Figure 5.2. The figure shows selected representative receptors within the study area, boundaries of Air Quality Management Areas (AQMAs), measured annual mean NO_2 concentrations for comparison to the Air Quality Strategy objective, exceedances of the annual mean NO_2 EU limit value in 2015 and 2020 respectively from Defra's Pollution Climate Mapping model and the locations of designated sites containing features sensitive to air pollution.

Traffic Data

5.2.18 The traffic impacts for the Proposed Scheme uses traffic data from a Saturn traffic model produced by the Jacobs-Atkins Traffic Modelling Team. The South East Regional Transport Model (SERTM) was used as the starting point for model development and was developed into a Scheme-specific model using additional network and zoning within the A1(M) corridor. The calibration of the model was updated using additional traffic count data provided by Hertfordshire County Council.

5.2.19 The Traffic Modelling and Air Quality Teams have identified air quality sensitive locations where traffic model performance is key. The air quality assessment requires detailed modelling of local air quality impacts at sensitive receptors, including human and ecological designated sites within 200m of the affected road network. The affected road network for the Proposed Scheme has been reviewed and the links within the traffic model, which are well validated, have been identified to form a traffic reliability area. Where necessary, a more detailed investigation of traffic model performance has been undertaken at key sites affected by changes to air quality with the Proposed Scheme.

5.2.20 Further details on traffic data are provided in Appendix 5.4.

Local Air Quality Assessment

5.2.21 A summary of the inputs required for dispersion modelling is provided below, with further details presented in Appendix 5.1.

5.2.22 A local air quality assessment, for relevant illustrative sensitive receptors, was undertaken using ADMS-Roads v4.1.1 to determine the operational effects of the Proposed Scheme on human health receptors and sensitive ecological receptors. The model used information on road link emission rates, road alignment and width, and local meteorological data taken from Luton Airport to estimate local air pollutant concentrations.

5.2.23 The dispersion model was set up based on the following key inputs and assumptions:

- Road sources were modelled using the ADMS Road source representation tool;
- Ordnance Survey (OS) Master Map topography base mapping was used to define the road geometry;
- A single centreline was entered in the model for modelled roads, with the exception of motorway links which have a centreline included for each carriageway directions; and
- Road widths have been manually measured through the measurement tool in Google Earth.

5.2.24 As traffic conditions vary throughout the course of a day, a morning peak period (AM) (7am to 10am), an inter peak period (IP) (10 am to 4pm), an evening peak period (PM) (4pm to 7pm), and an off-peak period (OP) (7pm to 7am) have been applied to each road link in the model to represent the corresponding variation in road traffic emissions. The ADMS Roads model was setup with a unit emission rate entered into the model for each road link (rather than the emission for an average hour) and a 'fac' file (which represents the diurnal emissions profile) created containing the estimated emissions per hour for the Proposed Scheme.

5.2.25 The traffic data provided and modelling approaches used follow the DMRB HA207/07 methodology with consultation and agreement of any deviations with Highways England. Further details of the emission rate estimation approach are shown in Appendix 5.1.

5.2.26 Estimates of the contribution from road traffic emissions to annual mean concentrations of NO_x were provided by the model at discrete selected representative receptors, which were combined with estimates of background concentrations to derive total annual mean NO_2 concentrations.

5.2.27 The modelled road NO_x and background NO_2, based on Defra background maps with a 2015 base year, were converted to total annual mean NO_2 for comparison with the UK Air Quality Strategy objective using the Defra NO_x to NO_2 tool, version 6.1, October 2017.

5.2.28 In order to avoid double counting the contribution from modelled emission sources, the in-square contributions within Defra background maps from motorways, primary A roads and trunk roads were removed from the total background NO_2 concentration.

5.2.29 The potential for exceedances of the 1 hour NO_2 UK Air Quality Strategy objective to occur was assessed based on whether annual mean NO_2 concentrations were greater than 60µg/m^3, in accordance with Defra LAQM.TG(16).

5.2.30 Base year (2017) modelled annual mean NO_2 concentrations were verified, by comparison against available ratified monitoring data in the study area, with reference to Defra's Technical Guidance LAQM.TG(16). The Proposed Scheme's study area was verified using data collected within the study area and a wider area covered by the same traffic model. Where systematic bias, i.e. the model's tendency to either over- or under-estimate, was clearly evident in the base year, adjustment was applied to bring modelled concentrations more into line with measured concentrations. Further details on verification are given in the section below and in Appendix 5.5.

5.2.31 Defra's advice on long term NO_2 trends creates a gap between projected vehicle emission reductions and the estimated annual rate of improvement in annual mean NO_2 within Defra's previously published technical guidance, and observed trends. Air quality assessments following Defra LAQM.TG(16) guidance are therefore considered likely to be overly optimistic in some cases. As such, IAN 170/12v3 requires that steps are taken to adjust the estimated total NO_2 concentrations from modelling, termed "gap analysis", in order to better reflect future trends. The assessment uses the Highways England LTT_{E6} projection factors based on analysis of monitoring data trend analysis, as presented in Appendix 5.3.

5.2.32 An additional scenario (projected base year) is required to enable the gap analysis to be completed. The projected base year scenario is modelled using the base year traffic data with the opening year vehicle emission factors and opening year background concentrations. Total NO_2 concentrations for the projected base year are calculated as described above. The results for the opening year are then adjusted using gap analysis to represent the observed long term trend profile.

5.2.33 Modelled annual mean NO_2 concentrations, and impacts with the gap analysis factor applied, have been evaluated with regard to compliance with the EU Directive on ambient air quality in accordance with IAN 175/13.

5.2.34 Commentary on compliance with the EU Air Quality Directive in accordance with IAN 175/13, has been provided where Defra Pollution Climate Mapping model links coincide with affected road network links to aid the assessment of significance of effect.

5.2.35 A total of 81 discrete receptors, selected to be representative of potential worst-case human health impacts, and 79 monitoring locations were included in the air quality model, as shown on Figures 5.2, 5.3 and 5.4 and listed in Table 5.6.1 Appendix 5.6.

5.2.36 Two nationally designated ecological sites were identified within the study area, containing features potentially sensitive to airborne nitrogen. There were no internationally designated sites within the affected road network for the Proposed Scheme. Further details of the designated ecological sites, habitat types and applicable critical loads, are provided in the Appendix 5.6. The designated sites assessed include:

- Sherrardspark Wood SSSI; and
- Knebworth Woods SSSI.

Verification

5.2.37 Model verification is the process by which uncertainties in the modelling are investigated and, wherever possible, minimised. The verification step involves comparison of model estimated pollutant concentrations with monitored values that are representative of the base year model (which for this assessment is 2017). Verification was undertaken in accordance with Defra's Technical Guidance LAQM.TG(16). Details of the verification process are provided in Appendix 5.5. The key findings of the verification process are summarised below.

5.2.38 The location of monitoring sites used for model verification and the model domain boundaries defined are shown in Figure 5.2. In summary:

- Seventy-nine monitoring sites were used to compare the modelled results with 2017 annual mean NO_2 concentrations;
- Unadjusted modelled road NO_X concentrations were compared with the monitoring data, which were converted to road NO_X values using Defra's NO_X to NO_2 calculator and background mapping;
- Separate adjustment factors for road NO_X were derived for:
  - Stevenage Local Authority (adjustment factor 3.11), where a regional variation in verification factor was seen. It has not been possible to definitively identify the source of this variation;
  - A small domain at the northern entrance/exit of the Welwyn Tunnels (adjustment factor 1.8), where the model prediction of road NO_X concentrations varied, due to the presence of cuttings along the A1(M); and

  - The rest of the modelled area (adjustment factor 2.4), where the model overpredicted annual mean road NO_X concentrations.
- The modelled concentrations were adjusted and converted to a total NO_2 concentration, using Defra's NO_X to NO_2 calculator and background mapping;
- The total NO_2 concentrations (including road NO_X adjustment) were considered to have acceptable model performance in accordance with Defra LAQM.TG(16), with all of the verification sites modelled being within 25% of measured values, and 69% being within 10% of measured values. No further adjustment to the results was undertaken. The model performance statistics are presented in Appendix 5.5 and
- The model results for human health and designated ecological receptors in each model domain were adjusted, where necessary, using the model adjustment factors derived for the base year scenario and also in the opening year with and without the Proposed Scheme.

5.2.39 Overall, the assessment has demonstrated that post adjustment, the model verification showed good agreement between modelled and monitored results, which leads to confidence in the results (See Appendix 5.5).

Regional Air Quality Assessment

5.2.40 A regional air quality assessment has been undertaken, in accordance with DMRB HA 207/07 and as set out in Appendix 5.1, to determine the change in pollutant emissions as a result of the Proposed Scheme for the entirety of the traffic reliability area. Emission calculations have been undertaken using emission rates derived from IAN 185/15 on speed banding. The pollutants included in this assessment were NO_x, PM_{10}, and CO_2.

5.2.41 The scenario modelled was: the existing base year of 2017, the opening year 2022 without (Do Minimum) and with (Do Something) the Proposed Scheme.

Receptors

5.2.42 Receptors that are potentially sensitive to changes in NO_x and NO_2 concentrations are defined in DMRB HA207/07 as representative sensitive human health receptors and designated ecological sites (containing habitats sensitive to NO_x) located within 200m of the affected road network. The assessment considers impacts at residential properties, schools and hospitals, and ecological receptors including the following types of designated sites: SSSI, Special Area of Conservation (SAC), Special Protection Area (SPA) and Ramsar sites. Receptors considered within this assessment are those located within 200m of the affected road network (not all receptors within 200m were modelled, as parts of the Proposed Scheme study areas are densely populated urban areas).

5.2.43 A selection of discrete representative receptors have been included within the air quality modelling at worst case locations within 200m of to the affected road network. In addition, relevant monitoring locations have been included in the air quality model for use during air quality model verification.

Magnitude of Change

5.2.44 Descriptors for magnitude of change (impact) and consequent significance of effect, due to changes in ambient concentrations of NO_2, are provided in Highways England's IAN 174/13. These criteria have been used in the assessment of annual mean concentrations of NO_2.

5.2.45 The changes in magnitude, which are based on an assumed measure of uncertainty (MoU) of 10%, may be described as imperceptible, small, medium or large, depending on the change in concentration relative to the air quality criterion as follows:

- A change in concentration less than or equal to 1% of the relevant air quality criterion is considered to be '**imperceptible**';
- A change in concentration greater than 1% and less than 5% of the relevant air quality criterion is considered to be '**small**';
- A change in concentration greater than 5% and less than 10% of the relevant air quality criterion is considered to be '**medium**'; and

- A change in concentration greater than 10% of the relevant air quality criterion is considered to be '**large**'.

5.2.46 Table 5.1 presents magnitude of change criteria for annual mean NO_2 concentrations. According to IAN 174/13, only those receptors that are predicted to exceed relevant air quality thresholds need to be considered when determining significance.

5.2.47 In line with guidance within IAN 174/13, where a change in annual mean concentrations of NO_x for the assessment of designated ecological sites is less than 0.4µg/m^3 this has been identified as imperceptible. Where a change is greater than 0.4µg/m^3 the magnitude of change has been assessed using professional judgement.

5.2.48 There is no guidance on classification of magnitude of change or significance of effect for the regional air quality assessment. The significance of the impacts on regional air quality is assessed using professional judgment.

Table 5.1 - Magnitude of change criteria, as set out in IAN 174/13

Magnitude of change in concentration	Value of change in annual mean NO_2
Large (>4µg/m^3)	Greater than full measure of uncertainty (MoU) value of 10% of the air quality objective (4µg/m^3).
Medium (>2 to 4µg/m^3)	Greater than half of the MoU (2µg/m^3), but less than the full MoU (4µg/m^3) of 10% of the air quality objective.
Small (>0.4 to 2µg/m^3)	More than 1% of the objective (0.4µg/m^3) and less than half of the MoU i.e. 5% (2µg/m^3). The full MoU is 10% of the air quality objective (4µg/m^3).
Imperceptible (≤0.4µg/m^3)	Less than or equal to 1% of objective (0.4µg/m^3).

Significance of Effect

5.2.49 In order to assess the significance of effects for annual mean NO_2, for receptors where air quality thresholds are exceeded in either the without Proposed Scheme and/or with Proposed Scheme scenarios, the number of receptors that fall within the 'small', 'medium', and 'large' magnitude of change categories is calculated and compared to the guidelines presented in Table 5.2. Where the difference in concentrations are less than 1% of the Air Quality Strategy Objectives (for example, less than 0.4µg/m^3 for annual mean NO_2) then the change at these receptors is considered to be 'imperceptible' and can be scoped out of the judgement on significance.

5.2.50 As outlined in IAN 174/13, for the determination of significance for NO_x effects on designated ecological sites, where the difference in concentration is less than 0.4µg/m^3 for annual average NO_x, the change at these receptors is considered to be 'imperceptible' and can be scoped out of the judgement on significance.

Table 5.2 - Guideline to number of receptors constituting a significant effect for air quality[43]

Magnitude of change in concentration	Number of receptors with:	
	Worsening of air quality objective already above objective or creation of a new exceedance	Improvement of an air quality objective already above objective or the removal of an existing exceedance
Large (>4µg/m^3)	1 to 10	1 to 10
Medium (>2 to 4µg/m^3)	10 to 30	10 to 30
Small (>0.4 to 2µg/m^3)	30 to 60	30 to 60

Stakeholder Engagement

5.2.51 No stakeholder engagement has been undertaken to date.

[43] Source: IAN 174/13

Assumptions and Limitations

5.2.52 Any air quality model has inherent areas of uncertainty, including:

- The traffic data used in the air quality model;
- The appropriateness of vehicle emissions data;
- Simplifications in model algorithms and empirical relationships that are used to simulate complex physical and chemical processes in the atmosphere;
- The appropriateness of background concentrations; and
- The appropriateness of meteorological data.

5.2.53 The key assumptions and limitations are presented below:

- **Opening year:** The first full year open to traffic is 2022;
- **Background concentrations and emission factors:** Defra background concentrations and vehicle emission factors both allow for improvements in future years, therefore the modelled opening year represents a conservative assessment compared to the eventual opening year.
- **Traffic data:** Use of validated traffic model data (see Appendix 5.4), with active engagement between traffic and air quality teams addressing uncertainty in traffic model output and post-processed traffic. The traffic data provided is based on the DF2 design.
- **Excluded schemes:** While the M11 Junction 7 upgrade scheme has the potential to affect movements between London and Cambridgeshire it has not progressed sufficiently at the time of development of the SMP scheme traffic model.
- **Emission rates:** Uncertainties associated with vehicle emissions data have been minimised by using the speed-band emission factors described within IAN 185/15 (but based on version 8.0 of Defra's Emission Factors Toolkit).
- **Model algorithms and empirical relationships:** Uncertainties associated with model algorithms and empirical relationships have been minimised by using algorithms and relationships that have been independently validated and judged as fit for purpose.
- **Meteorological data:** Use of historical meteorological data to estimate future pollutant concentrations assumes that conditions in the future will be the same as in the past. In line with best practice, the base year meteorology (as used in the model verification and adjustment process) has been used in future year modelling to allow any adjustments to be applied in future cases. The closest meteorological station to the Proposed Scheme is situated at Luton Airport.

5.3 Baseline conditions

5.3.1 The sources of baseline conditions are outlined in paragraph 5.2.14 and summarised below.

5.3.2 Estimates of current and future year background pollutant concentrations are available on the Defra UK-Air website. These background estimates, which are based on a combination of measured and modelled data, are available for each one-kilometre grid square for a base year of 2015 which is the basis for the future estimates up to 2030. These background estimates include contributions from all source sectors, e.g. road transport, industry, and domestic and commercial heating systems.

Local Air Quality Management

5.3.3 There are 6 Local Authorities located within the Proposed Scheme's study area, comprising Stevenage Borough Council, North Hertfordshire District Council, Hertsmere Borough Council, Bedford Borough Council, St Albans City and District Council and Welwyn Hatfield Borough Council. These local authorities have carried out regular reviews and assessments of local air quality and have shown that the UK Air Quality Strategy objective most likely to be exceeded is for annual average NO_2 due to road traffic emissions.

5.3.4 There are no AQMAs located within the study area. The nearest AQMA are more than 200m from the affected road network, as shown in Figure 5.2 and described in Table 5.3, and therefore are unlikely to be affected by the Proposed Scheme.

Table 5.3 - Closest AQMA to the Proposed Scheme's study area

Name	Air Quality Criteria Exceeded	Description	Distance from Scheme	Distance from local ARN (km)
Hertsmere Borough Council				
Hertsmere - AQMA No.2 (Charleston Paddocks, M25)	NO_2 annual mean	An area comprising the domestic property known as Charleston Paddocks, St Albans Road, South Mimms, Potters Bar.	13.6km	0.590
Hertsmere - AQMA No.3 (New Road, M25)	NO_2 annual mean	An Area comprising the domestic properties 31-39 Blanche Lane, South Mimms.	12.9km	0.550
Note: AQMA information taken from Defra AQMA website and local authority review and assessment reports.				

Pollution Climate Mapping

5.3.5 Information on where the annual mean NO_2 EU limit value is exceeded is available from Defra's Pollution Climate Mapping model. This model provides projected roadside concentrations of annual mean NO_2 in the years 2017-2030 inclusive, based on a 2015 base year. For the purposes of reporting compliance with the EU limit values, the UK is divided into 43 zones and agglomerations.

5.3.6 Where roads are not included in the Pollution Climate Mapping model, no assessment of compliance risk has been undertaken. This is in accordance with IAN 175/13, which states that "*where the two road networks intersect, only this subset of the road network should be used to inform the compliance risk*".

5.3.7 The locations of Defra Pollution Climate Mapping model links within the Proposed Scheme's study area are shown in Figure 5.2.

5.3.8 There are 9 Pollution Climate Mapping links which overlap with the affected road network for the Proposed Scheme. All of these links sit within the Eastern Zone. Defra Pollution Climate Mapping indicates that a roadside exceedance of the annual mean NO_2 EU limit value occurs along a single link within the Proposed Scheme's study area in the base year (2017). The location of this exceedance is along the A1(M) between junctions 4 and 5 (PCM Census ID 56070).

5.3.9 The annual mean NO_2 EU limit value is not projected to be exceeded within the affected road network for the Proposed Scheme in the opening year (2022).

Air Quality Monitoring

Local Authority monitoring

5.3.10 Air quality monitoring data from passive diffusion tubes in the Proposed Scheme's study area are presented in Appendix 5.3, shown on Figure 5.2, colour coded by the 2017 annual mean NO_2 concentration, and summarised below. There is 1 continuous monitoring site within 200m of the affected road network in the study area.

5.3.11 In 2017, 5 of the local authority diffusion tube sites within the Proposed Scheme's study area measured concentrations above the annual mean NO_2 UK Air Quality Strategy objective. These diffusion tubes are as follows:

- North Hertfordshire, diffusion tube NH88 which measured 40.5µg/m^3 of NO_2 in 2017;
- Stevenage, diffusion tube 17 which measured 48.6µg/m^3 of NO2 in 2017;
- Welwyn Hatfield, diffusion tube WH19 which measured 49.0µg/m^3 of NO2 in 2017;
- Welwyn Hatfield, diffusion tube WH22 which measured 43.0µg/m^3 of NO2 in 2017;
- Welwyn Hatfield, diffusion tube WH25 which measured 46.0µg/m^3 of NO2 in 2017.

5.3.12 Trend analysis of data from continuous monitoring sites was undertaken to determine the most suitable future year projections to use in the local air quality assessment. Trend analysis indicated that there is a statistically significant downward trend in annual mean NO_2 concentrations adjacent to the Proposed Scheme. Comparison of various future year projection methods, with annual mean NO_2 concentrations interpolated from monitored trends at roadside continuous monitoring sites, indicate that the Highways England IAN 170/12v3 LTTE6 future year projections are likely to be the most appropriate for the assessment of the Proposed Scheme. There were no continuous monitoring sites within the affected road network, and so the closest continuous monitoring sites to the Proposed Scheme with more than three years of data were used for this analysis. This includes 1 site adjacent to the A1(M) at Sandy, to the North of the affected road network. Further details on trend analysis are provided in Appendix 5.3.

Highways England monitoring

5.3.13 Highways England carried out an NO_2 diffusion tube survey in the Proposed Scheme's study area between 2013 and 2014.

5.3.14 The measured period means for the most recent 12 months of data obtained during this survey have been calculated and then annualised in accordance with the methodology within LAQM.TG(16) to provide 2017 annual means for use in verification. The annualised and bias adjusted NO_2 concentrations for 2017 are provided in Appendix 5.3.

5.3.15 The results indicate that of the 41 Highways England diffusion tubes, 2 exceedances of the annual mean NO_2 Air Quality Strategy objective were recorded, at monitoring sites 011 and 013, both situated in Welwyn Hatfield. These diffusion tubes are as follows:

- A1MJ3J7_011_0813, HE_011, A1001 Hatfield Tunnel roundabout, Roadside location, 2013-2015 period mean 50.5µg/m^3, annualised annual mean 40.7µg/m^3 in 2017; and
- A1MJ3J7_013_0813, HE_011, A1001 Hatfield Tunnel roundabout, Background, 2013-14 period mean 56.5µg/m^3, annualised annual mean 45.5µg/m^3 in 2017.

5.3.16 Following the scoping assessment for the Proposed Scheme, it was concluded that no additional air quality monitoring was required.

Ecological designations

5.3.17 There are 2 designated sites of national importance, Sherrardspark Wood SSSI and Knebworth Woods SSSI, within 200m of the Proposed Scheme affected road network, containing habitats sensitive to airborne NO_x and nitrogen deposition. Critical loads for nitrogen deposition are available from the Air Pollution Information System (APIS) website. The recommended United Nations Economic Commission for Europe (UNECE) critical loads for the main habitat type have been selected (where available) and these are set out in Appendix 5.3.

5.3.18 Baseline annual average NO_x concentrations at all sites exceed the vegetation objective of 30µg/m^3, at the roadside, however concentrations reduce with distance from the roadside. In the baseline year:

- Sherrardspark Wood SSSI exceeds the objective at up to 90m from the roadside;
- Knebworth Woods SSSI exceeds the objective at up to 120m from the roadside.

Modelled Baseline and Do Minimum

5.3.19 In the Baseline (2017) scenario, 1 modelled receptor exceeds the air quality objective for annual mean NO_2; this being receptor R029 (41.8µg/m^3) to the east of the northern entrance/exit to the Welwyn Tunnels. Concentrations at all other modelled receptors are below the objective. In general, concentrations are elevated towards the A1(M) and approach the objective in the vicinity of junctions and towards the eastern roadside (downwind of the prevailing wind) of the A1(M) (R004-7, R025, R026, R031, R073).

5.3.20 In the DM (2022) scenario, the modelled Baseline exceedance at R029 has dropped below the objective (37.0µg/m^3). In general, concentrations fall from 2017 values by between 1-5µg/m^3, although they follow similar geographic trends. This is due to the overall downward trend in NO_2 concentrations over time, caused the increased uptake of cleaner (i.e. Euro 6/VI) vehicles and projected background concentration improvements.

5.4 Assessment of effects

Operational effects

Local Air Quality Assessment

5.4.1 The air quality assessment results are presented in detail in Table 5.6.1 in Appendix 5.6, and shown on Figures 5.3 and 5.4.

5.4.2 The modelling results show that estimated concentrations exceed the NO_2 annual mean Air Quality Strategy objective of 40µg/m^3 at:

- One modelled receptor in the base year (2017);
- No receptors in the opening year (2022) without the Proposed Scheme. The maximum concentration is estimated to be 37.0µg/m^3, at receptor R029 adjacent to the A1(M) in Stevenage; and
- No receptors in the opening year with the Proposed Scheme. The maximum concentration is estimated to be 38.6µg/m^3, at receptor R029 adjacent to the A1(M) in Stevenage.

5.4.3 There are no modelled exceedances of the annual mean Air Quality Strategy objective with or without the Proposed Scheme in the opening year (2022).

5.4.4 At 66 of the modelled receptors, changes in concentrations are estimated to be 'imperceptible' (i.e. less than or equal to 0.4µg/m^3). Changes in annual mean NO_2, greater than 0.4 µg/m^3, are modelled to occur at 17 locations: at receptors R004-R007, R015-R019, R021-R025, R027, R029, and R031. The largest change in annual mean NO_2 concentrations occur at receptor R24, 2.99µg/m^3 and can be described as 'Medium' according to the criteria in Table 5.1.

Ambient Air Quality Directive Compliance Risk Assessment

5.4.5 Details of the Proposed Scheme's Compliance Risk Assessment are reported in Appendix 5.7.

5.4.6 There are 9 Pollution Climate Mapping links which overlap with the affected road network for the Proposed Scheme. According to the Defra Pollution Climate Mapping model, there are no exceedances of the annual mean NO_2 EU limit value projected to occur in the modelled opening year (2022). The link with the highest opening year Pollution Climate Mapping concentration is 56070 (32.1µg/m^3 in 2022).

5.4.7 The potential risk of the Proposed Scheme affecting compliance with EU limit values has been assessed by considering the changes in annual mean NO_2 concentration at the closest modelled receptors to those links where the EU limit value is projected to be exceeded. The Pollution Climate Mapping links are in parentheses. These are R030 & R031 (6078), R036 (8044), R065-68 (17453), R006, R007, & R029 (28412), R060-62 (48767), R004, R005, & R028 (56070), R049, & R051 (57468), R047, R048, & R050 (57636), R071, & R072 (57900). The maximum adverse impact of the Proposed Scheme adjacent to these links is less than 2µg/m^3. If this impact was added to the maximum opening year Pollution Climate Mapping concentration of 32.1µg/m^3, the risk of impacting on compliance with limit values would be negligible.

Designated ecological sites

5.4.8 The annual mean NO_x and nitrogen deposition results for all modelled ecological receptors are presented in detail in Appendix 5.7.

5.4.9 Additional discussion of the air quality predictions for these designated ecosystem sites is presented in the Chapter 6: Biodiversity. Overall no significant effects are identified.

5.4.10 The assessment has shown that there are exceedances of the annual mean NO_x UK Air Quality Strategy objective of 30µg/m^3 for the protection of vegetation in the base year (2017) and opening year (2022), either with or without the Proposed Scheme, at the two assessed designated sites.

5.4.11 The maximum change in annual mean NO_x concentrations (Table B-17) within Sherradspark Wood SSSI is 2.0µg/m^3. In accordance with IAN 174/13, as this change is greater than 0.4µg/m³, the effect on nutrient nitrogen deposition at this location has been estimated. The change in nitrogen deposition at the closest point in Sherrardspark Wood SSSI to the Great North Road as a result of the Proposed Scheme is estimated to be greater than 1% of the most relevant critical load. The assessment of the impacts and effects of nitrogen deposition at Sherrardspark Wood SSSI is presented in Chapter 6: Biodiversity.

5.4.12 The maximum change in annual mean NO_x concentrations (Table B-18) within Knebworth Woods SSSI is 19.9µg/m^3. In accordance with IAN 174/13, as this change is greater than 0.4µg/m³, the effect on nutrient nitrogen deposition at this location has been estimated. The change in nitrogen deposition at the closest point in Knebworth Woods SSSI to the motorway as a result of the Proposed Scheme is greater than 1% of the most relevant critical load. The assessment of the impacts and effects of nitrogen deposition on Knebworth Woods SSSI is presented in Chapter 6: Biodiversity.

Regional air quality assessment

5.4.13 Total emissions from roads within the traffic reliability area have been estimated for NO_x, PM_{10} and CO_2 in the base year (2017) and for both with and without the core cumulative scenarios in the opening year (2022) and design year (2037). In addition, the number of vehicle kilometres travelled is given for each scenario as presented in Table 5.6.1 in Appendix 5.6.

5.4.14 In the opening year (2022), there is a predicted increase in all pollutant emissions of between 0.8-4.0%. This is due to the predicted increase in vehicle kilometres travelled with the core cumulative scenario of 4.1% compared to without the Proposed Scheme.

5.4.15 In the design year (2037), there is a predicted increase in all pollutant emissions of between 2.6-5.5%. This is due to the predicted increase in vehicle kilometres travelled with the core cumulative scenario of 5.7% compared to without the Proposed Scheme.

Health Assessment

5.4.16 As the Proposed Scheme would not be progressed to opening without traffic mitigation measures ensuring that no significant worsening or new exceedances of standards, there would be no deterioration in the health status of residents.

5.5 Design and mitigation measures

5.5.1 There are no design or mitigation measures required for the Proposed Scheme after opening, as no significant air quality effects are anticipated.

5.6 Residual effects

5.6.1 No significant adverse residual effects are expected to occur as a consequence of the Proposed Scheme after opening.

5.7 Summary

5.7.1 This section presents the overall significance of effects tables for the Proposed Scheme.

Table 5.4 - Number of receptors with perceptible changes in air quality above the Objective Value

Magnitude of change in concentration	Number of receptors with:	
	Worsening of air quality objective already above objective or creation of a new exceedance	Improvement of an air quality objective already above objective or the removal of an existing exceedance
Large (>4µg/m^3)	0	0
Medium (>2 to 4µg/m^3)	0	0
Small (>0.4 to 2µg/m^3)	0	0

Table 5.5 - Overall evaluation of local air quality significance

Key Criteria Questions	Yes/No
Is there a risk that environmental standards will be breached?	No – there are no modelled exceedances of the annual mean objective.
Will there be a large change in environmental conditions?	No – the largest impact at any receptor is "Medium".
Will the effect continue for a long time?	N/A as there are no significant effects anticipated.
Will many people be affected?	N/A as there are no significant effects anticipated.
Is there a risk that designated sites, areas, or features will be affected?	Yes – The Proposed Scheme causes nitrogen deposition levels to increase at Sherrardpark Wood SSSI and Knebworth Woods SSSI.
Will it be difficult to avoid or reduce or repair or compensate for the effect?	No significant effects anticipated.
On balance is the overall effect significant?	No.

5.7.2 The findings of the air quality assessment indicate that the effects of the Proposed Scheme are not significant for air quality and the Proposed Scheme can progress without any additional mitigation.

Summary of potential operational effects

Table 5.6 - Summary of operational effects

Aspect	Post mitigation predicted effect
Air Quality - Operation	No proposed mitigation – no significant effect.
Health - Operation	No proposed mitigation – no significant effect.

Summary of cumulative effects

Table 5.7 - Summary of cumulative effects

Aspect	Post mitigation predicted effect
Air Quality - Construction	No significant effects
Air Quality - Operation	No significant effects
Health - Construction	No significant effects
Health - Operation	No significant effects

5.8 Recommendations

5.8.1 No recommendations have been made, as the results of the assessment indicate that no significant effects are anticipated as a result of the Proposed Scheme.

6. Biodiversity

Key features for this topic:

- No significant effects on 3 internationally designated sites;
- No significant effects are anticipated on any nationally or locally designated sites as a result of the construction and operation of the Proposed Scheme;
- Three ancient woodland sites are adjacent to the Proposed Scheme;
- A 10m strip of Knebworth Woods SSSI would experience increased nitrogen deposition but judged not to be significant;
- No significant effects on notable and/or legally protected species are anticipated;
- Surrounding woodland offers suitable habitat for roosting bats, but no roosts identified and the A1(M) structures offer negligible potential;
- Hazel dormouse (*Muscardinus avellanarius*) are considered to be absent from the soft estate;
- No active badger (*Meles meles*) setts have been identified within 30m of the highway boundary fence;
- Recent records of otter (*Lutra lutra*) and water vole (*Arvicola amphibius*) exist for the River Mimram but not evident from the 2018 survey;
- GCN and bat surveys required;
- No significant effects upon biodiversity are envisaged; and
- Enhancements opportunities exist at Knebworth Woods SSSI and Sherrardspark Woods SSSI.

6.1 Introduction

6.1.1 This chapter summarises the findings of a biodiversity impact assessment undertaken for the Proposed Scheme. It considers the potential impacts to relevant ecological receptors identified in both the Environmental Scoping Report P01.1 (May 2018)[44] and field surveys undertaken in 2018 and 2019, as well as mitigation and enhancement measures.

6.1.2 This chapter provides details of:

- European, nationally and locally designated sites;
- Priority habitat within the soft estate;
- Notable and protected species;
- An assessment of construction and operational effects; and
- Opportunities for the enhancement of biodiversity.

6.1.3 The supporting appendices are:

- Appendix 6.1 – A1(M) Junctions 6 to 8 Smart Motorway Ecological Survey Report.

6.1.4 Appendix 6.1 provides the following figures detailing the ecological surveys undertaken:

- Figure 1.1 – Proposed Scheme footprint and boundaries;
- Figure 2.1a – Extended phase 1 habitat survey map (Northern Section);
- Figure 2.1b – Extended phase 1 habitat survey map (Southern Section);
- Figure 2.2 – Priority Habitats within and outside of 500m;
- Figure 2.3 – Ancient Woodland within 2km of the Proposed Scheme;
- Figure 3.1a – Waterbodies surveyed 2018 (Northern section);
- Figure 3.1b – Waterbodies surveyed 2018 (Southern section);
- Figure 3.2a – Waterbodies not surveyed 2018 (Northern section);
- Figure 3.2b – Waterbodies not surveyed 2018 (Southern section);
- Figure 4.1 – Structures surveyed for roosting bats; and
- Figure 5.1 – Otter and water vole survey coverage on River Mimram

[44] Highways England 2018: A1(M) J6 to J8 Smart Motorway Scoping Report, MP0135-HEX-EGN-ZZ-AS-KK-0001

6.1.5 The supporting figures include:

- Figure 6.1 – Change in nitrogen deposition (Kg N/ha/year) at the boundary of Knebworth Woods (SSSI).

6.1.6 The professional competency of the topic lead for this chapter is detailed in Appendix 1.1. This information is provided to fulfil the requirement of EU Directive 2014/52/EU.

6.2 Scoping

6.2.1 The scope of this assessment is in accordance with the Environmental Scoping Report, although this has been refined as the Proposed Scheme design has developed and ecological data from survey work has been collected, for example, phase 1 habitat and protected species field data[45]. Protected species have been scoped out since the Environmental Scoping Report, for instance; hazel dormouse (*Muscardinus avellanarius*) based on the historical records and current distribution of this species, it is thought highly unlikely to be present within the highways boundary. In accordance with IAN 125/15[46]: Environmental Assessment Update, a detailed assessment has been carried out and is reported in this EAR.

6.2.2 As works are constrained to the motorway soft estate, the impacts upon ecological receptors are limited to temporary or permanent loss of habitat or from additional atmospheric nitrogen deposition upon international or nationally designated sites. No change to the quantity or quality of operational drainage discharges are expected. Potential temporary construction effects include:

- Works to priority outfalls potentially affecting riparian species;
- Vegetation removal;
- Water pollution or changes to local hydrology;
- Construction lighting;
- Dust deposition;
- Direct mortality/disturbance; and
- A change to local hydrology, water pollution.

6.2.3 Design avoidance, mitigation and enhancement measures are specified in the Outline Environmental Management Plan (OEMP)[47] to ensure that the effects upon protected species or habitat loss during construction will not give rise to a significant effect.

6.3 Methodology

6.3.1 This section summarises the following:

- The study area;
- Legislation, policy and guidance;
- Baseline information and data sources; Field survey;
- Valuing receptors;
- Magnitude of impacts;
- Significance of effects;
- Stakeholder engagement; and
- Assumptions and limitations.

Study area

6.3.2 The study area reflects the location of ecological receptors and their potential Ecological Zone of Influence (EZoI) for the Proposed Scheme. The potential EZoI of each important receptor differs according to the attributes of the receptor (see Table 6.1).

45 Great crested newt (Habitat suitability index and eDNA) surveys undertaken 26 to 29 June 2018, bat survey undertaken 21 August 2018 and otter and water vole survey undertaken 22 August 2018.
[46] Highways England. (2015). DMRB Interim Advice Norte 125/15: Environmental Assessment Update, UK.
[47] Highways England 2018: A1(M) J6 to J8 Smart Motorway OEMP Report, HE551539-WSP-EGN-SG-RP-LE-00023

Table 6.1 - Study area and EZoI for each ecological receptor

Ecological receptor	Study area	Zone of Influence
European and internationally designated sites for nature conservation	• Within 2km; • Within 30km for sites designated for bats; and • Within river catchment for European designated sites hydrologically connected to the Proposed Scheme.	• Within 200m of the footprint of Proposed Scheme; • Within 200m of the affected road network in relation to cumulative air quality impacts, this relates to operational effects only; • Within river catchment for sites over 200m, but hydrologically connected to the Proposed Scheme; and • Within 30km European designated sites designated for bats[48].
Sites of Special Scientific Interest (SSSI)	• Within 2km; and • Within river catchment for sites hydrologically connected to the Proposed Scheme.	• Within 200m of footprint of Proposed Scheme; • Within 200m of the affected road network (ARN) in relation to cumulative air quality impacts, this relates to operational effects only; and • Within river catchment for sites over 200m, but hydrologically connected to the Proposed Scheme.
Non-statutory designated sites for nature conservation Local Wildlife Sites (LWS) and Habitats of Principal Importance	• Within 500m • Ancient Woodlands within 200m	• Within 50m of the Proposed Scheme; • Within river catchment for sites over 200m, but hydrologically connected to the Proposed Scheme; and • Ancient Woodland within 15m.
Notable and legally protected species	• Within 2km	• For great crested newt, including waterbodies within 250m of the Proposed Scheme; • For roosting bats, within 50m of the Proposed Scheme; • For badger, within 50m of the Proposed Scheme; • For otter, within 50m of the Proposed Scheme; • For water vole, within 50m of the Proposed Scheme; • For white clawed crayfish, within 50m of the Proposed Scheme; • Please refer to the Protected Species Report, Appendix 6.1 for further explanation relating to the EZoI used for the notable and legally protected species; and • The EZoI for the ecological walkover surveys was 50m from proposed major infrastructure, however as no access to Highways England soft estate was achieved, surveys were undertaken from publicly accessible areas or private land where access had been granted. The walkover surveys included an assessment of the habitat to potentially support breeding birds, badgers, reptiles, water vole and otter and notable species such as plants, invertebrates, common toad and hedgehog.

[48] DMRB, Volume 11, Section 4, Part 1 Environmental Assessment, HD44/09 Assessment of Implications (of highways and/or road projects) on European Sites (including Appropriate Assessment)

Legislation, policy and guidance

6.3.3 Relevant legislation and policy is outlined in Appendix 6.1.

6.3.4 The assessment has been undertaken in a manner that reflects the current policy and regulatory framework and accordance with the following guidance:

- DMRB Volume 11, Section 2, Part 5 (HA 205/08) Assessment and Management of Environmental Effects;
- DMRB Volume 11, Section 3, Part 4 Ecology and Nature Conservation;
- DMRB Volume 11, Section 4, Part 1 (HD 44/09) Assessment of Implications of Highways and/or Road Projects on European Sites (including Appropriate Assessment);
- IAN 116/06: Nature Conservation Advice in Relation to Bats;
- IAN 130/10: Ecology and Nature Conservation - Criteria for Impact Assessment,
- IAN 183/14, Environmental Management Plans;
- Chartered Institute of Ecology and Environmental Management (CIEEM) guidelines[49];
- Mammal Society, 1989: Surveying Badgers[50];
- Water Vole Conservation Handbook, 3rd Edition[51]; and
- The Bat Conservation Trust (2016): Bat surveys for professional ecologists good practice guidelines 3rd Edition[52].

Baseline information and data sources

6.3.5 A desk study was undertaken in June 2018 (in addition to the desk study based A1(M) junction 6 to junction 8 Environmental Scoping Report supplied by Highways England) to obtain ecological information about statutory and non-statutory designated sites for nature conservation, notable habitats and notable and/or legally protected species present within the study area. Data was obtained from the following sources:

- Hertfordshire Environmental Records Centre (HERC);
- Highways England Environmental Information System (EnvIS) database (accessed June 2018);
- Multi-Agency Geographic Information for the Countryside (MAGIC) website www.magic.defra.gov.uk; and
- UK Air Pollution Information System (APIS) website (www.apis.ac.uk).

Field survey

6.3.6 Due to the localised and largely temporary nature of the construction disturbance associated with the Proposed Scheme, field surveys have focused upon those areas necessary to assess the impacts such as habitat fragmentation or to identify mitigation requirements. This has resulted in “targeted” surveys which only cover areas where proposed major infrastructure (new gantries, emergency areas and abnormal load areas) will be located or where clearance is required for access such as for the interrupter cable.

6.3.7 Where safe access allowed (or where areas of the soft estate could be viewed with permission from third party land owners), targeted ecological walkover surveys were undertaken during June 2018). Details of the ecological surveys can be found in Appendix 6.1. The ecological walkover surveys recorded habitat descriptions and included an assessment of the potential of each habitat to support notable and/or legally protected species. The ecological walkover surveys also involved a search for non-native invasive plant species included on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended).

[49] Chartered Institute of Ecology and Environmental Management. (2016). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (2nd Edition.). CIEEM, Winchester.
[50] Harris S., Cresswell, P. and Jefferies, D. (1989) Surveying Badgers. The Mammal Society.
[51] Strachan R. Moorhouse T. and Gelling M. (2011) Water Vole Conservation Handbook, 3rd Edition
[52] Collins, J. (ed.) (2016) Bat surveys for professional ecologists good practice guidelines 3rd Edition. The Bat Conservation Trust, London

6.3.8 Due to seasonal and access constraints, approximately 20% of the total area within the potential EZoI have not been subject to ecological surveys (see Appendix 6.1). These areas are currently intended to be surveyed between March and June 2019.

6.3.9 Where access was possible and where habitats could be viewed from adjacent third-party land or inferred from aerial imagery, surveys of notable and legally protected species were as follows:

- Assessment of suitable habitats for all species of breeding birds;
- Assessment of habitat potential for badgers and where possible, a search for signs of badger activity including setts, tracks, hairs, foraging holes and latrines[53, 54];
- Assessment of habitat potential for reptiles and amphibians, in particular great crested newts (due to seasonal and access restrictions this only included environmental DNA (eDNA) and Habitat Suitability Index (HSI) assessments);
- Assessment of structures that could support roosting, foraging and commuting bats (where in excess of normal maintenance would result in disturbance) within the EZoI (due to seasonal constraints and access restrictions full surveys, required prior to construction, could not be undertaken in 2018); and
- Assessment of habitat potential for other protected and/or notable species (such as plants, invertebrates and other mammal species).

6.3.10 Great crested newt HSI assessments and eDNA surveys were carried out on waterbodies located within 250m of the motorway soft estate in 2018. Due to seasonal constraints and access restrictions, 22 waterbodies were not surveyed. Waterbodies which have not been surveyed are shown on Figure 3.2a and 3.2b in Appendix 6.1, together with detailed survey methods and specific limitations to the methodologies. Further great crested newt surveys will be undertaken in the next appropriate pre-construction season window, and these will include HSI, eDNA and population size class assessments of those ponds which have not been accessed during 2018, and also any ponds with a positive eDNA score from 2018.

6.3.11 A preliminary bat roost appraisal of 14 structures within 50m the Proposed Scheme, and that will be affected by works during construction, was undertaken in August 2018. Detailed survey methods, together with specific limitations to the methodologies are provided in Appendix 6.1 and surveyed structures are shown on Figure 4.1.

6.3.12 A riparian mammal survey (otter and water vole) was undertaken in August 2018 along the River Mimram, a watercourse that bisects the A1(M) near to J6. Although the River Mimram will not be subject to construction works itself or be altered in any way as a result of the Proposed Scheme, there is potential for works to occur within close proximity of the river bank, which could potentially disturb habitat and places of shelter used by water vole. Detailed survey methods, together with any specific limitation to the methodologies are provided in Appendix 6.1 and surveyed watercourses are shown on Figure 5.1.

6.3.13 There are only 8 desk study records from HERC for hazel dormouse, 7 of these studies are dated pre-2000, the most recent record is 2008 with grid reference TL21G. The closest record is associated with Knebworth Woods SSSI, approximately 650m from the Proposed Scheme and dates back to 1970. As the Proposed Scheme is outside of the known range of this species and there is no suitable habitat within the study area to support hazel dormouse; their presence is considered highly unlikely. No surveys in relation to hazel dormouse have therefore been undertaken, and hazel dormouse is not considered further within this assessment.

[53] Harris S., Cresswell, P. and Jefferies, D. (1989). Surveying Badgers. The Mammal Society.
[54] Roper, T. (2010). A Survey of British Natural History - Badger. New Naturalist Library, HarperCollins.

6.3.14 There are desk study records from HERC for reptile species, including; grass snake (*Natrix helvetica*), common lizard (*Zootoca vivipara*) and slow worm (*Anguis fragilis*), with records of the latter within the soft estate. However, the majority of the soft estate and adjacent land offers sub-optimal habitat for reptiles, with limited areas for basking and seeking refuge, or hibernacula features for breeding. Due to the lack of records in the wider area and limited habitat available for reptiles, these species are not considered further within this assessment and no surveys in relation to reptiles have been undertaken. However, some general mitigation measures for reptiles are proposed in Section 6.6.

6.3.15 There are desk study records from HERC for invertebrate species notable for their conservation concern status. However, the structure and nature of the habitats within the soft estate does not provide the diversity required to support an invertebrate community of special interest. Therefore, invertebrates are not considered further within this assessment and no surveys in relation to invertebrates have been undertaken.

6.3.16 There are only 4 desk study records from HERC for white-clawed crayfish (*Austropotamobius pallipes*) within the study area associated with the Mimram, Lee and Colne rivers, which are all dated pre-2000. The most recent record dates back to 1988, and the closest record is from the River Lee which bisects the A1(M) at Lemsford, which is approximately 3km from the Proposed Scheme. The River Mimram is the closest watercourse to the Proposed Scheme, and will not be subject to construction works itself, or be altered in any way as a result of the Proposed Scheme. Therefore, white-clawed crayfish are not considered further within this assessment and no surveys in relation to this species have been undertaken. However, some general mitigation measures relating to pollution prevention are proposed in Section 6.6.

6.3.17 There are desk study records from HERC for hedgehog (*Erinaceus europaeus*) and brown hare (*Lepus europaeus*). However, due to the presence of optimal habitat within the wider landscape and the general widespread distribution of these species across the region, both hedgehog and brown hare are not considered further within this assessment and no surveys in relation to these species have been undertaken.

Valuing receptors

6.3.18 For the purpose of this assessment, the value of each ecological receptor has been based on the results of the desk and field surveys. Where field surveys are incomplete at the time of assessment, professional judgement has been applied in relation to resource valuation using known baseline data and a worst case scenario approach.

Table 6.2 - Resource valuation, adapted from IAN 130/10

Value	Examples of resource valuation based on geographical context
	International or European Value
Very High	• International or European designated sites[55], or sites that meet the published selection criteria for International or European designated sites but are not themselves designated as such; and • Resident or regularly occurring populations of species which may be considered at an at International or European level where loss of the population would adversely affect the conservation status or distribution at this geographic scale; where the population forms a critical part of a wider population at this scale; or where the species is at a critical phase of its life-cycle at this scale.
	National
Very High	• Nationally designated sites including Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR) and sites that meet published criteria for nationally designated sites but are not themselves designated as such; • Notable areas of key/priority habitats (including ancient woodland) where considered to be of national importance and not already otherwise designated or listed as habitats of principal importance for the conservation of biodiversity under Section 41 of the Natural Environment and Rural Communities Act (2006); and • Resident or regularly occurring populations of species which may be considered at International, European or National level where loss would adversely affect the conservation status or distribution at National level; where the population forms a critical part of a wider population at this scale, or where the species is at a critical phase of its life-cycle at this scale.
	Regional
High	• Resident or regularly occurring populations of species which may be considered at International, European or National level where loss of these species would adversely affect the conservation status or distribution at Regional level; where the population forms a critical part of a wider population at this scale; or where the species is at a critical phase of its life-cycle at this scale; and • Notable areas of key/priority habitats identified in the Regional Biodiversity Action Plan (BAP) (Hertfordshire BAP); notable areas of key/priority habitat identified as being of Regional value in the appropriate Natural Area Profile (or equivalent); areas that have been identified by regional plans or strategies as areas for restoration or re-creation of priority habitats; and notable areas of key/priority habitat listed within the Highways Agency's BAP.

[55] This includes: Sites or Community Importance, Special Protection Areas, potential Special Protection Areas, Special Areas of Conservation, candidate Special Areas of Conservation, Wetlands of International Importance, Biogenetic Reserves, World Heritage Sites (designated for their nature conservation value) and Biosphere Reserves.

Value	Examples of resource valuation based on geographical context
	International or European Value
	County
Medium	• Local Wildlife Sites (LWS); Sites of Biological Interest (SBI) and Local Nature Reserves (LNRs) designated in the county context; or sites that meet the published selection criteria for these designated sites but are not themselves designated as such.
	Examples of resource valuation based on geographical context
	• Notable habitats and habitats where considered to be of County importance (and not already designated); and • Resident or regularly occurring populations of species which may be considered at International, European or National level where loss would adversely affect the conservation status or distribution at County level; where the population forms a critical part of a wider population at this scale; or where the species is at a critical phase of its life cycle at this scale.
	Local (Immediate local area)
Low	• Designated sites including LNRs designated in the local context; and • Areas of habitat; or populations/ communities of species considered to appreciably enrich the habitat resource within the local context (such as veteran trees), including receptors of value for migration, dispersal or genetic exchange.
	Scheme (land within the Highway England boundary)
Negligible	• Notable habitats or species considered of value within the context of the Proposed Scheme only, such a small ponds, scrub or populations of notable species widespread in the local area.

6.3.19 Important ecological receptors carried through to assessment are those considered to be of local value and above. Ecological receptor values below this (i.e. within the Proposed Scheme boundary only), which are considered sufficiently widespread, unthreatened or resilient to impacts from the Proposed Scheme such as common toad and hedgehog, may still be subject to legal protection. As such, they may still require mitigation or compensation measures as outlined in Section 6.6, details of which will be addressed in the OEMP and at subsequent stages of the Proposed Scheme's development up to and during construction.

Magnitude of impacts

6.3.20 This assessment takes into account both on-site impacts and those that may occur to adjacent and more distant ecological receptors. Impacts may be adverse or beneficial to the receptors, permanent or temporary, and can occur through several mechanisms, including:

- Direct loss of habitats (including temporary loss of wildlife habitats during construction or small-scale permanent loss of habitats within the soft estate to accommodate proposed infrastructure;
- Fragmentation or isolation (dividing habitats or wildlife corridors within the soft estate).
- Changes to the local hydrology, water quality and/or air quality (pollution during construction and operation affecting the water environment and adjacent habitats);
- Direct mortality or injury to wildlife through construction activities and traffic accidents; and
- Disturbance to species from noise, light or other visual stimuli.

6.3.21 The magnitude of impact during the construction and operational phases is subject to professional judgement likelihood, reversibility, duration, timing and frequency of the potential disturbance and the probability that a designated site, priority habitat or protected/notable species would be affected. Definitions of magnitude of impact ratings are defined in Table 6.3.

Table 6.3 - Magnitude of impact for biodiversity[56]

Magnitude of Impact	Typical Criteria Descriptions
Major	**Adverse** - Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, receptors or elements. **Beneficial** - Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality.
Moderate	**Adverse** - Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, receptors or elements. **Beneficial** - Benefit to, or addition of, key characteristics, receptors or elements; improvement of attribute quality.
Minor	**Adverse** - Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, receptors or elements. **Beneficial** - Minor benefit to, or addition of, one (maybe more) key characteristics, receptors or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring.
Negligible	**Adverse** - Very minor loss or detrimental alteration to one or more characteristics, receptors or elements. **Beneficia**l - Very minor benefit to or positive addition of one or more characteristics, receptors or elements.
No change	No loss or alteration of characteristics, receptors or elements; no observable impact in either direction.

[56] Magnitude of Impact Ecology and Nature Conservation Criteria derived from DMRB Volume 11 Section 2, Part 5 – HA 205/08.

6.3.22 With regard to considering the magnitude of impact on receptors due to changes in ambient concentrations of nitrogen dioxide (NO2), change is described as follows:

- **Imperceptible**: A change in concentration less than or equal to 1% of the relevant air quality criterion;
- **Small:** A change in concentration greater than 1% and less than 5% of the relevant air quality criterion;
- **Medium:** A change in concentration greater than 5% and less than 10% of the relevant air quality criterion; and
- **Large:** A change in concentration greater than 10% of the relevant air quality criterion is considered to be 'large'.

Significance of effects

6.3.23 The effect on an individual ecological receptor is categorised as 'significant' or 'not significant' at the level at which the receptor is valued. A significant effect will constitute impacts on the structure and functions of designated sites, notable habitats, or ecosystems; or the conservation status of habitats and species at an appropriate geographic scale. Therefore, an effect can be significant at local, county, regional, national or international levels dependant on its value. Overall residual effects for each ecological receptor are categorised on a five point scale in line with IAN 130/10 (see Table 6.4 - Significance of effects (IAN 130/10)). Effects that are categorised as moderate or above are significant, effects that are categorised as slight or below are not significant.

Table 6.4 - Significance of effects (IAN 130/10)

Significance category	Typical descriptors of effect
Very large	An effect on one or more receptor(s) of international, European, UK or national value.
Large	An effect on one or more receptor(s) of regional value.
Moderate	An effect on one or more receptor(s) of county value.
Slight	An effect on one or more receptor(s) of local value or receptors within the survey area.
Neutral	No significant effects on important nature conservation receptors.

Stakeholder engagement

6.3.24 Stakeholder engagement has been undertaken for this assessment. Contact was made with the local biological records centre (HERC), where a data search was ordered to obtain wildlife records on habitats and species.

6.3.25 Natural England have been approached via a letter regarding the Habitats Regulations Assessment screening and impacts on European designated sites. However, as the Proposed Scheme is unlikely to cause an adverse effect on the integrity of any European designated site, only general advice was provided.

6.3.26 Future consultation with stakeholders is likely where protected species licence applications are required. Furthermore, the local authority will be contacted with regard to ecological enhancement opportunities in nearby designated sites, close to the Proposed Scheme.

Assumptions and limitations

6.3.27 Assumptions and limitations have been taken into account during this assessment, see Table 6.5.

Table 6.5 - Assumptions and limitations

Element	Assumption/Limitations
Assumptions	
Survey results	Where surveys are incomplete, professional judgement has been used to support the assessment, the need for licensing, and enhancement opportunities.
Great Crested Newt survey	Great crested newts are present in all un-surveyed waterbodies.
EPS licencing	At present, the current baseline information available for protected species associated with the Proposed Scheme is not considered sufficient to inform European Protected Species (EPS) Licence applications. Its assumed that all species surveys required to inform EPS licences will be carried out in survey seasons 2019/2020. Surveys are seasonal and failure to undertake them within the correct survey window could potentially result in a risk of delay to the construction programme.
Mitigation	Potential impacts on ecological receptors can be mitigated through standard mitigation measures in line with best practice guidelines.
Site clearance	The site clearance for infrastructure and working space assumptions detailed in Table 2.14 have been adopted.
Construction disturbance	No construction traffic noise or vibration is anticipated beyond the motorway and local roads servicing the compound sites/emergency diversion routes.
Environmental Management	Once the contractor is appointed for the design, a CEMP will be produced to cover ecological and environmental mitigation, which will include: tree root protection areas, pollution prevention controls; and essential species-specific mitigation precautionary measures including: nesting birds, amphibians and roosting bats Illumination of construction works would be directed away from areas of recognised ecological value. Any excavations from construction works will be covered or provided with a means of escape, to prevent any wildlife e.g. Badgers from entrapment. Sources of water e.g. ponds and rivers to be afforded protection from suitable pollution prevention measures during construction of the Proposed Scheme.
Arboriculture	The boundaries of ancient woodlands (Ninning's Wood and Watery Grove) align with the highway boundary fencing and that operational highways land no longer functions as ancient woodland. This assumption is based on the following: ➢ Construction of the A1(M) resulted in the loss of trees of all age classes and sizes along with associated significant soil disturbance to operational highways land such that its structure, flora and fauna has been substantially degraded in ecological terms; ➢ Any apparent overlap between ancient woodland and operational highways land has arisen due to variations in the location of land boundaries as shown on Ordnance Survey Mapping of different ages. In this instance, the boundaries of ancient woodland areas which were digitised using older mapping may not align precisely with more modern maps digitally derived from high quality aerial imagery.

Element	Assumption/Limitations
	➢ Whilst land within the highways soft estate may provide a rooting medium for trees, it is of much poorer quality than that which exists within areas of ancient woodland. This is a result of the following: ➢ soil will have been disturbed during construction, thereby altering its structure and introducing areas of compaction. ➢ soil moisture content may be altered due to the presence of highway drainage. ➢ seasonal applications of de-icing salt are potentially damaging to roots. ➢ There is an absence of mature, high quality trees along the edge of the ancient woodland areas and in proximity to the proposed works[57]. On this basis only immature, low quality trees are likely to be effected by construction of the Proposed Scheme.
Limitations	
Survey constraints	For reasons of safety, all surveys were confined to visual inspections of the soft estate[58] where access could be gained from adjacent land. The soft estate itself or the highway boundary was not accessed. It is considered highly unlikely access constraints would affect the overall assessment for each species or habitat surveyed. Where access was not achieved, a combination of views from accessible third-party land, views from footpaths and online aerial and Google earth imagery was used.
Habitat survey	It is considered that the entirety of the soft estate has been subject to habitat survey, by way of a combination of site visit and desk-based mapping
Great crested newt survey	Due to certain restrictions on access to third party land in 2018, it was not possible to carry out great crested newt eDNA surveys at 22 waterbodies within the study area. It is possible that some restrictions on access will not be resolved in the next survey seasons, which will affect great crested newt surveys, in terms of which waterbodies will be accessible for survey. Furthermore, the six ponds that tested positive for great crested newt through eDNA survey work in 2018 were not subject to population assessments due to seasonal constraints.
Bat survey	No assessment of trees for bat roost potential within the Proposed Scheme was undertaken due to access restrictions (i.e. the soft estate was not accessed*). Prior to tree felling or pruning works, targeted preliminary bat roost surveys will be undertaken on trees with potential roost features only. Where bat roost potential is identified further surveys will be required to inform mitigation. To date, bat roost appraisal surveys on 14 out of 19 structures present (overbridges and underbridges) proposed for treatment works during construction have been carried out. No follow up dusk emergence and dawn re-entry surveys have been recommended thus far, however roost assessments on the remaining bridge structures should be undertaken on five structures that had no access in 2018. These surveys can be undertaken at any time of year once access has been granted. They will need to be undertaken prior to construction commencing.

[57] Viewed using Google StreetView on 04 March 2019.
[58] The soft estate includes all of the land between the existing motorway and the highway boundary

Element	Assumption/Limitations
Badger survey	For reasons of safety, all field surveys were confined to the rear of the soft estate where access could be gained from adjacent land, the soft estate itself was not accessed. Therefore, complete coverage to determine the presence of badgers was not possible. Pre-works checks for the presence of badger will be undertaken prior to any vegetation clearance/pre-construction works.
Riparian species survey	Surveys for otter and water vole were limited to those watercourses forming part of the proposed works. The River Mimram is the single watercourse that is likely to be affected by the Proposed Scheme, and due to access constraints in 2018, some sections of this watercourse will require further survey work in the next appropriate season prior to construction. No other watercourses are to be surveyed.
Schedule 9 invasive species	Approximately 20% of soft estate where the presence of Schedule 9 invasive plant species was not surveyed. No invasive plant species were identified within the soft estate that could be viewed from publicly accessible land.
Survey Findings	Factors influencing the presence of plants and animals prevent surveys concluding that the absence of evidence of any particular species should not be taken as conclusive proof that the species is not present or that it would not be present in the future.
Survey Validity	The survey results are considered valid for a maximum of two years and can be relied upon to inform an EPS licence within that time period only.
Construction compounds	The location of the construction compound(s) and layout areas are unknown, although candidate areas within 250m have been considered.
Protected Species licencing	Further surveys will be undertaken for great crested newt, bats, otter and water vole in the next appropriate seasonal windows pre-construction to help inform mitigation and licensing required as part of the Construction Environmental Management Plan (CEMP).
Arboriculture	A walkover tree survey in accordance with BS 5837:2012 has not been undertaken. A proportionate approach has been instructed by Highways England, thus the surveys will be completed during detailed design (DF4/DF5), when locations of Smart Motorway infrastructure is accurately determined. Consequently, at this time, detailed information pertaining to the species, location and stem diameter of woodland edge trees is unknown.
Geotechnical Interventions	Geotechnical interventions e.g. retaining walls, have yet to be finalised/agreed with the Highways England geotechnical team and therefore a worst case assumption has been made.
*The soft estate includes all of the land between the existing motorway and the highway boundary.	

6.4 Baseline conditions

6.4.1 This section describes the following baseline components:

- Designated sites;
- Notable and other habitats;
- Notable species;
- Great crested newts;
- Bats;
- Badger;
- Otter and water vole;
- Breeding birds; and
- Invasive plant species.

Designated sites

6.4.2 There are 3 International or European designated sites for nature conservation within the study area. These are shown in Figure 4.1 of the Habitats Regulations Assessment Report[59] and comprise:

- Eversden and Wimpole Woods SAC;
- Lee Valley SPA; and
- Lee Valley Ramsar.

6.4.3 There are 2 Sites of Special Scientific Interest (SSSI) within the study area, these are:

- Knebworth Woods SSSI; and
- Sherrardspark Wood SSSI.

6.4.4 There are 14 local wildlife site's (LWS's) located within 50m of the Proposed Scheme or are hydrologically linked to the Proposed Scheme and therefore fall within the EZoI, these are:

- Margaret's Wood & Spoil Bank Wood, Todds Green LWS;
- Fishers Green Wood LWS;
- Knebworth Park LWS;
- Sandybottom Wood East LWS;
- Ninning's Wood LWS;
- Mardley Heath LWS;
- Danesbury Park LWS;
- Grassland E. of Danesbury Hospital LWS;
- Legs and Stockings Wood LWS;
- Old North Road & Central Reservation, Lockleys LWS;
- Brocket Park North LWS;
- Ayot Greenway LWS;
- Homer's Wood LWS; and
- Wagon and Horses Pond, Ayot Green LWS.

Notable and other habitats

6.4.5 The following Ancient Woodlands have been identified adjacent to soft estate (within 15m) or hydrologically connected to the Proposed Scheme:

- Ninning's Wood;
- Legs and Stockings Wood; and
- Watery Grove.

6.4.6 The following Habitats of Principal Importance[60] have been identified adjacent to the Proposed Scheme:

[59] A1(M) J6-8 Smart Motorways Programme, Habitats Regulations Assessment, HE551539-WSP-EBD-SG-RP-LE-0001

[60] Habitat of Principal Importance for the Conservation of Biological Diversity in England notified under Section 41 of the NERC Act 2006 and as listed in the England Biodiversity List.

- Semi-improved grassland;
- Lowland mixed deciduous woodland;
- Hedgerows;
- Ponds; and
- Rivers.

6.4.7 Habitats of Principal Importance have been identified within the footprint of the Proposed Scheme. This includes woodland, ponds and river habitats.

6.4.8 The ecology walkover surveys identified a variety of common habitats within the soft estate, identified on Figure 2.1.

Notable species

6.4.9 The following notable species[61] were recorded, from desk study, within the study area:

- Amphibians, including great crested newt *(Triturus cristatus)* and common toad (*Bufo bufo*);
- Bats, including; common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmaeus*), brown long-eared (*Plecotus auritus*), noctule (*Nyctalus noctula*), leislers (*Nyctalus leisleri*), natterers (*Myotis nattereri*), whiskered (*Myotis mystacinus*), daubentons (*Myotis daubentonii*), serotine (*Eptesicus serotinus*), barbastelle (*Barbastella barbastellus*);
- Badger (*Meles meles*);
- Otter - three records within the study area, associated with the River Mimram. The closest record for otter is less than 300m from the Proposed Scheme.
- Water vole - records for water vole within the study area, many of which are dated pre-2000 and associated with the River Mimram. The closest records for water vole are less than 200m from the Proposed Scheme; and
- Breeding and foraging bird species notable for their conservation concern status including records of 32 Birds of Conservation Concern (BoCC) Red listed birds, 38 BoCC Amber listed birds and 35 Schedule 1 (Wildlife and Countryside Act 1981 (as amended) birds.

Great crested newts

6.4.10 The survey methodology and results are provided in Appendix 6.1, with a summary of survey methodology and results to date outlined below.

6.4.11 Of the 46 waterbodies that were targeted for an HSI assessment, 24 were visited in 2018 and the remaining waterbodies were not accessed due to land access/ health and safety restrictions. Following HSI assessments, 13 waterbodies were subject to eDNA surveys. An eDNA survey was not carried out on the remaining waterbodies for one of the following reasons:

- The pond/ ditch was dry or not present;
- The pond/ ditch was unsuitable breeding habitat for great crested newts (i.e. was flowing or was stocked with numerous large fish); or
- The pond/ ditch was unsafe to access, or it was unsafe to take water samples.

6.4.12 Three waterbodies within 50m and 4 waterbodies between 50m and 250m of the Proposed Scheme, were discovered to be either dry, no longer present, or if present tested negative under eDNA survey for great crested newt presence.

6.4.13 There are 2 waterbodies within 50m and a further 4 waterbodies between 50m and 250m of the Proposed Scheme which tested positive following eDNA survey[62], confirming the presence of great crested newts (see Table 6.6).

[61] Notable invertebrates are taken as principal species for the conservation of biodiversity listed under Section 41 of the Natural Environment and Rural Communities Act 2006; species included in local biodiversity action plans, species considered notable for their conservation concern (for example, IUCN Red Data Books). Bird species are taken as those listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended); any bird species listed as Red, Amber of Green status in the Birds of Conservation Concern 3 (RSPB, 2009); and species considered rare in the UK or in local counties.

[62] A1(M) J6-J8 Smart Motorways, Great Crested Newt eDNA Results, Nature Metrics, Report ref. 18331-WS-PJ-1.

6.4.14 There are 22 other identified ponds within 250m that have not yet been assessed for great crested newt presence. As such, it is assumed that these waterbodies support great crested newt, and will not be scoped out of the assessment until eDNA or conventional methods can be undertaken on them.

6.4.15 The terrestrial habitats within the study area are suitable for foraging, sheltering, hibernating and dispersing great crested newts, where these habitats lie near to waterbodies used by this species to breed.

6.4.16 Great crested newts are considered to be of up to county importance and therefore of medium value, depending on the size of the metapopulations present.

Table 6.6 - Waterbodies with great crested newt confirmed

Waterbody Id	Land parcel	Approx. Grid Ref	Population Size	Distance to Highway Boundary (m)
8-GCN-40	HD516234	TL 22218 26486	Unknown	70
8-GCN-56	HD484498; HD461876	TL 22964 23225	Unknown	70
8-GCN-70	HD408424	TL 23224 22947	Unknown	15
8-GCN-84	HD189478	TL 22900 23398	Unknown	40
8-GCN-85	HD408424	TL 23014 23092	Unknown	120
8-GCN-86	HD408424	TL 23224 22905	Unknown	80

Bats

6.4.17 Habitats within and in the wider landscape surrounding the Proposed Scheme are likely to provide foraging and commuting opportunities for bats.

6.4.18 Construction works that may give rise to disturbance beyond that experienced under operational conditions are identified to take place at underbridges, overbridges and culverts across the Proposed Scheme. Surveys were consequently undertaken at 14 structures to determine their potential for use by bats as roost sites (see Table 6.7 - Potential for bat roosts in). A total of 5 structures (Structures No. 10, 11, 17, 18 and 19) could not be surveyed due to access restrictions (see Table 6.8).

Table 6.7 - Potential for bat roosts in structures

Id	Structure name	Structure type	Description of features	Suitability
1	Digswell Hill Bridge.	Concrete cast overbridge.	Join of supporting wall and bridge filled with white rubber sealant, creating lack of spaces for roosting bats. High noise and vibration levels.	Negligible
2	Welwyn Road Bridge.	Concrete cast overbridge.	Lighting underneath, frequent disturbance with traffic, high noise and vibrations. Good state of repair.	Negligible
3	Great North Road Bridge.	Concrete cast overbridge. Brick supporting walls.	Lighting underneath, frequent disturbed with traffic, high noise and vibrations. Gap located between brick supporting wall and concrete, but not suitable.	Negligible
4	The Avenue Bridge.	Concrete cast bridge with pillars.	16 Pillars, no obvious cracks, gaps underneath to provide roosting opportunities for bats.	Negligible
5	Pottersheath Road Bridge.	Concrete cast overbridge.	No street lighting on A1(M), High noise levels, no visible evidence of bats. No suitable roost spaces identified.	Negligible

Id	Structure name	Structure type	Description of features	Suitability
6	Pedestrian subway tunnel under A1(M)	Underpass	No lighting, no roost spaces or crevices to provide opportunities. A1(M) noise above.	Negligible
7	Wych Elm Lane Bridge.	Concrete cast overbridge.	Noise and vibration high A1(M) over top, no suitable roost spaces identified. Bridge in good state of repair.	Negligible
8	Park Lane Bridge.	Concrete cast overbridge.	Noise and vibration high A1(M) over top, no suitable roost spaces identified.	Negligible
9	North Lodge Bridge.	Concrete cast underbridge.	20 pillars, maintenance steel scaffolding underneath, no obvious roost spaces, no lighting but high noise and vibration from A1(M)	Negligible
12	Pedestrian subway tunnel under A1(M)	Underpass	Lighting within subway, no features considered suitable for roosting bats. Close to Knebworth Woods SSSI.	Negligible
13	Chadwell Road Bridge.	Brick and concrete built bridge.	No lighting, noise and vibrations from A1(M). Crevices/spaces present not deep enough to provide roosting opportunities.	Negligible
14	Kitching Lane Bridge.	Brick and concrete built bridge.	No lighting, noise and vibrations from A1(M). No obvious roosting spaces, good state of repair.	Negligible
15	Symonds Green subway tunnel under A1(M)	Underpass	No lighting, tunnel without suitable roost spaces, in good state of repair.	Negligible
16	Fishers Green Bridge.	Concrete cast overbridge.	No street lighting on A1(M), High noise levels, no visible evidence of bats. No suitable roost spaces identified.	Negligible

Table 6.8 - Structures without Preliminary Roost Assessment survey in 2018

Id	Structure name	Structure type	Description of features	Suitability
10	Langley Sidings South	Concrete cast overbridge	Unknown	Unknown
11	Langley Sidings North	Concrete cast overbridge	Unknown	Unknown
17	Todds Green railway	Underbridge	Unknown	Unknown
18	Coreys Mill South	Underbridge	Unknown	Unknown
19	Coreys Mill North	Underbridge	Unknown	Unknown

6.4.19 The above structures are considered to be of no more than scheme importance and therefore of negligible value.

6.4.20 No survey work has yet been carried out on structures 10, 11 17, 18 and 19, therefore the final roost status of these structures is at present unknown. These structures will need to be visited in 2019.

6.4.21 Trees along the A1(M) have not undergone survey to date, and surveys are not planned until more detailed plans have progressed on which trees are to be affected by the Proposed Scheme. At a later stage in the design, where safe access can be obtained to the soft estate prior to construction, surveys of trees will be undertaken to assess bat roosting potential to inform the CEMP and any licensing requirements.

Badger

6.4.22 The terrestrial habitats within the highway boundary and the adjacent land provide optimal foraging and commuting opportunities for badgers. Optimal sett construction opportunities were present along the soft estate embankments within the footprint of the Proposed Scheme and along hedgerows and woodland in adjacent land.

6.4.23 To date, no badger setts have been recorded during the ecological walkover surveys; however there are habitats present that have not been walked-over/surveyed, and therefore the presence of badger cannot be ruled out. In addition, field signs of badger were recorded at 1 location in the form of hairs on a wire fence, approximately 100m to the east of the A1(M) at grid reference (TL 23654 16439).

6.4.24 Badgers are widespread in Hertfordshire, and although this species may utilise the habitats within the highway boundary, it is unlikely that any population will have a value greater than within the context of the Proposed Scheme only.

6.4.25 In addition, the habitats within the highway boundary are generally all common and widespread, and therefore of negligible value and considered to be of scheme importance only.

Otter and water vole

6.4.26 The presence of waterways within the study area provides opportunities for the presence of otter and water vole that are supported by desk study records. However, no otter or water vole or signs of otter or water vole were identified during the riparian mammal survey in August 2018.

6.4.27 The habitats present within the highway boundary are unlikely to be used by otter and water vole, and only the River Mimram is considered to be of importance to these species, as the biological records would indicate. Otter and water vole are considered to be of medium or county value.

Breeding birds

6.4.28 Habitats within the highway boundary were assessed for their suitability to support breeding birds, (although no specific bird surveys have been undertaken nor deemed necessary) and are suitable for a range of common and widely distributed breeding bird species. The soft estate habitat is therefore considered to be of scheme importance (land within the highway boundary) only and therefore breeding birds are of negligible value and are not considered further within this assessment.

Invasive plant species

6.4.29 Himalayan Balsam (*Impatiens glandulifera*) has been identified outside of the footprint of the Proposed Scheme, associated with the River Mimram. However, to date, no invasive plant species have been identified within the footprint of the Proposed Scheme.

6.4.30 Any incidental records of invasive plant species should be recorded throughout the life-cycle of the Proposed Scheme. The information will be used to inform the CEMP.

Future baseline

6.4.31 Land within and surrounding the Proposed Scheme include roadside verges, agricultural land or human development (buildings/hardstanding); thus habitats within these land uses are heavily managed and maintained in their current state by human interventions, and are unlikely to change. Roadside habitats are regularly cut to maintain a mix of poor semi-improved grassland, scrub and immature trees and this management regime will not change in the future as it is required to maintain road safety.

6.4.32 Agricultural habitats (arable, improved grasslands) and their boundary hedgerows are productive areas, and their nature conservation value is unlikely to change unless they are taken out of production and returned to a semi-natural state, which is unlikely. Small changes could be expected to areas of scrub which may develop into taller woody vegetation, and grassland left to develop may be cut, but overall no change in the importance of habitats would be expected. Lastly, human development will only increase and although no net loss principles will attempt to maintain the conservation value of developed areas, the total area of habitats are likely to be at best maintained.

6.4.33 The exception is ancient woodland, which is present within the boundary of protected sites such as Knebworth Woods SSSI. Such woodland is subject to management plans which aim to improve its condition in future.

6.4.34 The future baseline for biodiversity is likely to remain at status quo, with little change from the baseline observed.

6.5 Assessment of effects

Construction effects

Designated sites

6.5.1 Construction of the Proposed Scheme will not have a significant effect on the conservation objectives of the Eversden and Wimpole Woods SAC, Lee Valley SPA and Lee Valley Ramsar (see Habitats Regulations Assessment Report). All proposed Smart Motorway equipment is associated within and around the boundary of the Proposed Scheme and as such is a significant distance away from all international designated sites (over 27km from the SAC and over 14km from the SPA and Ramsar).

6.5.2 In terms of national sites, the construction effects of the Proposed Scheme will not have a significant effect on the Knebworth Woods SSSI and Sherrardspark Wood SSSI. Although these sites are in close proximity to the Proposed Scheme, the nature of the proposed works are of a relatively low impact, therefore the magnitude of impact is considered to be negligible and only a slight adverse effect is considered likely. There are also no hydrological links (surface water) from the Proposed Scheme to the drains within or adjacent to these sites, due to the difference in elevation.

6.5.3 Construction of the Proposed Scheme will not have any significant effect on the structure and function of the 14 local wildlife site's, as there would be no loss of habitat within any of these sites. Works would be restricted to the strip of soft estate immediately adjacent to the carriageway close to, but not within, the boundary of the adjacent local wildlife site.

Notable and Other Habitats

6.5.4 The Proposed Scheme would not have a significant effect on the conservation status of identified Priority Habitats beyond the soft estate. However, within the soft estate, some temporary habitat loss is anticipated (see Table 6.9). No rivers or ponds would be modified during the works and pollution prevention measures would be implemented.

Table 6.9 - Loss of priority or notable habitats

Priority & Notable Habitat	Principal Locations	Permanent Loss (ha)	Temporary Loss (ha)	Other Impacts
Lowland Mixed Deciduous Woodland	Watery Grove (Knebworth Woods SSSI boundary)*	0.00	0.10	Nitrogen deposition along Knebworth Woods SSSI boundary

Priority & Notable Habitat	Principal Locations	Permanent Loss (ha)	Temporary Loss (ha)	Other Impacts
Ancient Woodland	Watery Grove (Knebworth Woods SSSI boundary)	0.00	0.00	Nitrogen deposition along Knebworth Woods SSSI boundary
Hedgerow	1 small section of hedgerow within highway boundary at grid ref. TL 23725 16742	0.00	0.09	None
Ponds	Various, scattered throughout study area	0.00	0.00	None
Rivers	River Mimram	0.00	0.00	None
*Small extent of Knebworth Woods SSSI boundary appears to be located within Highways England soft estate				

6.5.5 The Proposed Scheme requires the clearance of habitats within the soft-estate involving the removal of low quality deciduous woodland (*Oak Quercus sp.*), Ash (*Fraxinus excelsior*) and Field maple (*Acer campestre*), these areas are not representative of the habitat quality that is generally associated with Habitats of Principal Importance. Such clearance will create gaps in the continuity of habitats within the soft estate some of which will be permanent where clearance is needed for footway access to gantries and other structures.

6.5.6 Potential adverse impacts on ancient woodland may occur due to sightline clearance adjacent to ancient woodland, the location of gantry GA09 adjacent to Ninning's Wood and a ROTTM sign adjacent to Watery Grove. The impacts are likely to comprise:

- Severance of the tree roots during excavation of foundations and installation of underground services;
- Loss of rooting medium within the permanent footprint;
- Severance of branches to create sightlines; and
- Soil compaction and damage to roots caused by construction machinery.

6.5.7 However, it is considered that the construction of the Proposed Scheme would have no significant effect on the structure and function of ancient woodland, which lies adjacent to the Proposed Scheme. There would be no loss of habitat within areas of ancient woodland. Further, the adverse effects will derive from impacts to small, low quality woodland edge trees and as such will be localised. Adverse effects will be temporary in nature and will persist only as long as it takes for new vegetation to grow. Adverse effects will be limited to individual trees or groups of woodland edge trees and, in terms of the overall woodland unit, may actually prove to be beneficial insofar as they have the potential to improve the diversity of habitat typical of an ancient woodland.

6.5.8 Major earthworks adjacent to Ninning's Wood, Legs and Stocking Wood and Watery Grove will be avoided/minimised as far as practicable and best practice methods implemented.

Great Crested Newts

6.5.9 Construction of the Proposed Scheme is unlikely to have a significant effect on the favourable conservation status of local populations of great crested newt that are confirmed in 2 waterbodies (from eDNA results in 2018) or assumed to be present in 3 unsurveyed waterbodies within 50m of the A1(M) carriageway.

6.5.10 It is assumed that great crested newt use the habitats within the construction area for foraging, sheltering, hibernating and dispersal hence vegetation clearance would create temporary gaps in habitat continuity. As no ponds would be directly affected, and only small areas of terrestrial habitat would be removed and later replaced, most of the ecological connectivity will be maintained.

6.5.11 The magnitude of impacts from construction works are considered to be minor, short term and reversible, hence any disturbance to individual great crested newts is unlikely to have adverse consequences for that individual's chance of survival and or breeding success, as appropriate measures would be taken to reasonably ensure the continued ecological function of the surrounding terrestrial habitat. See Section 3.8.4 within Appendix 6.1 for more information.

Bats

6.5.12 The Proposed Scheme is considered unlikely to have a significant effect on the favourable conservation status of the local to county populations of bats. This is based upon preliminary roost assessments undertaken during August 2018 on 14 structures that may be subject to parapet replacements, vehicle restrain system or installation of slot drain, with the potential to cause disturbance above baseline levels. However, all 14 structures surveyed are considered to have negligible potential to support roosting bats. Five structures were unable to be surveyed and so did not undergo a preliminary roost assessment. However, all but one (Todds Green railway underbridge) are very similar to the other 14 road bridges in that they are likely to be negligible in their potential support roosting bats.

6.5.13 Vegetation clearance and temporary lighting from construction works may reduce the overall availability of suitable foraging and commuting habitat for bats. However, habitat temporarily lost during the short duration of temporary lighting is unlikely to form a large proportion of the foraging or commuting habitat of bats within the local area. In addition, there is a large amount of suitable alternative foraging habitat (hedgerows, woodlands, fields and waterbodies) available in the wider landscape surrounding the Proposed Scheme for the bats.

6.5.14 It is considered that the Proposed Scheme will not result in fragmentation or isolation of populations of bats, as the A1(M) is already present, and only existing soft estate habitat will be affected. As such, it is considered there will be a negligible adverse magnitude of impact on bat populations resulting in a possible slight adverse effect.

Badger

6.5.15 Habitat scoping surveys undertaken (within accessible areas) to-date have not revealed any badger setts within the soft estate, or along the highway boundary.

6.5.16 Under the current design, no setts are due be lost or damaged as a result of the proposed works. However, there are still substantial sections of the soft estate that were not checked, or obscured from view due to limited access and time of year (summer when vegetation is dense), and so it is possible that badger setts may be present within or near to soft estate, that have not yet been recorded.

6.5.17 There may be requirement for temporary exclusion or permanent closure of badger setts during the construction period; this is to avoid the risk of killing, injuring or disturbing badgers that may be using setts in or adjacent to the Proposed Scheme footprint during the construction phase. The mitigation approach would be subject to agreement with Natural England as part of the licence application, and developed as part of the detailed design of the Proposed Scheme and final construction programme. This would ensure there is no detriment to the conservation status of local badger populations.

6.5.18 Vegetation clearance and construction works would lead to temporary and permanent loss of foraging habitats within the soft estate, but the majority of construction works would be close to the hard shoulder, which is generally of poor suitability for foraging badgers. There is also sufficient suitable habitat in the wider landscape for badgers to use for foraging. No significant effects are anticipated on badger movement or interruption of commuting activities during the construction period.

Otter and Water Vole (Riparian Species)

6.5.19 There will be no direct construction impacts on any riparian habitats within the Proposed Scheme, as such it is considered that there will be no adverse impacts on populations of otter or water vole and therefore no effects on these species.

6.5.20 In addition, appropriate pollution prevention and run-off measures will be implemented. General mitigation measures relating to pollution prevention are proposed in the OEMP.

Breeding Birds

6.5.21 No evidence exists of notable bird species using habitat within or adjacent to the soft estate and hence the loss of breeding and feeding habitat would not affect the conservation status of the local population of breeding birds.

Operational Effects

Designated Sites

6.5.22 In terms of international sites, the Habitats Regulations Assessment Report concluded that there would be no significant effects on the conservation objectives of international designated sites; Eversden and Wimpole Woods SAC, Lee Valley SPA and Lee Valley Ramsar.

6.5.23 With regard to nationally designated sites, it is considered that there will be no land take effects on any within the study area, however air quality modelling has shown there may be an effect on part of Knebworth Woods SSSI regarding nitrogen (N) deposition.

6.5.24 Nitrogen deposition modelling has been undertaken to determine the deposition of nitrogen compounds into the soil (the 'Critical Load' of nitrogen) within Knebworth Woods SSSI, and determine whether there will be significant effects on this SSSI. Deposition was modelled along a transect from the A1(M) centreline, with sampling points at 5m intervals from this point to a maximum distance of 100m. The Critical Load is calculated as kilograms of nitrogen deposited per hectare per year (kg N/ha/year), with lower and upper threshold values indicating the zone within which nitrogen deposition could have significant adverse effects on the designated features of the SSSI. (Nitrogen deposition above the upper Critical Load would certainly lead to significant effects).

6.5.25 Habitat within the SSSI adjacent to the A1(M) is comprised of broad-leaved, mixed and yew woodland. The lower Critical Load for the SSSI is 15kg N/ha/year, and the upper Critical Load 20kg N/ha/year; a 5kg N/ha/year zone where significant effects could result from nitrogen deposition[63]. Acid grassland and neutral grassland are also present within the SSSI and have different Critical Load thresholds, but are not present adjacent to the A1(M) and consequently not affected by nitrogen deposition from the carriageway. Baseline nitrogen deposition rates as modelled using expected traffic emissions in 2021 (the Proposed Scheme's opening year) show the lower Critical Load threshold is exceeded, indicating woodland habitat would already experience a significant effect due to atmospheric nitrogen deposition from the A1(M).

[63] Air Pollution Information System. (2019). Knebworth Woods SSSI. Nitrogen Critical Loads. APIS.

6.5.26 Increases in nitrogen loading above this point would enhance the magnitude of impact on the SSSI towards the upper Critical Load threshold, and cannot be scoped out as imperceptible; widely accepted environmental benchmarks for imperceptible impacts are set at 1% of Critical Load thresholds[64].

6.5.27 Knebworth Woods SSSI is approximately 5m from the A1(M) carriageway along its eastern-most edge where woodland meets the roadside verge. Here the Proposed Scheme would lead to an increase in nitrogen deposition of 0.7kg N/ha/year at this point, resulting in a deposition rate of 4.7% and 3.5% of the lower and upper Critical Load thresholds respectively, and therefore impacts here would not be imperceptible. Nitrogen deposition drops below 1% of the upper Critical Load threshold at 25m (change in deposition of 0.2kg N/ha/year), and below 1% of the lower Critical Load threshold at 30m (change in deposition of 0.1kg N/ha/year). Thus, the zone of perceptible effects of nitrogen deposition is a narrow band along the eastern-boundary of Knebworth Woods SSSI approximately 25m wide and 1.2ha in area. This is shown on Figure 6.1.

6.5.28 The area due to be affected by this increase in nitrogen deposition is the Watery Grove compartment (SSSI unit 4) of Knebworth Woods SSSI. The woodland at Knebworth Woods is considered nationally rare and is ancient in origin and ecologically diverse. It is described by Natural England as "a most important woodland in the north of the county lying on poorly drained soils derived from underlying clay-with-flints"[65]. Knebworth Woods is 120.8ha in size, and the area modelled to be affected by perceptible nitrogen deposition is 1.0% of the total site area.

6.5.29 Desk study information and surveys revealed Watery Grove to include woodland composed of ancient hornbeam (*Carpinus betulus*) and oak (*Quercus robur*) coppice, with an understorey of silver birch (*Betula pendula*) and hazel (*Corylus avellana*) and a ground flora of bluebell (*Hyacinthoides non-scripta*), primrose (*Primula vulgaris*), ground ivy (*Glechoma hederacea*) and areas of bracken (*Pteridium sp.*). Most forb species are considered to be adapted to low levels of soil nitrogen, and are vulnerable to nitrogen deposition[66].

6.5.30 Watery Grove is situated immediately adjacent to the A1(M) and is already subject to the effects of nitrogen deposition as discussed above. As such, any increases in traffic related nitrogen deposition are likely to further degrade the habitat along this boundary (which is currently assessed as "unfavourable – recovering" by Natural England). Around two thirds of SSSIs in the UK exceed their critical loads as a result of current atmospheric nitrogen deposition[67]. The section of land to be affected marks the edge of the woodland SSSI designation, and the habitat supports trees and other ground vegetation which are of an age and type considered to be indicator species of ancient woodland.

6.5.31 Natural England Report NECR210 investigated the effects of small increments of atmospheric nitrogen deposition (above Critical Load thresholds) on semi-natural habitats of conservation importance. The report studied the responses of vegetation to long-term nitrogen deposition from 5 semi-natural UK habitats; acid grasslands, upland heath, lowland heath, bog and sand dunes. Although woodland was not included for analysis (due to gaps in the literature), the effects of nitrogen deposition can be inferred on the basis of results from these other habitats.

[64] Natural England. (2018). Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations. Peterborough: Natural England.

[65] Knebworth Woods citation. (2015). Sites of Special Scientific Interest. Natural England.

[66] The impact of nitrogen deposition on semi-natural terrestrial ecosystems. (2018). Evidence Statement 01. Department for Environment Food & Rural Affairs.

[67] Caporn, S., Field, C., Payne, R., Dise, N., Britton, A., Emmett, B., Jones, L., Phoenix, G., Power, S., Sheppard, L. & Stevens, C. (2016). Assessing the effects of small increments of atmospheric nitrogen deposition (above the critical load on semi-natural habitats of conservation importance. Natural England Commissioned Reports, Number 210.

6.5.32 Appendix 5 of NECR210 shows a summary table of relationships between nitrogen deposition and species richness by habitat. Critical Load thresholds of habitats listed are for the most part lower than that for woodland within the SSSI. Thresholds for woodland are comparable to those listed for Upland Heath (15 and 20kg N/ha/year respectively for lower and upper Critical Loads). The guideline figures in Appendix 5 for percentage species loss show that for these categories it would be around -0.6% and -0.4% for 15kg nitrogen and 20kg nitrogen, respectively. Nitrogen deposition is highly unlikely of triggering anything more than this for ancient woodland.

6.5.33 Expected effects of nitrogen deposition, where this occurs at 1% above Critical Load threshold, would lead to ~1% decrease in species richness for Upland Heath; by comparison a similar decrease in species richness could be expected within the 25m wide zone within Knebworth Woods SSSI, with this effect mainly confined to the area within 10m of the boundary with the A1(M) roadside verge. This effect is small and unlikely to lead to the loss of species in reality, although it will contribute to increasing the overall soil nitrogen loading in this area. As such, taking these areas into account, and the size of the area to be affected (a small area of a much larger site) it is considered that there will not be a significant effect on the Knebworth Woods SSSI designation overall.

6.5.34 In terms of hydrological impact-effect pathways to any SSSI designations, the Proposed Scheme would not alter the volume or quality of runoff and thus the conservation status would be unchanged.

Protected species

6.5.35 No significant effects on any protected species are anticipated, as a result of the operation of the Proposed Scheme.

Notable habitats and other habitats

6.5.36 Potential adverse impacts on ancient woodlands, adjacent to the Proposed Scheme, are likely to comprise of the repeated pruning of branches to maintain sightlines.

6.5.37 No significant effects on notable habitat adjacent to the Proposed Scheme are anticipated as a result of the operation of the Proposed Scheme.

6.6 Design, mitigation and enhancement measures

6.6.1 As noted above, the Proposed Scheme would not give rise to significant effects upon designated sites, habitats or species. Nevertheless, a series of further surveys and measures are to be undertaken to minimise further the potential for adverse effects upon biodiversity. In addition, enhancement measures are to be taken that contribute towards the Highways England biodiversity objectives.

6.6.2 While the OEMP provides details of timing and location of specific biodiversity measures to be undertaken, (see Table 6.10) which provides an overview of these measures. The following proposed additional surveys are recommended to be undertaken preconstruction:

- **Otter and water vole surveys** - sections of watercourse that access couldn't be granted in 2018;
- **Great creasted newts -** (eDNA on 22 ponds not accessed 2018) population assessments on waterbodies tested positive for GCN; and
- **Bat survey** – Potential Bat Roost Assessment (PBRAs) on 5 bridges that could not be accessed in 2018, and any trees to be affected within the soft estate.
- **Badger surveys** – inspection of soft estate to be undertaken within the highway boundary covering all the soft estate where habitat removal is proposed, to account for any badger setts that may be present.
- **Invasive species** – the soft estate to be inspected for invasive plants where works are proposed prior to construction, within the soft estate of the highway boundary.

Table 6.10 - Design, mitigation and enhancement measures

Receptors	Measures	Rationale
International sites		
Eversden and Wimpole Woods SAC, Lee Valley SPA, Lee Valley Ramsar	• No design, mitigation or enhancement measures required.	The sites are sufficiently distant from the Proposed Scheme that no impacts/effects would arise.
National sites		
Knebworth Woods SSSI, Sherrardspark Wood SSSI	• Habitat enhancement measures, for example replanting, installation of nesting/breeding sites and other features to improve conditions of habitats.	To improve the quality of habitats present within nearby national sites and to improve their ability to support local populations of protected species.
Local sites		
Margaret's Wood & Spoil Bank Wood, Todds Green LWS; Fishers Green Wood LWS; Knebworth Park LWS; Sandybottom Wood East LWS; Ninning's Wood LWS; Mardley Heath LWS; Danesbury Park LWS; Grassland E. of Danesbury Hospital LWS; Legs and Stockings Wood LWS; Old North Road & Central Reservation, Lockleys LWS; Brocket Park North LWS; Ayot Greenway LWS; Homer's Wood LWS; Wagon and Horses Pond, Ayot Green LWS.	• Major earthworks adjacent to these designated sites will be avoided as far as is practicable and a buffer zone will be put in place supported by standard pollution prevention measures which will include silt barriers where necessary. • Woodland areas where required will be protected according to British Standard (BS) 5837:2012 *Trees in relation to design, demolition and construction* to prevent damage to tree roots and stems during works.	No works would occur within the boundaries of these sites, but note 14 sites lie immediately adjacent to the Proposed Scheme.

Receptors	Measures	Rationale
Notable habitats		
Semi-improved grassland, lowland mixed deciduous woodland, hedgerows, ponds, rivers	• In view of the nature of the proposed works it is anticipated that the area of semi-improved neutral grassland to be lost during construction will be very limited and it will be possible to re-instate this habitat post-construction. • Areas of lowland mixed deciduous woodland that require removal will be replanted post-construction as far as practicable. • The short lengths of hedgerow that require removal will be replanted post-construction. • Pollution prevention measures would be implemented through the CEMP.	To replace habitats temporarily lost, and to prevent pollution occurring to waterbodies within the vicinity of construction works.
Other habitats		
Ancient woodland	• Woodland areas where required will be protected according to BS 5837:2012 *Trees in relation to design, demolition and construction* to prevent damage to tree roots and stems during works. This mitigation is likely to include the activities, provided they do not pose a health and safety risk: ○ Tree protection fencing to delineate a working area and create a construction exclusion zone to the rear of the fencing; ○ The use of ground protection measures to prevent soil compaction and root damage; and ○ A methodology of work which ensures that impacts to roots and soil associated with excavation are minimised. • Buffer zones for earthworks within 15m of ancient woodland would be established[68]. • A walkover tree survey, in accordance with BS5837: 2012, should be conducted for woodland edge trees prior to construction. The purpose of the survey shall be to confirm the absence of substantive trees and to identify a more generalised root protection area for smaller, low value trees which may be effected by the Proposed Scheme works. Following completion of the walkover survey in accordance with BS 5837: 2012, an arboricultural method statement for the protection of trees and a tree protection plan shall be produced. These documents shall specify all relevant tree protection measures the purpose of which shall be to limit adverse impacts to woodland edge trees.	To ensure the continued protection of ancient woodland.

[68] Natural England and the Forestry Commission's standing advice for planning authorities is that a minimum buffer of 15 metres should be maintained between ancient woodland and development hhttps://www.gov.uk.guidance/ancient-woodland-and-veteran-trees-protection-surveys-licences

Receptors	Measures	Rationale
Other habitats	• Loss of notable habitat will be minimised. • Habitat will be re-planted or left to recolonise naturally. • Planting plans will be designed to compensate for the floristic and structural diversity of the habitats lost during construction, which on maturity will provide a greater area of valuable habitat than that lost. • creation of dense aggregations of floristically interesting herbaceous layers would contribute to the National Pollinator Strategy[69]. • Wildflower grassland to be sown on low nutrient soils. • Retained habitats outside of the construction footprint would be protected and provisions of compensation habitat within the soft estate supplied prior to construction where practicable.	To replace habitats temporarily or permanently lost to the Proposed Scheme, and to contribute to Highways England's biodiversity objectives.
Protected species		
Great crested newts	• It is considered likely that habitat clearance, as proposed within the OEMP, would be carried out under a scheme-wide development licence. • Should access be afforded, an eDNA survey of the 22 waterbodies that weren't surveyed in 2018 will be undertaken in the appropriate season pre-construction. • In addition, further survey work is proposed on the 6tene ponds testing "positive" for great crested newt presence, to obtain population estimates to inform a EPS Licence (if required). • All habitat clearance would be carried out between March and October following a method statement under a scheme-wide licence for great crested newt, dependent on results of surveys. This would include Tool Box Talks for site contractors, ecological watching briefs where required and hand searches for species by an ecologist prior to clearance.	To minimise the risk of killing and injury to individual great crested newts and maintain the favourable conservation status of local great crested newt populations.
Bats	• Updated survey work (preliminary roost assessments) should be carried out in the next survey season to inform the CEMP, which will include surveys of 5 structures that will be affected by construction activities and any trees which will be removed during construction to ensure appropriate measures are taken if any roosting bats are found. This may include construction works being completed under a Precautionary Method of Working (PMW) or protected species licence method statement.	To maintain the favourable conservation status of local bat populations.

[69] Defra (2014) The National Pollinator Strategy: for bees and other pollinators in England. Available from: www.gov.uk/government/publications.

Receptors	Measures	Rationale
	• Should roosting bats be recorded, appropriate measures would be taken to ensure that no disturbance to bats takes place (for example, use of acoustic barriers can provide additional screening to roosts, particularly at locations where noise level increases during construction works are predicted). If impacts cannot be avoided, works would take place under a protected species licence method statement. • An endoscope inspection of trees with potential for bat roosts prior to pruning or felling. Appropriate managed soft-felling of trees identified as offering suitability to support roosting bats, to allow undiscovered bats to escape if at all present. • Appropriate, directional lighting used during any night time construction works would minimise light spill into surrounding habitats, including underbridges that are likely to be used by commuting bats. This would also reduce any temporary impacts on bat foraging/commuting routes within land adjacent to the Proposed Scheme. • Where possible, a buffer strip of vegetation would be retained at the highway boundary fence to prevent light spill and minimise potential short-term/temporary interruption of bat foraging/commuting routes within land adjacent to the Proposed Scheme, due to temporary night-time construction lighting. These measures outlined above will be included within the OEMP.	
Badger	• Checks will be undertaken prior to vegetation clearance/pre-construction works. • Measures to prevent badgers becoming trapped in any pits, piping, chemical containers or wire mesh would be undertaken. • Disturbance or closure of a sett would only be undertaken under Natural England Development licence and would require fitting exclusion fencing and a one way exclusion gate and an exclusion period of a minimum of 21 days (between July and November).	To maintain the favourable conservation status of local badger populations.
Otter and water vole	• Measures to protect riparian habitat and watercourses from disturbance and pollution would be put in place. • Avoidance of lighting affecting habitat used by otter.	To maintain the favourable conservation status of local otter and water vole populations.
Reptiles	• A qualified ecologist would supervise vegetation clearance in areas potentially supporting reptiles during March to September.	To maintain the favourable conservation status of local reptile populations.

Receptors	Measures	Rationale
	• Retained habitat outside the construction area will be protected and where necessary and appropriate, enhanced with log/brash piles to ensure that this habitat can support the low numbers of reptiles anticipated to be displaced by construction. • Creation of “open areas” on south facing slopes for basking areas.	
Breeding birds	• Clearance of suitable breeding habitat during breeding bird season would be completed under a watching brief.	To maintain the favourable conservation status of local breeding bird populations.
Schedule 9 invasive plant species	• Although no invasive plant species have been recorded to date within the Proposed Scheme footprint, checks will be undertaken prior to vegetation clearance/pre-construction works. • Non-native invasive species would be subject to avoidance measures within a written method statement.	To prevent the spread of Schedule 9 invasive plant species.

6.6.3 Standard good practices, as the CIRIA Environmental Good Practice on Site Guidelines[70], would be implemented during the construction phase to minimise harm to ecological receptors and avoid impacts on the favourable conservation status of species and habitats. These measures detailed in the OEMP include:

- Standard measures to prevent potential pollution risks (water, dust, noise) particularly at sites of nature conservation value and ancient woodland;
- Site clearance would be carried out at appropriate times of the year to minimise risks to notable and/or legally protected species in accordance with a written method statement such as a PMW or protected species licence method statement (as required);
- All excavations left open overnight would include measures to prevent mammals becoming trapped (ramped sides or wooden planks). All excavations would be checked for animals prior to infilling; and
- Appropriate storage of materials, equipment and machinery ensuring vehicles are kept off retained habitats in the soft estate.

6.6.4 The planning strategy including the grassland species mixes, appropriate to functional design requirements (e.g. high maintenance visibility splays as opposed to species rich areas), will be specified at PCF Stage 5 as part of the detailed design process. In addition, the following specific areas have been identified for ecological enhancement measures:

- Knebworth Woods SSSI; and
- Sherrardspark Wood SSSI

6.7 Residual effects

6.7.1 No significant residual effects on designated sites, notable habitats (trees and hedgerows) or notable and/or legally protected species are anticipated as a result of the Proposed Scheme.

[70] Charles, P, Edwards, P (eds). 2015. CIRIA *Environmental Good Practice on Site Guidelines*

7. Landscape and Cultural Heritage

Key features for this topic:

- The local landscape is well vegetated and the motorway is well integrated;
- There are no nationally designated landscapes in the study area;
- There are no locally designated landscapes in the study area;
- No landscape character areas will be adversely affected;
- Landscape and visual effects at construction, year 1 and year 15 would be **neutral to slight adverse** with the exception of a single **moderate adverse** visual effect to recreational and residential receptors at Norton Green;
- Enhancement opportunities have been identified within the north of the Proposed Scheme to the east of Graveley;
- During construction, there would be temporary **slight adverse** effects on the setting of Dicket Mead Roman Villa Scheduled Monument, Grade II* Registered Knebworth Park and Garden, Grade II Registered Homewood Park and Garden, Grade II* The Dairy at Stebbing Farm, The Old Farmhouse Stebbing Farm and Tudor House at Stebbing Farm, and the Grade II Thatched Cottage; and
- During operation, there would be **slight adverse** effects on the setting of the Grade II* Registered Knebworth Park and Garden and Grade II Registered Homewood Park and Garden.

7.1 Introduction

7.1.1 This chapter considers effects on landscape, visual amenity and the setting of cultural heritage assets that would result from the construction and operation of the Proposed Scheme, including vegetation clearance, and the introduction of new highways infrastructure. The findings are set out in this chapter with further information provided on Figure 7.1 and in the Landscape, visual effects schedule found in Appendix 7.1.

7.1.2 The Proposed Scheme passes through low level plateaus and valleys, supporting predominantly arable farmland and urban fringe land uses, interspersed with numerous blocks of woodland.

7.1.3 This chapter provides a landscape and visual assessment to address the following key landscape and visual receptors:

- The landscape setting of 1 potentially susceptible landscape character area (LCA) (LCA 208 Knebworth Parkland);
- Views from residential property locations most likely to be susceptible to a change in view as a result of the Proposed Scheme. In particular Welwyn, Oaklands and the western fringes of Stevenage;
- Views from residential properties within 100m of the highway boundary;
- Views from Public Rights of Way (PRoW) within 50m of the highway boundary; and
- Potential impacts on the landscape setting of designated cultural heritage assets identified for further assessment within the cultural heritage section of the Environmental Scoping Report.

7.1.4 The supporting appendices are:

- Appendix 7.1 - Visual Effects Schedule.

7.1.5 Supporting plans include:

- Figure 7.1 – Landscape character and visual receptor plan (1-13)
- Figure 7.2 – Viewpoint photographs

7.1.6 The professional competency of the topic lead for this chapter is detailed in Appendix 1.1. This information is provided to fulfil the requirement of EU Directive 2014/52/EU.

7.2 Scoping

7.2.1 The assessment has been undertaken in accordance with the conclusions of the Environmental Scoping Report[71] and thus there has been no change to its findings that the Proposed Scheme would not have significant effects on designated landscape receptors or landscape character. This follows a review of the proposals at DF2 to confirm this assessment, which, with the exception of potential impacts on landscape character area (LCA) 208 Knebworth Parkland, confirms that the remainder have been scoped out of this assessment.

7.2.2 The Environmental Scoping Report concluded that that the Proposed Scheme would have the potential to cause significant effects on visual receptors and the setting of cultural heritage assets. Highly sensitive receptors may have views of parts of the Proposed Scheme because of the loss of existing mature vegetation during construction and the installation of smart motorway all lane running infrastructure, specifically gantries and emergency areas.

7.2.3 Receptors identified within the Environmental Scoping Report were reviewed and confirmed on site with others added or removed as necessary to ensure a representative range of visual effects within the assessment. Table 7.1 lists receptors that were added or removed from the list presented in the Environmental Scoping Report. PRoW 1 has been excluded because the site visit indicated that views of the Proposed Scheme would be screened by intervening vegetation. The viewpoints that are considered to be of high sensitivity and where the view is potentially susceptible to change are presented in Table 7.9 and on Figure 7.1.

[71] MP0135-HEX-EGN-ZZ_AS-KK-0001

Table 7.1 - Change to potentially susceptible receptors recorded in the Environmental Scoping Report

Id	Location	Observation	Additional /Scoped Out
Residential receptors and recreational users			
PSVR1.1	Node Way Gardens, Welwyn	Small cluster of suburban edge residential properties south west of Junction 6 northbound slip off (northbound side).	**Scoped in** – this additional receptor was added following the review of the latest developed design which has been advanced from Design Fix 2 (DF2).
PSVR3.1	Great North Road, Oaklands	Residential properties located adjacent the eastern southbound edge of the motorway (approximately 1.3km north of Junction 6).	**Scoped in** – this additional receptor was added following the review of the latest developed design which has been advanced from DF2.
PSVR3.2	The Avenue, Oaklands	Residential property located along The Avenue, Oaklands, adjacent the eastern southbound edge of the motorway (approximately 500m north of Junction 6).	**Scoped in** – this additional receptor was added following the review of the latest developed design which has been advanced from DF2.
PSVR4.1	Cannonsfield Road	Small cluster of suburban residential properties located off Cannonsfield Road and adjacent to the eastern southbound edge of the A1(M) (approximately 2km north of Junction 6)	**Scoped in** – this additional receptor was added following the review of the latest developed design which has been advanced from DF2. Specifically, a new noise barrier is proposed at this location.
PSVR5.1	The Crest and The Avenue, Oaklands	Small cluster of suburban residential properties located to the eastern extent of the Crest and The Avenue, adjacent the western northbound edge of the A1(M) (approximately 1.6km north of Junction 6)	**Scoped in** – this additional receptor was added following the review of the latest developed design which has been advanced from DF2.
PSVR6	Danesbury Park Homes, Oaklands	Small cluster of rural residential properties (static caravans) located approximately 4.7km south of Junction 7 (northbound side).	**Scoped in** – this additional receptor was added following the review of the latest developed design which has been advanced from DF2. Specifically, a new noise barrier is proposed at this location.
PSVR7.1	Park Wood	Park Wood residential cottage and semi-natural woodland located on the southern side of Park Lane, Old Knebworth, adjacent the western northbound edge of the A1(M), approximately 2.45km south of Junction 7 (northbound).	**Scoped in** – this additional receptor was added following the review of the latest developed design which has been advanced from DF2.

Id	Location	Observation	Additional /Scoped Out
PSVR9.1	Open Access Land (Symonds Green) and the Crooked Billet Pub	Registered Common Land located between Symonds Green Lane and Clovelly Way, Symonds Green, approximately 700m east of the A1(M) boundary (southbound), and a commercial property - the 'Crooked Billet' pub.	**Scoped in** – this additional receptor was added following the review of the latest developed design which has been advanced from DF2.
PSVR9.2	Minehead Way, Symonds Green	Clusters of residential housing groups along Minehead Way, Symonds Green, located adjacent the eastern southbound edge of the A1(M), approximately 2.9km north of Junction 7.	**Scoped in** – this additional receptor was added following the review of the latest developed design which has been advanced from DF2.
PSVR9.3	Brighton Way, Symonds Green	Cluster of residential properties along Brighton Way, located adjacent the eastern southbound edge of the A1(M), approximately 3km north of Junction 7.	**Scoped in** – this additional receptor was added following the review of the latest developed design which has been advanced from DF2.
PSVR10.1	Kessingland Avenue, Fishers Green North	Cluster of residential properties located along Kessingland Avenue, Symonds Green, adjacent the eastern southbound edge of the A1, approximately 550m south of Junction 8 (southbound).	**Scoped in** – this additional receptor was added following the review of the latest developed design which has been advanced from DF2.
Public Rights of Way			
PRoW1	Local PRoW (B197 to Harmer Green Lane)	PRoW running parallel to the boundary of the A1(M) for approximately 320m, located 500m north of Junction 6 (southbound slip off).	**Scoped out** - due to presence of existing roadside planting and infrastructure proposed north of the B197
PRoW7.1	Local PRoW (PRoW 34a and Symonds Green Open Access Land)	PRoW running between perpendicular to the A1(M) (northbound), approximately 1.9km south of Junction 8, and in parallel to the A1(M) for approximately 90m (southbound) before connecting to Symonds Green Open Access land.	**Scoped in** – this PRoW was added following the review of the latest developed design which has been advanced from DF2.
PRoW10	NCR 12 (Old Knebworth Lane)	Sustrans National Cycle Route that follows Old Knebworth Lane and passes beneath the A1(M) at chainage 8600	**Scoped in** – this was an additional recreational route not identified in Scoping exercise.

7.2.4 The assessment of effects on the setting of designated heritage assets is restricted to the assets listed within Section 7.6.12 and in Table 7.8 of the Environmental Scoping Report. The scoping in of these assets was confirmed by a site visit. However, the following asset was removed from further consideration as, due to the distance, topography and location of existing dense vegetation between the asset and the motorway, there would be no change or impact on its setting:

- Scheduled Monument: Lockleys Roman Villa (NHLE 1015581).

7.2.5 Following the site visit, the assets listed below were scoped in for assessment as potential risks to their setting were identified:

- Grade II Listed: Thatched Cottage (NHLE 1347466); and
- Grade II* Listed: The Dairy, the Old Farmhouse and the Tudor House at Stebbing Farm (NHLE 1175952).

7.2.6 The location of assets scoped into the assessment is shown on Figure 7.1, and Table 7.11 presents those cultural heritage assets for which an assessment has been undertaken.

7.2.7 The following aspects have been scoped out of the assessment:

- Historic assets between 300m and 1km from the Proposed Scheme were assessed for exceptional sensitivity (such as long-range historic views) during the scoping study, with none identified. Therefore, assets between 300m and 1km from the Proposed Scheme have been scoped out of further assessment;
- Non-designated heritage assets were scoped out of this assessment during the scoping exercise due to the limited protection of their historic views and setting, and the nature of the works within an existing context of an operational motorway;
- A Zone of Visual Influence (ZVI) has been scoped out due to the scattered nature of the proposed interventions and the localised effects which these interventions may give rise and be limited to; and
- Night-time surveys or assessment have been scoped out as there are no significant changes to the lighting regime along the Proposed Scheme length and as a result lighting will not give rise to a significant adverse effect.

7.3 Methodology

7.3.1 This section summarises the following:

- The study area;
- Legislation, policy and guidance;
- Baseline information and data sources;
- Landscape and visual amenity assessment criteria;
  - Valuing receptors;
  - Magnitude of impacts
  - Significance of effects
- Heritage asset setting assessment criteria;
  - Valuing receptors;
  - Magnitude of impacts;
  - Significance of effects;
- Stakeholder engagement; and
- Assumptions and limitations.

Study area

Landscape and visual

7.3.2 The study area for the landscape and visual assessment is based on a 1km offset from the Proposed Scheme highway boundary, as identified within the Environmental Scoping Report, within which locations where changes as a result of construction or operation may be experienced. As visual effects would be generated within the existing highway boundary and would largely be experienced by receptors located within 300m of the motorway, any visual effects beyond this, are considered negligible.

Cultural heritage

7.3.3 The study area for cultural heritage assets is based on a 300m offset from the Proposed Scheme as set out in the Environmental Scoping Report.

Legislation, policy and guidance

Landscape and visual

7.3.4 Given that this assessment is looking at minor alterations to a section of existing, established motorway corridor and the Proposed Scheme is anticipated not to give rise to significant effects, the assessment has been carried out broadly in accordance with a Simple Assessment, as set out within Interim Advice Note (IAN) 135/10: Landscape and Visual Effects Assessment. The assessment also takes account of Guidelines for Landscape and Visual Impact Assessment (GLVIA) 3rd Edition (Landscape Institute and Institute of Environmental Management and Assessment, 2013).

Cultural heritage

7.3.5 The assessment methodology uses guidance set out in DMRB, Volume 11, Section 3, Part 2 (HA 208/07). The value and magnitude of impact on heritage assets will be judged in accordance with the factors described in Annexes 5, 6 and 7.

Baseline information and data sources

7.3.6 Data sources used in this assessment comprise:

- Natural England National Character Area (NCA) profiles;
- Ordnance Survey – 1:50,000 and 1:25,000 scale maps;
- Google Earth and Street View;
- Highways England A1(M) J6 – J8 Environmental Scoping Report, May 2018 (MP0135-HEX-EGN-ZZ_AS-KK-0001);
- Aerial photography to determine the likely structure and integrity of existing vegetation within and outside the boundaries of the road corridor;
- National Heritage List for heritage designations, including World Heritage Sites, Listed Buildings, Scheduled Monuments and Conservation Areas, Registered Battlefields and Registered Parks and Gardens[72];
- The Setting of Heritage Assets, Historic Environment Good Practice Advice in Planning[73];
- Highways England Smart Motorways Programme Portal;
- Defra magic maps (https://magic.defra.gov.uk/), accessed January 2019.
- Welwyn Hatfield District Plan; and
- Stevenage District Plan.

7.3.7 The character of the landscape within 1km of the Proposed Scheme has been studied at the local scale. Local landscape character areas (LCA) have been identified from the following landscape character assessments:

- Hertfordshire County Council (2000-2005) Landscape Character Assessment; and
- North Hertfordshire District Council (2011) North Herts Landscape Study.

[72] https://www.historicengland.org.uk/listing/the-list/data-downloads
[73] https://historicengland.org.uk/images-books/publications/gpa3-setting-of-heritage-assets/

7.3.8 Up to date Conservation Area designations have been reviewed, these include:

- Ayot Green Conservation Area.

7.3.9 Site visits were made in October 2018 to carry out the landscape and visual assessment from publicly accessible areas. In October 2018 deciduous vegetation was in leaf. Therefore, consideration of visual effects during winter months in the absence of leaf cover has been based on professional judgement, in line with best practice.

7.3.10 In accordance with a Simple Assessment and to make the assessment proportionate to the Proposed Scheme, visual effects have been considered in broad terms. Specific and representative viewpoints have been selected and assessed to illustrate the visual effects from a range of visual receptors surrounding the Proposed Scheme. These encompass the majority, and occasionally expand upon, the receptors identified within the Environmental Scoping Report, those scoped out have been identified in Section 7.2.3 above.

7.3.11 Visual amenity and heritage setting effects have been assessed from publicly accessible vantage points at specific scoped in receptors and from key representative viewpoints for more general views. Where access to the viewpoint was not possible, i.e. residential properties, the existing view and likely visual effects were determined by using professional judgement and comparison to views from nearby accessible locations, together with the use of aerial photography. All site assessment work has been undertaken at ground level and on foot and any descriptions of views from first floor windows have been assumed using professional judgement.

Landscape and visual assessment criteria

Valuing receptors

7.3.12 The criteria which determines the sensitivity of identified landscape and visual receptors are set out in Table 7.2 below.

Table 7.2 - Landscape and visual sensitivity criteria[74]

Sensitivity	Landscape - typical criteria descriptors	Visual – typical criteria descriptors
High	Landscapes which by nature of their character would be unable to accommodate change of the type proposed. Typically, these would be: • Of high quality with distinctive elements and features making a positive contribution to character and sense of place. • Likely to be designated, but the aspects which underpin such value may also be present outside designated areas, especially at the local scale. • Areas of special recognised value through use, perception or historic and cultural associations. • Likely to contain features and elements that are rare and could not be replaced.	Residential properties. Users of Public Rights of Way or other recreational trails (such as National Trails, footpaths, bridleways etc.). Users of recreational facilities where the purpose of that recreation is enjoyment of the countryside (such as Country Parks, National Trust or other access land etc.)
Medium	Landscapes which by nature of their character would be able to partly accommodate change of the type proposed. Typically, these would be: • Comprised of commonplace elements and features creating generally unremarkable character but with some sense of place. • Locally designated, or their value may be expressed through non-statutory local publications. • Containing some features of value through use, perception or historic and cultural associations. • Likely to contain some features and elements that could not be replaced.	Outdoor workers. Users of scenic roads, railways or waterways or users of designated tourist routes. Schools and other institutional buildings, and their outdoor areas.
Low	Landscapes which by nature of their character would be able to accommodate change of the type proposed. Typically, these would be: • Comprised of some features and elements that are discordant, derelict or in decline, resulting in indistinct character with little or no sense of place. • Not designated. • Containing few, if any, features of value through use, perception or historic and cultural associations. • Likely to contain few, if any, features and elements that could not be replaced.	Indoor workers. Users of main roads (such as trunk roads) or passengers in public transport on main arterial routes. Users of recreational facilities where the purpose of that recreation is not related to the view (such as sports facilities).

[74] Landscape and Visual Sensitivity Criteria derived from IAN 135/10.

Magnitude of Impact

7.3.13 The magnitude of impact experienced by landscape receptors relates to the degree of change that would be caused by the Proposed Scheme. Factors taken into consideration include the scale, duration and nature of potential changes present at each assessment point and the effectiveness of mitigation measures. Definitions relating to the magnitude of landscape impact are defined in Table 7.3 and IAN 135/10.

Table 7.3 - Magnitude of impact landscape criteria[75]

Magnitude of Impact	Typical Criteria Descriptions
Major	**Adverse** - total loss or large scale damage to existing character or distinctive features and elements, and/or the addition of new but uncharacteristic conspicuous features and elements. **Beneficial** - large scale improvement of character by the restoration of features and elements, and/or the removal of uncharacteristic and conspicuous features and elements, or by the addition of new distinctive features.
Moderate	**Adverse** - partial loss or noticeable damage to existing character or distinctive features and elements, and/or the addition of new but uncharacteristic noticeable features and elements. **Beneficial** - partial or noticeable improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic and noticeable features and elements, or by the addition of new characteristic features.
Minor	**Adverse** - slight loss or damage to existing character or features and elements, and/or the addition of new but uncharacteristic features and elements. **Beneficial** - slight improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic features and elements, or by the addition of new characteristic elements.
Negligible	**Adverse** - barely noticeable loss or damage to existing character or features and elements, and/or the addition of new but uncharacteristic features and elements. **Beneficial** - barely noticeable improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic features and elements, or by the addition of new characteristic elements.
No change	No noticeable loss, damage or alteration to character or features or elements.

7.3.14 The scale, type and duration of impact which the Proposed Scheme would bring to key representative viewpoints have been assessed in outline terms in accordance with Simple Assessment. The criteria defined in Table 7.4. have been used to define the magnitude of visual impact within this assessment.

[75] Magnitude of Impact Landscape Criteria derived from IAN135/10.

Table 7.4 - Magnitude of impact visual criteria[76]

Magnitude of impact	Typical criteria descriptors
Major	The Proposed Scheme, or a part of it, would become the dominant feature or focal point of the view.
Moderate	The Proposed Scheme, or a part of it, would form a noticeable feature or element of the view which is readily apparent to the receptor.
Minor	The Proposed Scheme, or a part of it, would be perceptible but not alter the overall balance of features and elements that comprise the existing view.
Negligible	Only a very small part of the Proposed Scheme would be discernible, or it is at such a distance that it would form a barely noticeable feature or element of the view.
No change	No part of the Proposed Scheme, or work or activity associated with it, is discernible.

Significance of effect

7.3.15 The significance of landscape and visual effects is a function of sensitivity and magnitude of impact and has been determined as set out in Table 7.5.

7.3.16 Moderate, large or very large significance of effect values are considered to be significant and are arrived at using the Table 7.5 below as a guide and balanced using professional judgement.

Table 7.5 - Significance of effect for landscape and visual receptors[77]

Landscape/Visual Sensitivity	Magnitude of Impact				
	No change	**Negligible**	**Minor**	**Moderate**	**Major**
Very High	Neutral	Slight	Moderate/ Large	Large/ Very Large	Very Large
High	Neutral	Slight	Moderate/ Slight	Moderate/ Large	Large/ Very Large
Medium	Neutral	Neutral/ Slight	Slight	Moderate	Moderate/ Large
Low	Neutral	Neutral/ Slight	Neutral/ Slight	Slight	Slight/Moderate
Negligible	Neutral	Neutral	Neutral/ Slight	Neutral/ Slight	Slight

7.3.17 The assessment schedule in Appendix 7.1 records and describes each assessed landscape area and key viewpoints in terms of sensitivity and the predicted impact and effect of the Proposed Scheme at construction, operation Year 1 and future Year 15.

Heritage asset setting assessment criteria

7.3.18 The National Planning Policy Framework (NPPF) defines significance of heritage assets as *"The value of a heritage asset to this and future generations because of its heritage interest*." (Annex 2 Glossary). In addition, the NPPF sets out criteria which should be considered when assessing the significance of heritage assets, which include archaeological, architectural, artistic and historic values. These criteria have therefore been used in the assessment of significance for each affected asset. This information, in conjunction with professional judgement, is used to assess the significance of heritage assets.

[76] Magnitude of Impact Visual Criteria derived from IAN135/10.
[77] Significance of Landscape and Visual Effect Categories derived from Guidelines for Landscape and Visual Impact Assessment Third edition (GLVIA3 April 2013).

Valuing receptors

7.3.19 The criteria outlined in Table 7.6 have been used to define the value of potentially affected assets in line with Tables 5.1 (Annex 5), 6.1 (Annex 6) and 7.1 (Annex 7) in DMRB Volume 11, Section 3 Part 2 (HA 208/07).

Table 7.6 - Value of heritage assets criteria

Value	Archaeological assets	Historic buildings	Historic landscape character
Very High	World Heritage Sites (including nominated sites). Assets of acknowledged international importance. Assets that can contribute significantly to acknowledged international research objectives.	Structures inscribed as of universal importance as World Heritage Sites. Other buildings of recognised international importance.	World Heritage Sites inscribed for their historic landscape qualities. Historic landscapes of international value, whether designated or not. Extremely well preserved historic landscapes with exceptional coherence, time-depth, or other critical factor(s).
High	Scheduled Monuments (including proposed sites). Undesignated assets of schedulable quality and importance. Assets that can contribute significantly to acknowledged national research objectives.	Scheduled Monuments with standing remains. Grade I and Grade II* Listed Buildings. Other listed buildings that can be shown to have exceptional qualities in their fabric or historical associations not adequately reflected in the listing grade. Conservation areas containing very important buildings. Undesignated structures of clear national importance	Designated historic landscapes of outstanding interest. Undesignated landscapes of outstanding interest. Undesignated landscapes of high quality and importance, and of demonstrable national value. Well preserved historic landscapes, exhibiting considerable coherence, time-depth or other critical factor(s).
Medium	Designated or undesignated assets that contribute to regional research objectives.	Grade II Listed Buildings. Historic (unlisted) buildings that can be shown to have exceptional qualities in their fabric or historical associations. Conservation areas containing buildings that contribute significantly to its historic character. Historic Townscape or built-up areas with important historic integrity in their buildings, or built settings (e.g. including street furniture etc.).	Designated special historic landscapes. Undesignated historic landscapes that would justify special historic landscape designation, landscapes of regional value. Averagely well-preserved historic landscapes with reasonable coherence, time-depth or other critical factor(s).

Value	Archaeological assets	Historic buildings	Historic landscape character
Low	Designated and undesignated assets of local importance. Assets compromised by poor preservation and/or poor survival of contextual associations. Assets of limited value, but with potential to contribute to local research objectives.	'Locally Listed' buildings. Historic (unlisted) buildings of modest quality in their fabric or historical association. Historic Townscape or built-up areas of limited historic integrity in their buildings, or built settings (e.g. including street furniture etc.).	Robust undesignated historic landscapes. Historic landscapes with importance to local interest groups. Historic landscapes whose value is limited by poor preservation and/or poor survival of contextual associations.
Negligible	Assets with very little or no surviving archaeological interest.	Buildings of no architectural or historical note; buildings of an intrusive character.	Landscapes with little or no significant historical interest.
Unknown	The importance of the resource has not been ascertained.	Buildings with some hidden (i.e. inaccessible) potential for historic significance.	Not applicable.

Magnitude of impact

7.3.20 The criteria outlined in Table 7.7 have been used to define the magnitude of impact to potentially affected assets in line with Table 5.3 (Annex 5), Table 6.3 (Annex 6) and Table 7.3 (Annex 7) in DMRB Volume 11, Section 3 Part 2 (HA 208/07).

Table 7.7 - Magnitude of impact heritage assets criteria

Magnitude	Archaeological Assets	Historic Buildings	Historic landscape character
Major	Change to most or all key archaeological materials, such that the resource is totally altered. Comprehensive changes to setting.	Change to key historic building elements, such that the resource is totally altered. Comprehensive changes to the setting.	Change to most or all key historic landscape elements, parcels or components; extreme visual effects; gross change of noise or change to sound quality; fundamental changes to use or access; resulting in total change to historic landscape character unit.
Moderate	Changes to many key archaeological materials, such that the resource is clearly modified. Considerable changes to setting that affect the character of the asset.	Change to many key historic building elements, such that the resource is significantly modified. Changes to the setting of an historic building, such that it is significantly modified.	Changes to many key historic landscape elements, parcels or components, visual change to many key aspects of the historic landscape, noticeable differences in noise or sound quality, considerable changes to use or access; resulting in moderate changes to historic landscape character.
Minor	Changes to key archaeological materials, such that the asset is slightly altered. Slight changes to setting.	Change to key historic building elements, such that the asset is slightly different. Change to setting of an historic building, such that it is noticeably changed.	Changes to few key historic landscape elements, parcels or components, slight visual changes to few key aspects of historic landscape, limited changes to noise levels or sound quality; slight changes to use or access: resulting in limited changes to historic landscape character.

Magnitude	Archaeological Assets	Historic Buildings	Historic landscape character
Negligible	Very minor changes to archaeological materials, or setting.	Slight changes to historic buildings elements or setting that hardly affect it.	Very minor changes to key historic landscape elements, parcels or components, virtually unchanged visual effects, very slight changes in noise levels or sound quality; very slight changes to use or access; resulting in a very small change to historic landscape character
No change	No change.	No change to fabric or setting.	No change to elements, parcels or components; no visual or audible changes; no changes arising from in amenity or community factors.

Significance of effect

7.3.21 Assessment of significance of effects on heritage assets follows a similar matrix-based approach to reach a value for significance of effect as shown in Table 7.5 above. The approach is based upon the guidance provided in DMRB Volume 11 Section 3 Part 2 (HA 208/07), Good Practice Note 3 –The Setting of Heritage Assets[78] and professional judgement. A detailed description of the historic asset setting and impacts on it are found in Table 7.11.

7.3.22 Where a choice of 2 impact significance descriptors is available, only one should be chosen. This allows for professional judgement and discrimination in assessing impacts. This approach is based on the author's professional judgement and is in line with DMRB methodology.

Stakeholder engagement

7.3.23 Discussions have been undertaken with the following stakeholders:

- Discussions have been undertaken with Kier Highways with regard to potential enhancement measures within the A1(M) corridor; and
- Historic England (introductory email sent on 8 November 2018 and response received 13 November 2018). The purpose of this engagement is to inform Historic England about the works and provide reassurance there will be no adverse impacts on the Scheduled Monument of the Roman Bath House which is buried beneath the highway. The location of the Scheduled Monument was identified early in the design process and no infrastructure will be located here. Measures to protect the site are include in the Outline Environmental Management Plant (OEMP).

Assumptions and limitations

Landscape and visual

7.3.24 The following assumptions and limitations are applicable for the assessment of landscape and visual effects during construction and operation of the Proposed Scheme:

- **Viewpoints:** Visual effects have been considered from specific and representative viewpoints so that the assessment is proportionate to the scale of the proposals. However, due to the built-up nature of the landscape surrounding the Proposed Scheme the assessment is limited to those viewpoints that represent groups of properties. Whilst not every visual receptor has been assessed on an individual basis, this recognised method illustrates a range of visual effects from a variety of highly sensitive viewpoints surrounding the Proposed Scheme;

[78] Historic England. (2015). Historic Environment Good Practice Advice in Planning; Note 3: The Setting of Heritage Assets.

- **Public Access:** Visual effects have been assessed from publicly accessible vantage points at key representative viewpoints. In some cases, notably individual private properties, close access to the viewpoint was not possible and this has limited the assessment. In these cases, the existing view and likely visual effects were determined from views towards the viewpoint from footpaths, footbridges and nearby local roads combined with the use of aerial photography and professional judgement. All site assessment work has been undertaken at ground level and on foot, therefore views from upper floors have not been fully assessed and have been based on professional judgement;
- **Site clearance:** Assumptions are based on the indicative areas required for infrastructure and working space detailed in Table 2.14, and are considered a worst case scenario (detailed vegetation clearance requirements will be developed during PCF Stage 5). In visually sensitive locations working methods will be specified in relation to site specific tree protection or remediation requirements.
- **Tree Survey:** A detailed tree survey has not been undertaken, therefore, the locations of trees that will be retained on the edge of vegetation clearance areas will be more accurately identified at the detailed design stage or through site consultation with an engineer to physically show the line of the works extents. This way an arboriculturist, or other appropriately qualified professional, can determine whether trees outside of the works footprint can be retained or require felling due to the threat of wind throw or because of tree root severance;
- **Noise barriers**: This assessment assumes that all existing noise barriers shown to be retained in the design would be retained in situ. Only local sections will be removed to facilitate construction and then replaced in situ. Temporary visual intrusion during construction and the extent of existing vegetation loss would likely result in a greater impact on sensitive receptors, if the barriers are not temporarily replaced;
- **Construction:** It has been assumed that general construction activity within the highway boundary would include the presence of construction machinery, vegetation removal (as illustrated at DF3) and installation/removal and replacement of screen fences/noise barriers, gantries and associated features. It has been assumed that noise barriers would be removed and replaced in a progressive operation and within a short timeframe. Where properties are within 100m, reference should be made to Chapter 8: Noise and Vibration. The location of the construction compounds, detailed treatment of verge slopes, detailed vegetation clearance plans and retaining structures within the working area were not known at the time of this assessment so cannot be fully assessed at this stage, therefore representing a limitation to the assessment; and
- **Replacement planting:** Where vegetation is cleared to facilitate construction, planting will be provided to replace that removed, except where this would compromise the safe operation of the highway e.g. sightlines for CCTV, forward visibility for motorists.
- **Geotechnical interventions:** For example, retaining walls, have yet to be finalised/agreed with the Highways England geotechnical team and therefore a worst case assumption has been made.

Cultural heritage

7.3.25 The following assumption and limitation is applicable for the assessment of heritage effects during construction and operation of the Proposed Scheme:

- **Data:** Information about the cultural heritage assets used to assess the value and interest is based on the information held on the National Heritage List and is assumed to be accurate.

7.4 Baseline conditions

7.4.1 This section describes the following baseline components:

- Landscape character;
- Historic environment;
- Existing vegetation;
- Visual amenity;
- Representative viewpoints; and
- Sensitivity of resource.

Landscape character

7.4.2 The landscape is not covered by any national or local designation.

7.4.3 The topography is gently undulating. The lowest land along the route of the Proposed Scheme study area is approximately 75m above ordnance datum (AOD) where the motorway crosses the River Mimram just north of Junction 6. The highest ground along the route is at 125m AOD some 2km north of Junction 6 near Ninning's Wood. At Homewood there is a low point of 105m AOD before the land rises up gradually again to 120m AOD at Lodge Farm. Another low point of 90m occurs around Knebworth Park and Junction 7. The land rises to around 115m AOD at Symonds Green and falls again to 90m AOD at Junction 8.

7.4.4 The surrounding topography consists of minor undulations which occasionally rise to form small hillocks, the most notable of which is the Almshoe plateau west of Stevenage. The latter is generally unwooded and therefore open in character whereas other summits are so well vegetated as to be far less noticeable.

7.4.5 The landscape to the west of the A1(M) is characterised by open farmland or woodland, interspersed with small scale settlement patterns in the north of the study area and larger urban areas in the south. To the east, urban influences are more apparent due to the presence of larger settlements at Stevenage, Knebworth and Oaklands. These consist of a range of built elements, including residential properties, commercial and industrial buildings. These areas are commonly set back or screened by fencing treatments or established belts of vegetation present within narrow verges.

7.4.6 The route passes through or immediately adjacent to 9 LCAs identified in the Hertfordshire County Council (2000-2005) Landscape Character Assessment. However, as stated in paragraph 7.1.3, only LCA 208 Knebworth Parkland is considered to be potentially susceptible to change, due to the Proposed Scheme (see Figure 7.1). The characteristics of this area, a description of the soft estate within the area and the landscape condition, value and importance of this LCA are summarised in Table 7.8.

7.4.7 The locations of the landscape areas, key representative viewpoints and cultural heritage assets are indicated on Figure 7.1 and Figure 7.2. All Highly Sensitive Receptors identified in the Environmental Scoping Report are also indicated for reference.

7.4.8 Refer to Chapter 10: Assessment of Combined and Cumulative Effects for identified development proposals that may result in potentially significant cumulative effects on landscape character.

Table 7.8 - Summary of landscape character

LCA	Description	Soft Estate	Value
LCA 208 Knebworth Parkland	The A1(M) forms the eastern boundary of the LCA adjacent to Junction 7 None of the key characteristics of the LCA have the potential to be significantly affected by the proposals A1(M) mainly at grade through the LCA. Much of the LCA is at a higher elevation than the A1(M) and visually separated from it by woodland	Well vegetated (linear belts of trees and shrubs and scattered trees). Some tree planting within the central reservation.	Partly designated for cultural heritage reasons. Good condition. High value and of local importance

Historic environment

7.4.9 The Environmental Scoping Report primarily considered 300m as the distance within which the setting of an asset was likely to be impacted. The Environmental Scoping Report identified the following cultural heritage assets whose setting could be potentially impacted by the Proposed Scheme:

- Scheduled Monument: Lockleys Roman Villa (NHLE 1015581);
- Scheduled Monument: Dicket Mead Roman Villa, include the museum under the A1(M) carriageways (NHLE 1015580);
- Grade II* Registered Park and Garden: Knebworth Park (NHLE 1000255); and
- Grade II Registered Park and Garden: Homewood (NHLE 1000911).

7.4.10 The walkover survey assessed all designated assets within the 300m study area. This resulted in a further two cultural heritage assets being scoped in for assessment as it was considered that their settings could be impacted by the Proposed Scheme:

- Grade II Listed: Thatched Cottage (NHLE 1347466); and
- Grade II* Listed: The Dairy, the Old Farmhouse and the Tudor House at Stebbing Farm (NHLE 1175952).

7.4.11 The walkover survey established that there would be no impacts on the setting of Lockley's Roman Villa (NHLE 1015581), and therefore this asset has subsequently been scoped out of further assessment. Table 7.11 presents the assets scoped into the assessment, and the location of each asset is shown on Figure 7.1.

7.4.12 Below-ground archaeology had been scoped out of further assessment as works, excluding the candidate construction compounds, are within the existing highways boundary which has previously been disturbed.

Existing vegetation

7.4.13 The southern part of the study area between Welwyn and Knebworth includes substantial blocks of mature vegetation, in the form of trees and shrubs and the A1(M) bisects a large block of mature woodland which includes Ninning's Wood and Aunt Wood. Watery Grove is another large woodland block abutting the western side of the motorway within the Knebworth Parkland LCA. Smaller woodland blocks in close proximity to the A1(M) include copses in Danesbury LCA and Park Wood within the Codicote Plateau LCA. North of Norton Green, west of Stevenage and the Almshoe Plateau, woodland cover is much less of a characterising feature in the local landscape.

7.4.14 The existing highway vegetation consists of linear belts of trees and shrubs which help to integrate the road into the surrounding landscape and provide screening to nearby receptors. Planting occurs either side of the carriageway for most of its length in the study area, but also within the central reservation adjacent to Watery Grove where scattered trees are present.

7.4.15 As a result of the maturity and extent of woodland and shrub planting along the motorway, views towards traffic and infrastructure along it are frequently screened from adjacent visual receptors and in these locations vegetation is achieving an effective screen and/or integrating the corridor within the wider landscape. Mitigation and enhancement proposals, taking into consideration of Highways England Licence and RIS environmental objectives, are documented in section 7.7 and the OEMP and Project Design Report.

7.4.16 Areas of ancient woodland have been identified in Appendix 2.1. There are 4 Tree Preservation Order Trees within the immediate vicinity of the Proposed Scheme. Four areas of ancient woodland exist within 15m of the Proposed Scheme, these include:

- Two large woodland blocks on both sides of the motorway in the southern extents of LCA 037 Datchworth Settled Slopes, which includes Ninning's Wood (including Legs and Stocking Wood);
- Watery Grove between Knebworth and Norton Green adjacent to the northbound carriageway; and
- Margarets Wood south west of junction 8 neat Todd's Green.

Visual Amenity

7.4.17 The motorway is bordered by residential areas at the edge of the settlements at:

- **Welwyn (east):** Node Gardens, Maran Avenue, Clockhouse Gardens and St John's Close adjacent to the west (northbound);
- **Oaklands:** immediately adjacent to both carriageways;
- **Knebworth:** some 100m from the southbound carriageway at its closest point; and
- **Stevenage:** immediately adjacent to the east (southbound).

7.4.18 Individual residential properties, hamlets and villages are located at:

- Lockley Farm;
- Pottersheath;
- Oaklands;
- Rableyheath;
- Park Lane overbridge between Knebworth and Old Knebworth (including Wood Cottage, Martlets, Lodge Farm and Homewood Lodge);
- Norton Green;
- Symonds Green;
- Fishers Green; and
- Todds Green.

7.4.19 The study area includes 10 Public Rights of Way's, and 1 recreational cycle route: NCR 12 (Old Knebworth Lane), refer to Table 7.1.

7.4.20 Notable blocks of woodland and linear tree belts integrate the motorway into the landscape and provide a strong sense of enclosure. There are relatively infrequent views to and from the carriageway within the highways estate due to the topography (including cuttings and embankments), landcover in the form of extensive belts of mature trees and shrubs, and orientation of the motorway. Views that do occur are as follows:

- LCA 133a Danesbury Settled Slopes, short range views adjacent to northbound carriageway (chainage CH3700) – Viewpoint R1;
- Long view for road users south across Welwyn and the Mimram valley (chainage CH4450);
- LCA 205 Codicote Plateau, short to mid-range views for road users and users of the public right of way south of Park Lane adjacent to northbound carriageway (chainage CH6350 to CH6900);
- Long view north for road users towards Stevenage and LCA 209 Almshoe Plateau (chainage CH7600);
- Intermittent short to mid-range views for road users and recreational users of footpaths and NCR across farmland in LCA 037 Datchworth Settled slopes, both sides of the carriageway (chainage CH7600 to CH8400);

- LCA 208 Knebworth Parkland, short to mid-range view for road and recreational users adjacent to northbound carriageway (chainage CH9200);
- Short range view into Norton Green adjacent to northbound carriageway (chainage CH10600 to CH10700) – Viewpoint 7;
- LCA 209 Almshoe Plateau, intermittent mid to long range views for road and recreational users adjacent to northbound carriageway (chainage CH11500 to CH12100) – Viewpoint R4; and
- LCA 215 Wymodley and Titmore Green, short range views adjacent to northbound carriageway (chainage CH13400 to CH13550) – Viewpoint R7.

7.4.21 Generally, views in/out of the motorway are more commonplace on the western half of the study area. The slightly elevated Almshoe plateau west of Stevenage has sparse woodland associated with it. The open character here is reinforced by the lack of hedgerows and the large field sizes.

7.4.22 The combination of woodland blocks and the extensive belts of mature trees and shrubs within the soft estate screens or filters most views to the motorway and traffic. This screening is further reinforced by prominent screen bunds in Fishers Green. Existing views include detracting elements not directly associated with the motorway such as industrial estates, masts, pylon towers and overhead lines; these are most noticeable near Stevenage.

7.4.23 The viewpoints which are considered to be of high sensitivity and where the view is potentially susceptible to change are presented in Table 7.9.

7.4.24 Refer to Chapter 10: Assessment of Combined and Cumulative Effects for identified development proposals that may result in potentially significant cumulative visual effects on previously identified viewpoints.

Representative viewpoints

7.4.25 Representative viewpoints have been selected to identify visual effects on the highly sensitive visual receptors identified within the Environmental Scoping Report. These receptors were reviewed and refined on site to account for accessibility and others added to ensure that a representative range of visual effects was included in the assessment as listed in Table 7.1.

7.4.26 Representative viewpoints are shown on Figure 7.1 and are listed in Table 7.9 below. Descriptions of the viewpoints are set out in Appendix 7.1.

7.4.27 All of the representative viewpoints are considered highly sensitive to the Proposed Scheme.

Table 7.9 - Representative viewpoints

Representative Viewpoint No.*	Representative Viewpoint Description	Approx. No. of Receptors
1A	Maran Avenue, Welwyn viewing East	17
1B	Node Way, Welwyn Gardens viewing East	20
2	Clockhouse Gardens, Welwyn viewing East	45
R1	Footpath, Herts PRoW 39 and Danesbury LNR, viewing East	2
3A	Great North Road, Oaklands, viewing West	4
3B	No. 9 The Avenue, Oaklands, viewing West	1
4A	The Brambles and Gwynfa Close, Oaklands (viewing west)	22
4B	The Crest and The Avenue, Oaklands (viewing east)	10
4C	Cannonsfield Drive, Oaklands	4
4D	Danesbury Park, Oaklands	8
R2	Normans Lane BOAT / Bridleway, Herts PRoW 12 (both sides)	1
5	5 Darby Drive and 4 Wych Elm Lane, Rableyheath, viewing east	2

Representative Viewpoint No.*	Representative Viewpoint Description	Approx. No. of Receptors
6	Wood Cottage, Old Knebworth viewing east	1
R3	Bridleway (Herts PRoW 98 / Chadwell Road) viewing east	1
7	Norton Green viewing east	15
R4	Shepherds Lane Bridleway (Herts PRoW 35) viewing east	1
8	Symonds Green, the Crooked Billet Pub, viewing west	2
R5	Footpath, Herts PRoW 34a (both sides) and Symonds Green Open Access Land viewing west	2
9	Symonds Green Minehead Way viewing west	10
R6	Footpath, Herts PRoW 18, viewing east	1
10	Brighton Way viewing west	8
R7	Footpath, Herts PRoW 58 (both sides)	1
11A	Fishers Green north, viewing west	11
11B	Todds Green viewing east	2

*refer to Figure 7.1

Sensitivity of resource

7.4.28 The sensitivity of the identified landscape, visual receptors and heritage assets is recorded in Table 7.10 and Table 7.11 respectively.

Table 7.10 - Visual receptors potentially sensitive to visual intrusion

ID	Location	No. of receptors	LCA	Observation	Existing view	Existing barrier	Mitigation/ Enhancement potential	Nearest carriageway (N- northbound S –southbound)	Distance (m)	Length of exposure (est.) (m)	Sensitivity
PSVR1	Maran Avenue, Welwyn	17	Urban	Small cluster of suburban edge residential properties located north west of Junction 6 northbound slip off (northbound side).	Short range filtered views to the motorway present on embankment. Views are filtered by the soft estate vegetation, and intervening vegetation outside the highway boundary (northbound).	Yes	Low	N	40	100	High
PSVR1.1	Node Way Gardens, Welwyn	20	Urban	Small cluster of suburban edge residential properties south west of Junction 6 northbound slip off (northbound side).	Short-mid range filtered views to the top of vehicular movement present from first floor windows. Views are filtered by the estate soft vegetation, and intervening vegetation outside the highway boundary (northbound). The properties are further separated by a northbound slip lane.	No	Low	N	45-85	50	High
PSVR2	Roman Road, Danesbury (Welwyn)	45	Urban	Small cluster of suburban edge residential properties located west of Junction 6 (northbound slip on) (northbound side).	Short range filtered views to the motorway present on embankment. Views are filtered by the soft estate vegetation, and intervening vegetation outside the highway boundary (northbound).	No	Low	N	70	100	High
PSVR3	Danesbury LNR	1	LCA: 133a	Danesbury Park Road, located within Danesbury LNR between approximately 5.2km and 6.1km south of A1(M) Junction 7.	Short range filtered views to the motorway present on embankment. Views are filtered by various estate vegetation, and intervening vegetation outside the highway boundary (northbound).	No	Low	N	80	20	High

ID	Location	No. of receptors	LCA	Observation	Existing view	Existing barrier	Mitigation/ Enhancement potential	Nearest carriageway (N- northbound S –southbound)	Distance (m)	Length of exposure (est.) (m)	Sensitivity
PSVR3.1	Great North Road, Oaklands	4	Urban	Residential properties located adjacent the eastern southbound edge of the motorway (approximately 1.3km north of Junction 6).	Short-mid ranged filtered views to the top of motorway traffic present from rear facing first floor windows. Views are filtered by the estate soft vegetation, and intervening vegetation outside the highway boundary (southbound).	No	Moderate	S	90-150	150	High
PSVR3.2	No. 9 The Avenue, Oaklands	1	Urban	Residential property located along The Avenue, Oaklands, adjacent the eastern southbound edge of the motorway (approximately 500m north of Junction 6).	Short range filtered views to the top of motorway traffic present. Views are filtered by the estate soft vegetation	No	Moderate	S	20	20	High
PSVR4	Gwynfa Close, Oaklands	11	Urban	Small cluster of suburban edge residential properties (located approximately 5.1km south of Junction 7 (southbound side).	Short range filtered views to the motorway present on embankment. Views are filtered by the soft estate vegetation, and intervening vegetation outside the highway boundary (northbound). A noise barrier is present at this location	No	Moderate	S	30	80	High
PSVR 4.1	Cannonsfield Road	4	Urban	Small cluster of suburban residential properties located off Cannonsfield Road and adjacent to the eastern southbound edge of the A1(M) (approximately 2km north of Junction 6)	Short ranged filtered views to the top of traffic from rear facing first floor windows. Views are partially screened by an existing noise barrier.	Yes	Moderate	S	25-40	80	High

ID	Location	No. of receptors	LCA	Observation	Existing view	Existing barrier	Mitigation/ Enhancement potential	Nearest carriageway (N- northbound S –southbound)	Distance (m)	Length of exposure (est.) (m)	Sensitivity
PSVR5	The Brambles, Oaklands	11	Urban	Small cluster of suburban edge residential properties (located approximately 4.7km south of Junction 7 (southbound side).	Short range filtered views to the motorway present in cutting. Views are filtered by the soft estate vegetation outside the highway boundary (northbound)	Yes	Moderate	S	60	120	High
PSVR5.1	The Crest and The Avenue, Oaklands	10	LCA: 133a	Small cluster of suburban residential properties located to the eastern extent of the Crest and The Avenue, adjacent the western northbound edge of the A1(M) (approximately 1.6km north of Junction 6)	Short ranged filtered views to the top of traffic from rear facing first floor windows. Views are filtered by the estate soft vegetation, and intervening vegetation outside the highway boundary.	No	Moderate	S	25-65	80	High
PSVR6	Danesbury Park Homes, Oaklands	20	LCA: 133b	Small cluster of rural residential properties (static caravans) located approximately 4.7km south of Junction 7 (northbound side).	Short range filtered views to the motorway present in cutting. Views are filtered by the soft estate vegetation, and intervening vegetation outside the highway boundary (northbound).	Yes	Moderate	N	20	60	High
PSVR7	Darby Drive and Wych Elm Lane, Rabley Heath	2	LCA: 133b	Semi-rural residential properties located along Darby Drive and at No. 4 Wych Elm Lane, Rabley Heath, adjacent the western northbound edge of the A1(M) (approximately 3.6km north of Junction 6)	Short range filtered views to the motorway present in slight cutting. Views are partially filtered by the soft estate vegetation, and intervening vegetation outside the highway boundary (northbound). A noise barrier is present at this location	Yes	Low	N	160	50	High

ID	Location	No. of receptors	LCA	Observation	Existing view	Existing barrier	Mitigation/ Enhancement potential	Nearest carriageway (N- northbound S –southbound)	Distance (m)	Length of exposure (est.) (m)	Sensitivity
PSVR7.1	Park Wood	1	Rural	Park Wood residential cottage and semi-natural woodland located on the southern side of Park Lane, Old Knebworth, adjacent the western northbound edge of the A1(M), approximately 2.45km south of Junction 7 (northbound).	Mid-long distant filtered views to the motorway present across landscape. Views are set back and filtered by soft estate vegetation and intervening vegetation outside the highway boundary.	No	Low	N	80	50	High
PSVR8	Norton Green Farmstead and Local PRoW in Subway	15	LCA: 209	Small cluster of suburban edge / rural residential properties and farmstead located approximately 1km north of Junction 7 (northbound side).	Short range filtered views to the motorway present at grade. Views are partially filtered by the soft estate vegetation, and intervening vegetation outside the highway boundary (northbound). No noise barrier at this location	No	High	N	90	35	High
PSVR9	Caravan Site, Dyes Lane	15	LCA: 209	Caravan site on Dyes Lane, located approximately 1.8km north of A1(M) Junction 7.	Short range views to the motorway present in slight cutting. Views are filtered by the soft estate vegetation, and intervening vegetation outside the highway boundary.	No	Low	N	40	240	High

ID	Location	No. of receptors	LCA	Observation	Existing view	Existing barrier	Mitigation/ Enhancement potential	Nearest carriageway (N- northbound S –southbound)	Distance (m)	Length of exposure (est.) (m)	Sensitivity
PSVR9.1	Open Access Land (Symonds Green) and the Crooked Billet Pub	2	Urban	Registered Common Land located between Symonds Green Lane and Clovelly Way, Symonds Green, approximately 700m east of the A1(M) boundary (southbound), and a commercial property - the 'Crooked Billet' pub.	Mid-range filtered views to the motorway and top of traffic present across landscape. Views are filtered by the soft estate vegetation and the intervening vegetation outside the highway boundary (southbound). Views are also obstructed by an existing pile on and associated cabling running north-south along the motorway boundary (southbound).	Yes	Low	S	170	90	High
PSVR9.2	Minehead Way, Symonds Green	10	Urban	Clusters of residential housing groups along Minehead Way, Symonds Green, located adjacent the eastern southbound edge of the A1(M), approximately 2.9km north of Junction 7.	Set back mid-range views towards the motorway and associated traffic present over embankment. Views are set back and filtered by intervening vegetation outside of the highway boundary. Views are also obstructed by a 2.4m high (approximately) timber noise barrier which runs parallel to the highway (southbound) to the southern-most properties.	No	Low	S	20-40	380	High
PSVR9.3	Brighton Way, Symonds Green	8	Urban	Cluster of residential properties along Brighton Way, located adjacent the eastern southbound edge of the A1(M), approximately 3km north of Junction 7.	Set back mid-range views to the top of traffic present over embankment. Views are set back and filtered by intervening vegetation along the outside of the highway boundary and obstructed by the embankment level difference.	Yes	Low	S	60	180	High

ID	Location	No. of receptors	LCA	Observation	Existing view	Existing barrier	Mitigation/ Enhancement potential	Nearest carriageway (N- northbound S –southbound)	Distance (m)	Length of exposure (est.) (m)	Sensitivity
PSVR10	Open Access Land (Fishers Green)	1	Urban	Open access common land, with permissive routes located approximately 1km south of Junction 8 (southbound side).	Short range filtered views. Views are filtered by the soft estate vegetation, and intervening vegetation outside the highway boundary. Views are also partially screened by the intervening earthworks. No noise barrier at this location	No	Low	S	140	70	High
PSVR10.1	Kessingland Avenue, Fishers Green North	11	Urban	Cluster of residential properties located along Kessingland Avenue, Symonds Green, adjacent the eastern southbound edge of the A1, approximately 550m south of Junction 8 (southbound).	Set back mid-range views towards the motorway and associated traffic present over landscape and embankment. Views are set back and filtered by intervening vegetation along the outside of the highway boundary. Views are further disrupted by a level change in the embankment bordering the motorway.	No	Low	S	50-80	90	High
PSVR11	Stevenage Road, Todd's Green	2	LCA: 215	Small cluster of suburban edge / rural residential properties located approximately 650m south of Junction 8 (northbound side).	Short range filtered views to the motorway in cutting. The soft estate vegetation provides some filtering to views. No noise barrier at this location	No	Low	N	180	80	High
PRoW1	Local PRoW (B197 to Harmer Green Lane)	1	LCA: 035	PRoW running parallel to the boundary of the A1(M) for approximately 320m, located 500m north of Junction 6 (southbound slip off).	Short range filtered views to the motorway present at grade. Views are partially filtered by the soft estate vegetation and intervening vegetation outside the highway boundary.	No	Low	S	20	34	High

ID	Location	No. of receptors	LCA	Observation	Existing view	Existing barrier	Mitigation/ Enhancement potential	Nearest carriageway (N- northbound S –southbound)	Distance (m)	Length of exposure (est.) (m)	Sensitivity
PRoW2	Local PRoW	1	LCA: 133a	PRoW running between Roman Road, and Danesbury Park Road, between approximately 5.2km and 6.1km south of A1(M) Junction 7.	Short range filtered views to the motorway present on embankment. Views are filtered by the soft estate vegetation, and intervening vegetation outside the highway boundary.	No	Low	S	80	20	High
PRoW3	Local PRoW, Normans Lane Subway	1	LCA: 036	PRoW running between Spinney Lane, and Heath Road, located in part along Normans Lane within Ninning's Wood approximately 1.1km and 4km south of A1(M) Junction 7.	Short range filtered views to the motorway present on structure. Views are filtered by the soft estate vegetation, and intervening vegetation outside the highway boundary (Ninning's Wood).	Yes	Low	N	20	5	High
PRoW4	Local PRoW (Cowpasture Wood, to Old Knebworth Lane)	1	LCA: 037	PRoW running between Park Lane and old Knebworth Lane, located between approximately 1.1km and 2.2km south of A1(M) Junction 7.	Short to Mid-range views to the motorway present on slight embankment. Limited filtering from lack of soft estate within highway boundary. Some filtering offered by vegetation outside of highway boundary.	No	Low	N	630	0	High
PRoW5	Local PRoW, Dyes Lane	1	LCA: 209	PRoW running parallel to northbound carriageway between Chadwell Road and Dyes Lane, located approximately 1.8km north of A1(M) Junction 7.	Short range views to the motorway present in slight cutting. Views are filtered by the soft estate vegetation, and intervening vegetation outside the highway boundary.	No	Low	S	40	240	High

ID	Location	No. of receptors	LCA	Observation	Existing view	Existing barrier	Mitigation/ Enhancement potential	Nearest carriageway (N- northbound S –southbound)	Distance (m)	Length of exposure (est.) (m)	Sensitivity
PRoW6	Local PRoW, (Dyes Lane to Kitching Lane)	1	LCA: 209	PRoW running between Dyes Lane and Kitching Lane, located approximately. 2.8km south of A1(M) Junction 8, in part parallel to northbound carriageway for approximately 200m.	Short range views to the motorway present in slight cutting. Limited filtering from lack of soft estate within highway boundary. Some filtering offered by vegetation outside of highway boundary.	No	Low	N	50	355	High
PRoW7	Local PRoW, (Kitching Lane to Shepherds Lane)	1	LCA: 209	PRoW running between Kitching Lane and Shepherds Lane, located approximately. 2.3km south of A1(M) Junction 8, for approximately 300m (northbound), and in Subway between Meadway (southbound) and Kitching Lane (northbound).	Short range views to the motorway present at grade and on slight embankment. Limited filtering due to lack of soft estate vegetation and vegetation outside of highway boundary.	No	Low	N and S	20	600	High

ID	Location	No. of receptors	LCA	Observation	Existing view	Existing barrier	Mitigation/ Enhancement potential	Nearest carriageway (N- northbound S –southbound)	Distance (m)	Length of exposure (est.) (m)	Sensitivity
PRoW7.1	Local PRoW (PRoW 34a and Symonds Green Open Access Land)	1	LCA: 209	PRoW running between perpendicular to the A1(M) (northbound), approximately 1.9km south of Junction 8, and in parallel to the A1(M) for approximately 90m (southbound) before connecting to Symonds Green Open Access land.	Short range filtered views of the motorway present at grade and over embankment. Limited filtering due to lack of soft estate vegetation (northbound). Views west (southbound) are obstructed by a 2.4m high (approximately) noise barrier and various groups of vegetation.	Yes	Low	N	0-100	90	High
PRoW8	Local PRoW (Almshoebury to Symonds Green)	1	LCA: 209	PRoW running between Almshoebury, and Symonds Green, located approximately. 2km south of A1(M) Junction 8, (northbound side), and parallel to northbound side of A1(M) for approximately 300m.	Short range filtered views of the soft estate vegetation present on slight embankment. Views are filtered by the soft estate vegetation.	No	Low	N	20	20	High

ID	Location	No. of receptors	LCA	Observation	Existing view	Existing barrier	Mitigation/ Enhancement potential	Nearest carriageway (N- northbound S –southbound)	Distance (m)	Length of exposure (est.) (m)	Sensitivity
PRoW9	Local PRoWs (Shangri-La Farm / Lucas Wood & Fishers Green)	1	LCA: 215	Dual PRoWs running parallel to and along the boundary of the A1(M) for approximately 500m. On the southbound side the route is located on the boundary of the motorway and on the Northbound carriageway 120m west between approximately 800m and 1.3km south of Junction 8. The route also passes in subway beneath the motorway.	Short range filtered views to the motorway present at grade. Views are partially filtered by the soft estate vegetation (northbound), and the soft estate and intervening vegetation outside the highway boundary (southbound).	No	Low	N and S	180	5	High
PRoW10 CH: 6800	NCR 12 (Old Knebworth Lane)	1	LCA: 037	National Cycle Network (Sustrans Route 12) following the alignment of Old Knebworth Lane	Medium distance views of the golf course and open arable fields, towards the A1(M), partially screened by existing roadside planting. Corridor alternating between cutting and embankment with traffic clearly visible	No	Moderate	N and S	0	350	High

Table 7.11 - Cultural heritage receptors potentially sensitive to setting impacts

Id	Historic receptor	Receptor description	Heritage asset	Existing setting	Nearest carriageway	Distance (m)	Value
DHR1	NHLE 1000255: Knebworth Registered Park and Garden	The estate has existed in some form since the 14th century and in the 16th century was a well known Deer Park. The estate remained largely untouched until the early 19th century when the owner demolished part of the central building which stood on the site, including the medieval gatehouse. In the late 19th century, the gardens were redesigned and altered to formal gardens with ornate flower beds, fountains, statues and shrubbery walks. It is still in use as a Park and Garden.	Grade II* Registered Park and Garden	The Park and Garden is located is surrounded by areas of dense woodland to the north, and open agricultural land and small areas of settlement to the south and west. To the east is the A1(M) and the south-eastern edge of Stevenage. Views from Park and Garden towards the motorway are screen by existing vegetation along the park boundary and along the highway	West (Grid Ref: 523498, 221535)	40m	The Grade II* Registered Park and Garden originates from the 14th century and was once one of the best deer parks (1700's). The condition of the park, along with the historical value and architectural value, means that the heritage value is **high**.
DHR2	1000911: Homewood Registered Park and Garden	The Registered Park and Garden has been in existence since 1902 when it was ordered by Dowager Countess of Lytton to be built by Sir Edwin Lutyens. This has a direct view from the eastern edge of the park to the A1(M). The topography and positioning of the A1(M) has meant that the road was raised higher than the land to the west, which sloped down from the park.	Grade II Registered Park and Garden	The setting of the park and garden is principally open agricultural land and areas of woodland. The topography and positioning of the A1(M) has meant that the road was raised higher than the land to the west, which sloped down from the park. There is no vegetation bordering the road.	West (Grid Ref: 523826, 219846)	340m	The Park was completed by 1902 and built by Sir Edwin Lutyens. The gardens contain a house in the centre; this property was built as a private property and is still in use as such. Due to the historical and architectural value, the heritage value is **medium**.

Id	Historic receptor	Receptor description	Heritage asset	Existing setting	Nearest carriageway	Distance (m)	Value
DHR3	National Heritage List Entry (NHLE) 1015580: Dicket Mead Roman Villa, including the museum under the A1(M) carriageways.	Dicket Mead Roman Villa includes the visible and buried remains of the Roman Villa which was situated in the valley of the River Mimram. It was discovered during the construction of the A1(M) and the remains of the bath house are preserved under the motorway within a museum. Archaeological excavations in the 1960's revealed an extensive and prestigious villa complex which was supported through the finds here which indicated great wealth. Further scheduled remains are located immediately to the east of the A1(M). As the Roman Villa runs under the A1(M) there are views towards the A1(M) from either side, although the embankment itself is excluded from the scheduling.	Scheduled Monument	The Roman baths and museum are buried under the existing highway and are accessed from A1000 to the west of the motorway. The remainder of the asset is located in the grounds of Sherradswood School is screened from the motorway by vegetation and the topography	Underneath and East (Grid Ref: 523225, 216009)	0m 25m	The Scheduled Monument is an extensive and prestigious villa complex which includes a museum underneath the carriageways. It is located near to Lockleys Villa although it is unknown if the two are related. However, the dates are similar. Due to the archaeological value, historical value and the accessibility to this monument, the heritage value is **high**.
DHR4	1175952: The Dairy, Old Farmhouse and Tudor House at Stebbing Farm	This collection of buildings was once known as Stebbing Dairy Farmhouse and were built in the late 15th century, although they have been considerably altered since in the 17th and 19th centuries.	Grade II* Listed Building	The heritage asset is located north of Fishers Green and north of Kessingland Avenue, in the north of Symonds Green. The asset is located within a late 20th century residential estate. The buildings occupy a location lower than the A1(M), which is screened through vegetation, although there is a significant amount of noise from the Highway.	East (Grid Ref: 522415, 226531)	77m	The collection of buildings were originally known as Stebbing Dairy Farmhouse with 17th and 19th century alterations. Due to the historical value and the changes to the buildings, the heritage value is **high**.

Id	Historic receptor	Receptor description	Heritage asset	Existing setting	Nearest carriageway	Distance (m)	Value
DHR5	1347466: Thatched Cottage	The cottage is from the 16th century and thought to originate from AD 1579, and was formerly known as the Warrener's House. There were two phases of extension, one in 1939-40 and the second in 1960. The A1(M) is located to the south-east of the property, with a clear view towards the A1(M) and a bridge, containing Fishers Green Road.	Grade II Listed Building	The heritage asset is located on the east side of Stevenage Road, to the east of Symonds Green and west of Titmore Green. It is located at an area which is mix of residential, commercial and agricultural land. The A1(M) is located to the south-east of the property, with a clear view towards the A1(M) and a bridge, containing Fishers Green Road	West (Grid Ref: 522114, 226363)	124m	The Thatched Cottage is of 16th century date. The heritage value is drawn from the historical value and overall is considered to be **medium**.

Future baseline

Landscape and visual

7.4.29 Whilst much of the open countryside is designated as green belt, immediately adjacent to the urban areas of Stevenage and Welwyn are predicted to become more suburban (i.e. built up and busy) due to the pressure for housing sites and employment. Stevenage West (outside the green belt) is allocated for the development of approximately 1,350 dwellings, with further development areas identified to the north of the town. Further employment areas have been identified immediately east of the A1(M) to the south of the town.

Cultural heritage

7.4.30 Given the nature of heritage assets, the baseline is not likely to change in the future without the Proposed Scheme in place.

7.5 Assessment of effects

Construction effects

7.5.1 This section considers construction effects on the landscape, visual amenity and cultural heritage assets. The impacts are generally of short term duration, where the impact would be medium to long term and can be limited by adherence to good practice during construction as set out in the OEMP, except for tree removal which can be perceived as a permanent impact.

Landscape effects

7.5.2 This assessment is based on the Vegetation Site Clearance GIS data provided at DF2. Potential clearance areas have been considered for the assessment based on General Arrangements and assumptions set out in Chapter 2: The Proposed Scheme.

7.5.3 Vegetation loss would be restricted to what is essential for the implementation of the Proposed Scheme and is generally around 4m from the existing verge edge. As the majority of vegetation is set back from the verge edge, loss within the 4m would be limited. However, where gantries and emergency areas are proposed and for sight line and bank regrading purposes, greater clearance would be required. Loss of existing vegetation within the highway boundary would cause a **negligible adverse** magnitude of impact on the highways soft estate and a **negligible adverse** significance of effect within the study area during construction. This would be subject to further assessment if the Proposed Scheme changes materially. This is a result of the affected area (or estimated clearance area) being approximately 9.3 ha total vegetation cover within the soft estate of the study area and the sensitivity of the landscape resource being medium. This estimate is based on the assumptions detailed Chapter 2: The Proposed Scheme (Table 2.12 Site Clearance Assumptions).

7.5.4 The character, setting and perception of the local landscape will not markedly change as a result of construction activities.

7.5.5 The north-east fringe extending for a length of approximately 300 m of LCA 208 Knebworth Parkland, would experience direct landscape impacts as a result of vegetation removal to accommodate infrastructure, sightlines and indirect impacts as a result of increased visual intrusion by the A1(M) corridor. For this reason, the magnitude of impact would be **negligible adverse** to reflect the small proportion of the overall character area affected by construction activities and the fact that the Proposed Scheme would be contained within the existing highway boundary and largely screened in cutting. The significance of effect would be **slight adverse**.

Visual effects

7.5.6 During construction there would be visual effects of **moderate adverse** significance from 1 representative viewpoint, PSVR 8 Norton Green (viewpoint 7) because:

- The existing residential property at Norton Green Cottage is less than 50m from gantry G-A1(M) 09 and external areas and upper floor windows are anticipated to have direct views of the construction activity;
- Fourteen additional properties to the north of Norton Green (under construction) are located within 100m of gantry G-A1(M) 09;
- There is a row of small trees/shrubs which would screen the lower parts of the gantry but this vegetation is likely to be removed during construction;
- Users of the bridleway and local residents, both of which are considered highly sensitive receptors, will experience views during access/egress, from upper floor windows and external spaces, due to the proposed gantry being out of scale with the existing outlook and representing a visually prominent element of the view; and
- There is some scope to mitigate through planting in the current location although this is constrained by the presence of the existing footpath.

7.5.7 During construction there would be visual effects of **slight adverse** significance on the remaining 19 representative viewpoints because of:

- The distant nature of the view and filtering effect of existing vegetation in the foreground;
- The temporary impact of activity to replace noise barriers, including temporary views exposed to the A1(M) corridor until sections of barrier are replaced;
- Only partial views of construction activity would be available due to intervening screening elements; and
- Existing views of the motorway and other detracting visual features are open and construction activity would be viewed in this context.

7.5.8 During construction there would be no change in view and a **neutral** significance of effect from 1 representative viewpoint: Node Way, Welwyn. This is as a result of the flats in this location not having any outdoor amenity areas and the properties, access and egress all being heavily screened from the Proposed Scheme by intervening elements, that include the slip roads, roadside shrubs and tree planting.

Lighting effects

7.5.9 Lighting during construction would be set within the context of existing lighting near to motorway junctions. Impacts from the temporary duration of lighting during construction would occur in unlit sections of road and have been included and reported in the assessment of representative viewpoints.

Heritage assets

Scheduled Monument: Dicket Mead Roman Villa (NHLE 1015580)

7.5.10 During the construction period, there is potential for temporary adverse impacts due to construction related activities resulting in an increase in noise, lighting, dust and pollution, resulting in the setting being slightly degraded. The magnitude of impact during the construction period is considered to be **minor**, resulting in a **slight adverse** significance of effect.

Grade II* Registered Park and Garden of Knebworth (NHLE 1000255)

7.5.11 There is potential for four gantries to impact this heritage asset; these comprise:

- G-A1(M) 07 Northbound Gantry – Secondary Advanced Direction Sign (ADS) Variable Message Sign (VMS);
- G-A1(M) 08 Northbound Gantry – Continuation VMS;
- G-A1(M) 22 Southbound Gantry – Gateway Signal and VMS / Emergency Area / VMS; and
- G-A1(M) 23 Southbound Gantry – Emergency Area / VMS.

7.5.12 During construction, there is potential for impacts to the setting of the heritage asset due to visual intrusion along with increases in noise and lighting, which will alter the assets physical surroundings and the way in which the asset is experienced. Due to gaps in the vegetation along with A1(M) and around the border of Knebworth Park, there is potential for the gantries to be seen during the building work and potentially heard due to the presence of construction vehicles. The impacts would be temporary and the effects reversible once the construction phase is complete.

7.5.13 Gantry G-A1(M) 22 would span 3 lanes and is this lies 200m to the east of the asset. This gantry is the most likely to impact the heritage asset due to its proximity and size, and also due to its positioning in an area of limited vegetation making it more likely to be visible from the south-east of the asset. The impacts will derive from the increased visual intrusion of the Proposed Scheme within the park, which will reduce the sense of tranquillity and isolation of the asset from the wider landscape. During the construction period it is believed there will be a temporary **minor adverse** magnitude of impact on the setting of the heritage asset of high value due to the change in the physical surroundings and the way in which the asset is experienced, resulting in the setting being slightly degraded, although the impacts are reversible to pre-development conditions. The effects will be temporary **slight adverse**.

7.5.14 Gantry G-A1(M) 08 lies 350m north-east of the asset and will span a single lane of the Proposed Scheme. It is predicted to be visible from the north-east entrance due to a lack of vegetation in this area, and therefore change the asset's physical surroundings and the way in which is experienced. The magnitude of impact is likely to be temporary **minor adverse** during construction due to the setting being slightly degraded, resulting in a temporary **slight adverse** significance of effect.

7.5.15 Gantry G-A1(M) 07 is 600m east of Knebworth Park and Gantry G-A1(M) 23 is 900m east and may impact the setting of the park visually. During construction, there is potential for construction works to be visible This would have a temporary **negligible adverse** magnitude of impact to the setting of the asset as it will not be changed sufficiently to alter the contribution of the setting to the value of the asset, resulting in a temporary **slight adverse** significance of effect.

<u>Grade II: Registered Park and Garden of Homewood (NHLE 1000911)</u>

7.5.16 Homewood Registered Park and Garden has the potential to be impacted by 2 proposed gantries (G-A1(M) 06 and G-A1(M) 24) along with 1 proposed emergency area (EA NB 2). Due to the topography, with the road being elevated above the fields, these are likely to be prominent in the landscape and represent a visual intrusion within the wider, predominately rural landscape. G-A1(M)06 lies 365m to the north-east of Homewood Registered Park and Garden, G-A1(M)24 lies 445m to the south-east of the asset and one emergency area (EA NB 2) also lies 495m south-east of the asset.

7.5.17 The construction period will see the presence of construction vehicles on site, which (if used at night) would cause an increase in lighting. This presence would cause a visual change and potentially a change to the noise levels within the area, representing a temporary changing in both the physical surrounding and the way the asset is experienced. The magnitude impact during the construction period to the setting of the asset of medium value is considered to be temporary **minor adverse**, as the setting will only be slightly degraded and the impacts reversible to pre-development conditions, resulting in a **slight adverse** significance of effect.

Grade II*: The Dairy at Stebbing Farm, The Old Farmhouse Stebbing Farm and the Tudor House at Stebbing Farm (NHLE 1175952) and Grade II: Thatched Cottage (NHLE 1347466)

7.5.18 Due to the gantry G-A1(M) 16 being positioned between both assets, the impacts are judged to be the same and therefore are discussed together. Gantry G-A1(M) 16 is a Gateway Signal and VMS which crosses all three carriageways. Activities undertaken during the construction period will result in a temporary increase in noise levels and will alter the experience of the setting at the assets. There would be no visual intrusion from this phase of works due to the vegetation which is present along both sides of the carriageway. The magnitude of impact on the setting of these assets is considered to be negligible adverse as the setting will not be altered sufficiently to alter its contribution of the asset's importance, resulting in a slight adverse significance of effect.

Operational effects

Landscape effects - Year 1

7.5.19 This section considers operational landscape and visual amenity effects in winter Year 1 following Proposed Scheme completion, when vegetation would not be in leaf and when replacement would be immature and ineffective in contributing to the landscape fabric and as visual screening. This provides an assessment of the 'reasonable worst case' scenario.

7.5.20 Following vegetation loss within the highway boundary and before replacement planting matures the additional infrastructure will slightly increase the prominence of the existing motorway and the Proposed Scheme within the landscape. As discussed in the assumptions and limitations outlined in Section 7.3, areas of removed vegetation will be replaced where feasible, although full replacement will not be possible in order to satisfy footprint, sight line and safety requirements.

7.5.21 The motorway corridor already has a strong influence on its surrounding environment and the effects associated with minor alterations to a motorway in the context of a broader landscape will not be significant. This is due to the existing awareness of traffic, gantries and other infrastructure, combined with the relative lack of publicly accessible land in close proximity to the Proposed Scheme. Therefore, the magnitude of impact on LCA 208 Knebworth Parkland will be **negligible** and the significance of effects no greater than **slight adverse**.

Landscape effects – Year 15

7.5.22 In the longer term, replacement planting will mature and the majority of gaps created by initial clearance during construction will have closed up. Despite there being changes to the location and extent of some tree and shrub vegetation overall, the general landscape character and function of the highway planting/ screening within verges will be reinstated and there will be no net loss overall. Following maturation of the replacement planting, the additional infrastructure will be integrated into the motorway corridor and the prominence of the motorway within the landscape will only slightly increase, primarily as a result of gantries and associated signs being visible above intervening highway vegetation. However, in the context of the experience of the broader landscape surrounding the corridor and the existing awareness of the motorway, any increase in prominence will be barely perceptible and not alter the perception of the surrounding landscape.

7.5.23 The motorway corridor already has a strong influence on its surrounding environment and the effects associated with minor alterations to an existing motorway in the context of a broader landscape will not be significant. This is due to both the existing awareness of traffic, gantries and other infrastructure and the lack of publicly accessible land within close proximity to the Proposed Scheme. Following completion of the Proposed Scheme when mitigation planting has matured, the magnitude of impact on LCA 208 Knebworth Parkland will be **no change** and the significance of effects **neutral**.

Visual effects – Winter Year 1

7.5.24 Appendix 7.1 provides a schedule of visual effects from representative viewpoints (illustrated on Figure 7.1). By Year 1, construction activities would have ceased, with working areas and verges reinstated. There would remain increased visibility of the highway and associated infrastructure as a result of loss of vegetation along the motorway corridor and potentially an increase in traffic visible at closer proximity and increased width due to all lane running. Where views are of the whole road, rather than elements visible above the cutting slope, a new solid central reservation would be a feature, as would structural elements have associated with gantries located in the verge.

7.5.25 There will be visual effects of **moderate adverse** significance during operation in winter Year 1 for residential and recreational receptors at PSVR 8 Norton Green Farmstead and therefore one significant effect at Year 1 of Operation.

Visual effects – Summer Year 15

7.5.26 Appendix 7.1 provides a schedule of visual effects from representative viewpoints (illustrated on Figure 7.1).

7.5.27 Of the 24 representative viewpoints assessed, all would have **slight adverse** or **neutral** significance of effect (see Table 7.1.1 in Appendix 7.1). This would include the receptor PSVR 8 Norton Green Farmstead as a result of the proposed mitigation measures detailed in Section 7.6, having matured, providing a foil to views of the adjacent gantry. The reduction in impacts from Year 1 are the result of replacement planting having grown to its design size and resulting ability to screen elements of the Proposed Scheme from receptors.

Lighting effects – Year 1 and 15

7.5.28 Lighting effects during operation will be the same at Year 1 and Year 15, and are reported here only to avoid repetition.

7.5.29 During operation, dependant on the provision of funding, there will be a slight change to the extent of lighting, associated with existing lighting at the slip roads. The type of light source will change to LED directional lamps and would represent an improvement over the existing light source in terms of light spill and glare. The alteration to the type of light source and location of individual columns near to junctions will result in no significant impacts on landscape and visual receptors due to the lighting proposals.

Heritage assets Year 1

Scheduled Monument: Dicket Mead Roman Villa (NHLE 1015580)

7.5.30 There is potential for the Roman Villa's setting to be altered due to the presence of a Proposed Noise Barrier (NNB1) and Gantry (G-A1(M) 28). It is proposed to place a noise barrier on the north-bound carriageway, furthest from the asset. Currently there is well established tree line along both carriageway boundaries which, if left as it is, will screen the asset visually from the barrier during the operational phase. During operation, the magnitude of impact would be **no change**, resulting in a **neutral** significance of effect, provided the vegetation is not reduced or removed. Should the majority of the existing vegetation be permanently removed, there would be a **negligible** magnitude of impact on the setting, with effects of **slight adverse** significance.

Grade II* Registered Park and Garden of Knebworth (NHLE 1000255)

7.5.31 The presence of Gantry G-A1(M) 22 would lead to a **minor adverse** magnitude of impact on the setting of this asset due to the increased visibility of the motorway from the asset, which will slightly degrade the setting. This will result in a **slight adverse** significance of effect.

7.5.32 The presence of Gantry G-A1(M)08 would lead to a **negligible adverse** magnitude of impact on the setting of this asset as it will not alter the contribution of the setting to the asset, resulting in a **neutral** significance of effect.

7.5.33 The presence of Gantry G-A1(M)07 Gantry G-A1(M)23 would lead to a **negligible adverse** magnitude of impact on the setting of this asset due to the intervening distance and minimal visual prominence of the gantries, which will not alter the contribution of the setting to the asset, resulting in a **neutral** significance of effect.

Grade II: Registered Park and Garden of Homewood (NHLE 1000911)

7.5.34 The operational period will see a permanent change to the setting of this heritage asset with the introduction of the gantry within the view from the asset. This will change the physical surroundings by making the motorway a more prominent part of the setting. The magnitude of impact to the setting during the operational period is predicted to be **minor adverse** as the importance and contribution of the setting to the value of the asset will only be slightly degraded, resulting in a **slight adverse** significance of effect.

Grade II*: The Dairy at Stebbing Farm, The Old Farmhouse Stebbing Farm and the Tudor House at Stebbing Farm (NHLE 1175952) and Grade II: Thatched Cottage (NHLE 1347466)

7.5.35 During the operational period there is unlikely to be any impacts on the setting of these heritage assets as the motorway is not visible from the assets. The impacts are therefore neutral and the effect neutral.

Heritage assets – Year 15

7.5.36 At Year 15, the effects on the cultural heritage assets will be unchanged from Year 1.

7.6 Design, mitigation and enhancement measures

7.6.1 The Proposed Scheme involves limited interventions to an established motorway corridor that constitutes a part of the existing landscape character. Where vegetation is cleared to facilitate construction, planting will be provided to establish landscape/ecological function, except where this would compromise the safe operation of the highway e.g. sightlines for CCTV, forward visibility for motorists. Due to the localised works within the soft estate, the perception would be that, with assumed mitigation planting in place and maturing, the majority of the vegetation along both carriageways would be comparable to the present situation, and would continue to achieve integration.

7.6.2 Replacement planting will be provided, where appropriate and possible, as outlined in Chapter 2: The Proposed Scheme. Secondary and specific mitigation measures have been outlined below.

7.6.3 Associated with PSVR 8 Norton Green, and between chainage 10600 and 10650, mitigation is proposed in the form of additional planting to reinforce the existing highway boundary hedge. In addition, feathered trees will be planted within land owned by Highways England to provide screening in the medium to long term and to reduce the significant effect identified as arising following construction (refer to paragraph 7.5.27). This mitigation is secured through clause Land035 of the OEMP.

Landscape and visual

7.6.4 The following measures are embedded into the Proposed Scheme design (refer to paragraph 2.4.10) and have formed an integral part of the assessment:

- Gantries, emergency areas and cabinet sites have been located to reduce potentially significant landscape and visual effects where feasible in terms of engineering and safety constraints; and
- Soft landscape earthwork solutions for retaining options have been prioritised and existing areas of hard standing used for the emergency areas where available.

7.6.5 Where existing noise barriers or screen fences are to be removed and replaced they shall be replaced within a short timeframe to reduce any visual (and noise) impact, and affected residents informed appropriately. Existing noise barriers will be removed and replaced in the following locations:

- **ENB2** is located near Oaklands and a 50m section will be removed to allow for the construction of a gantry (G-A1(M) 26); and
- **ENB5** is located near Symonds Green and a 50m section will be removed to allow for the construction of a gantry (G-A1(M) 18).

7.6.6 The following mitigation principles will be applied to detailed design and construction and carried forward to the Environmental Management Plan:

- Vegetation will be removed only where essential to construct the Proposed Scheme and to allow for sight lines and safety requirements. Where the extent of proposed vegetation removal in a particular location will result in a sensitive impact this will be mitigated by the proposed landscape design proposals at the detailed design stage;
- As far as practical, individual trees within / adjacent to or on the boundary of areas identified for vegetation clearance will be retained at sensitive locations through a preference of pruning and crown lifting rather than removal. Furthermore, through the detailed design process clearance up to the highway boundary will be avoided and where there is a requirement to maintain key screening vegetation, the Proposed Scheme design will seek to retain and protect a reasonable belt of vegetation;
- Screen planting will be reinstated where existing screening vegetation is lost as a result of clearance to accommodate equipment and structures, where sufficient room allows for this. Screening value will be reinstated when mitigation planting matures;
- Where it is considered, during further design, that sufficient replacement planting is not possible, due to engineering or space constraints and where this may then result in a significant visual or landscape impact, alternative solutions to the design or the installation of a visual screen shall be explored and developed to prevent a significant effect;
- Proposed planting will be of locally indigenous native plants and/or non-invasive to reflect the distinctive local character and of a similar species mix or improved habitat to that removed;
- The planting strategy will aim to retain a ‘sense of place’ by using plants which reflect the local landscape character and reinforce traditional features and patterns that offer habitat enhancement;
- Where feasible the installation of the noise barriers will be completed to avoid existing vegetation removal with a preference for pruning over removal and hand digging so as to avoid damage to existing tree roots;
- Where barriers are to be constructed in close proximity to residential property and where an existing fence or barrier is present (but subject to temporary removal / realignment), a temporary screen fence will be used where space permits to maintain screening and will remain until the noise barrier is erected;
- Where practical opportunities to soften the appearance of noise barriers through planting will be considered and developed through detailed design and/or through the retention of existing vegetation;
- Use of native tree and shrub planting to create woodlands, copses and shelterbelts to screen structures, traffic and lighting and help integrate the Proposed Scheme into the existing landscape pattern; and
- Use of planting on the highway boundary, where appropriate, to link into existing field boundary planting to provide screening and integration into the local pattern, as well as connection of existing wildlife corridors, in locations where other planting is not proposed.

7.6.7 The Proposed Scheme involves limited interventions to an established motorway corridor that constitutes a part of the existing landscape character. Due to the localised works within the soft estate, the majority of the vegetation along both carriageways would be similar to the present situation following a 15-year time period, post clearance to achieve integration.

Cultural heritage

7.6.8 The assessment has identified that the impacts on setting would arise mostly from the construction phase and would be temporary in nature, with only **slight adverse** effects from the operation phase resulting in the placement of two gantries which are predicted to be visible from the two Registered Park and Gardens. Where possible, the impacts on should be mitigated through the design, such as altering the colour of the gantries to reduce the visual impact. Where design measures cannot be employed, screening may be used to reduce the impacts.

7.6.9 The Proposed Scheme would not have any direct physical impact any heritage asset. However, in the unlikely event that archaeological remains are found during construction, works will be stopped to allow for appropriate recording and reporting and any relevant mitigation measures determined in consultation with the local authority archaeologists and/ or Historic England.

Enhancement opportunities

Landscape and visual

7.6.10 There is scope to deliver enhanced landscape integration, nature conservation, visual screening or improvement in the setting to a heritage asset in support of Highways England's Road Investment Strategy (RIS)1: Improving green infrastructure and RIS2: Being environmentally responsible.

7.6.11 The following principles shall be considered at further design stages. It should be noted that these measures have not been included in the assessment, however, where they may have additional benefits this has been noted in the assessment tables in Appendix 7.1 Additional enhancement resulting from the implementation of these principles, would be experienced during the operational stage.

- Infill gaps and/or improve, existing planting to screen visual receptors and aid integration of the motorway into the local landscape through new planting within the highway estate at the following locations:
  - Norton Green to tie into the existing landscape framework and reduce views from open areas to the west.
- Enhance/improve the existing species mix/habitat typology in otherwise poor quality areas to improve biodiversity and connectivity along the route taking the opportunity to tie into the local landscape through which the road passes, particularly adjacent woodlands, scrub, field boundary hedgerows and flight lines:
  - Local PRoWs (Shangri-La Farm / Lucas Wood & Fishers Green); and
  - Open Access Land (Fishers Green)
- Improve driver experience through planting to enhance the local character in opened out, restricted and filtered views of the landscape through which they are passing.
- Onsite areas suitable for enhancement would be identified and proposals established as part of further design stages. Areas with the potential for onsite enhancement noted at this stage include:
  - North of Stevenage and west of Gravely there are opportunities to include new hedgerows to the southbound verge to reinforce the existing boundary and screening to Gravely.

7.6.12 In addition, later design work may consider areas of off-site enhancement to meet the Highways England licence and RIS environmental objectives; to further promote green infrastructure, integrate the Proposed Scheme as a whole into the wider landscape, and enhance the local character. It should be noted that any off-site measures have not been included in the assessment as such areas shall be considered at later stage, however, some potential measures have been noted briefly below and in more detail at specific locations within the assessment tables in Appendix 7.1:

- Provide opportunities for improvements through off site planting to local nature reserves and/or park areas to enhance local biodiversity and further limit the impact of the existing and proposed motorway at the following locations:

  - Danesbury LNR; and
  - Homewood Registered Park and Garden.
- Additional individual tree planting to key off site areas to break up existing views towards the motorway and integrate the motorway into the landscape at the following locations:
  - Dowagers Lane PRoW.

7.6.13 In protecting and enhancing the biodiversity value of the soft estate the Design Team will:

- Integrate ecological, landscape, geotechnical and engineering considerations to minimise the loss of habitats, biodiversity and impact on protected species;
- Maximise the environmental functions that the landscape can provide through planting design; and
- Integrate the landscape within the soft estate with neighbouring habitats and landscape features.

Cultural heritage

7.6.14 No opportunities for enhancement of cultural heritage assets have been identified.

7.7 Residual effects

Landscape

7.7.1 The existing Proposed Scheme corridor has a strong influence on its surrounding environment and the effects associated with additional infrastructure such as gantries, signs, emergency areas and CCTV/ Radar masts will slightly increase the awareness of the scheme corridor as a feature through the landscape, immediately following construction. However, in the long term and as mitigation planting matures, the majority of gaps created by initial clearance works during construction will have closed up after 15 years. With mitigation planting having matured, there will be no material changes to the way in LCA 208 Knebworth Parkland is perceived, and the significance of effects on landscape character will be **neutral**.

Visual effects

7.7.2 Moderate adverse operational effects were identified in winter year 1 on residential and recreational receptors at PSVR8 Norton Green Farmstead (see paragraph 7.5.24). However, these are reduced to slight adverse residual effects following the application of mitigation measures.

7.7.3 Views towards the Proposed Scheme would be restricted by intervening vegetation, natural landform, and noise barriers. For most visual receptors, visual effects would be limited because the Proposed Scheme would be set within the context of the existing highway infrastructure and associated traffic. Whilst there would be some residual visual effects of **slight adverse** significance from residential receptors and PRoWs immediately adjacent to the Proposed Scheme corridor, these effects being highly localised.

Heritage assets

7.7.4 The Proposed Scheme would not have any significant adverse effects on the setting of the surrounding cultural heritage assets assessed.

7.7.5 Chapter 10: Assessment of Combined and Cumulative Effects provides an assessment of the intra-project and inter-project cumulative effects, covering the topics of landscape, visual amenity and the setting of cultural heritage assets.

7.8 Summary

7.8.1 There would be no permanent significant residual landscape and visual amenity effects, or significant residual effects on the setting of heritage assets.

7.8.2 During construction and operation, potentially significant localised effects have been identified for 1 key visual location.

7.8.3 Overall in the long term, the Proposed Scheme is considered to have a residual **slight adverse** effect in terms of local landscape and visual amenity within 100m.

Summary of potential construction effects

Table 7.12 - Summary of construction effects

Aspect	Post mitigation predicted effect
Landscape - Construction	• **Slight adverse** effect on LCA 208: Knebworth
Visual Effects - Construction	• **Slight adverse** effect on 23 viewpoints • **Moderate adverse** effect on one viewpoint, associated with PSVR8 and the impact of gantry G-A1(M) 09, at Norton Green
Cultural Heritage - Construction	• **Slight adverse** effects on one Scheduled Monument (Dicket Mead Roman Villa) • **Slight adverse** effects on two Registered Park and Gardens (Knebworth and Homewood) • **Slight adverse** effects on one Grade II* Listed Building (The Dairy at Stebbing Farm, The Old Farmhouse Stebbing Farm and the Tudor House at Stebbing Farm) and one Grade II Listed Building (Thatched Cottage)

Summary of Potential operational effects

Table 7.13 - Summary of operational effects

Aspect	Post mitigation predicted effect
Landscape - Operation	• **Slight adverse** effect on LCA 208: Knebworth
Visual Effects - Operation	• **Slight adverse** effect on 23 viewpoints • **Moderate adverse** effect on one viewpoint at Year 1, associated with PSVR8 and the impact of gantry G-A1(M) 09, at Norton Green, reducing to **slight adverse** by Year 15.
Cultural Heritage - Operation	• **Slight adverse** effects on two Registered Park and Gardens (Knebworth and Homewood)

7.8.4 Whilst the majority of receptors would not be subject to a moderate adverse i.e. significant effect, a single gantry location G-A1(M) 09 and associated infrastructure is anticipated to result in a significant effect (PSVR 8: Norton Green) on adjacent properties. Mitigation measures set out in paragraph 7.6.6 are anticipated, by Year 15, to reduce the magnitude of impact such that the significance of effect would no longer be significant.

8. Noise and Vibration

Key features for this topic:

- Twelve noise Important Areas occur within the wider calculation area, including 10 that occur along the Proposed Scheme;
- The temporary removal of an existing noise barrier will be required at 2 locations; in the vicinity of Oaklands and Symonds Green. A 50m section will be temporarily removed at each existing noise barrier, affecting a total of 112 residential receptors and a care home within 100m of the removed barriers;
- Sensitive receptors located within Todds Green, Fishers Green, Symonds Green, Norton Green, Knebworth, Rabley Heath, Potters Heath, Oaklands, Danesbury and Welwyn could potentially experience prolonged periods of construction noise;
- Construction vibration may have an impact on 730 properties within 160m of potential piling, and management is therefore required at the following locations; Todds Green, Fishers Green, Symonds Green, Norton Green, Knebworth, Rabley Heath, Potters Heath, Oaklands, Danesbury and Welwyn;
- Vegetation clearance could lead to the perception of increased noise levels within Todds Green, Fishers Green, Rabley Heath, Old Knebworth, Knebworth, Norton Green, Symonds Green, Oaklands, Danesbury and Welwyn;
- Five new noise barriers amounting to approximately 2.3km in length are for rectification purposes and have been included in the Proposed Scheme design and therefore included in the noise modelling and assessment;
- Assuming approval of the 5 noise barriers, 1,176 dwellings that are exposed to noise levels above the Lowest Observed Adverse Effect Level (LOAEL) are predicted to experience perceivable improvements in noise, with 4 dwellings predicted to experience a perceivable increase in noise, in the opening year;
- With the Proposed Scheme, 84 receptors are no longer predicted to be above the Significant Observed Adverse Effect Level (SOAEL) in the short-term and 53 are no longer predicted to be above the SOAEL in the long-term;
- With the Proposed Scheme, 8 receptors increase above the SOAEL in the short-term and 53 increase above the SOAEL in the long-term;
- No residual significant adverse effects are anticipated from operational noise; and
- There is an opportunity for offsite noise attenuation by increasing the height of the existing bund at Fishers Green. This opportunity would be examined in further prior to DF4.

8.1 Introduction

8.1.1 This chapter sets out the findings of the noise and vibration assessment for both the construction and operation of the Proposed Scheme. It builds on the findings and recommendations of the Environmental Scoping Report, and incorporates relevant new information and recent changes to Highways England guidance since the Environmental Scoping Report [79] was produced.

8.1.2 The chapter provides:

- A summary of the assessment methodology adopted, including a description of the noise calculation area;
- A review of existing and future baseline conditions;
- An assessment of construction noise and vibration;
- An assessment of operational noise;

[79] Highways England A1(M) Junction 6 to 8 Environmental Scoping Report: May 2018

- Details of mitigation (where required to mitigate potentially significant adverse effects) and rectification measures to address the aims of the Noise Policy Statement for England (NPSE)[80]; and
- Measures to manage temporary construction noise and vibration.

8.1.3 The supporting appendices are:

- Appendix 8.1 – Regulatory and policy framework;
- Appendix 8.2 – Road committed developments included in the traffic model;
- Appendix 8.3 – Noise and vibration calculation and assessment assumptions;
- Appendix 8.4 – Analysis of noise rectification measures; and
- Appendix 8.5 – Traffic noise annoyance.

8.1.4 The following figures support this chapter:

- Figure 8.1 – Noise constraints map;
- Figure 8.2 – Noise change contour plots: Do Something 2022 vs Do Minimum 2022 day-time;
- Figure 8.3 – Noise change contour plots: Do Something 2022 vs Do Minimum 2022 night-time;
- Figure 8.4 – Noise change contour plots: Do Something 2037 vs Do Minimum 2022 day-time;
- Figure 8.5 – Noise change contour plots: Do Something 2037 vs Do Minimum 2022 night-time;
- Figure 8.6 – Noise change contour plots: Do Minimum 2037 vs Do Minimum 2022 day-time;
- Figure 8.7 – Noise change contour plots: Do Minimum 2037 vs Do Minimum 2022 night-time;
- Figure 8.8 – Noise receptors J6–J7 diversion route; and
- Figure 8.9 – Noise receptors J7–J8 diversion route.

8.1.5 The professional competency of the topic lead for this Chapter is detailed in Appendix 1.1. This information is provided to fulfil the requirement of EU Directive 2014/52/EU.

8.2 Scoping

8.2.1 This assessment has been undertaken in accordance with the assessment methodology presented in the Environmental Scoping Report, with the exception of the Significant Observed Adverse Effect Level (SOAEL) and Lowest Observed Adverse Effect Level (LOAEL) values for construction vibration:

- There has been a change to the vibration level adopted for the LOAEL and SOAEL from that presented in the Environmental Scoping Report. In the Environmental Scoping Report, the LOAEL was defined as a Peak Particle Velocity (PPV) below 10mm/s and the SOAEL as a PPV above 10mm/s. In this Environmental Assessment Report (EAR), the LOAEL has been defined as a PPV below 1mm/s and the SOAEL as greater than or equal to 1mm/s. This change brings the adopted LOAEL and SOAEL more in line with the guidance presented in BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration

8.2.2 There has been no change in the number of candidate noise barriers to be assessed from that presented in the Environmental Scoping Report.

8.2.3 Topics scoped out of the assessment are:

[80] Defra, 2010: Noise Policy Statement for England, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69533/pb13750-noise-policy.pdf

- **Operational ground-borne vibration:** Older roads that experience a high traffic flow, such as the A1(M), are likely to have an uneven surface due to deterioration over time. However, due to the re-surfacing of all 3 lanes as a result of the Proposed Scheme, the level of road traffic ground-borne vibration is likely to be reduced as the effects of potholes and cracks are eliminated. Furthermore, the Design Manual for Roads and Bridges (DMRB) HD 213/11 states “no evidence has been found to support the theory that traffic induced vibrations are a source of significant damage to buildings…Such vibrations are unlikely to be important when considering disturbance from new roads and an assessment will only be necessary in exceptional circumstances”. Consequently, ground-borne vibration at receptors as a result of operational road traffic from the Proposed Scheme is considered unlikely to be significant and has therefore been excluded from this assessment.
- **Construction traffic noise:** Apart from movements to and from construction compounds, construction traffic would primarily be using the A1(M) for accessing works. Given the volume of traffic already using the A1(M), any increase in noise level as a result of construction related traffic is considered unlikely to be significant and so construction traffic noise has been excluded from this assessment.

8.2.4 It is noted that annoyance is measured in terms of the percentage of the population that is bothered “very much” or "quite a lot" by virtue of a specific traffic-related noise level. As annoyance does not contribute towards decisions over the environmental impact of a Smart Motorway Programme (SMP) scheme, the assessment is presented in Appendix 8.5.

8.3 Methodology

8.3.1 This section summarises the following:

- The noise calculation area;
- Legislation, policy and guidance;
- Baseline information and data sources;
- Traffic data and forecasting scenarios;
- Construction noise and vibration;
- Provision of noise barriers;
- Magnitude of impacts;
- Significance of effects;
- Limits of deviation;
- Assumptions and limitations; and
- Stakeholder engagement.

Noise calculation area

8.3.2 The calculation areas for construction and operational noise and vibration assessments are as follows:

- **Construction noise:** No significant adverse effects are expected beyond 300m from proposed construction activities and candidate construction compound locations;
- **Construction vibration:** No significant adverse effects are expected beyond 100m from works to structures, pavement or piling operations (with the exception of impact piling where significant adverse effects could be expected beyond 100m); and
- **Operational noise:** A calculation area based on a 600m distance from the Proposed Scheme has been used. In addition, the calculation area extends 600m around affected roads[81] with a change in noise level of at least 1dB $L_{A10,18h}$ in the short-term or at least 3dB $L_{A10,18h}$ in the long-term, up to a maximum distance of 1km from the Proposed Scheme. The operational noise calculation area is shown in Figure 8.1.

[81] http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/hd21311.pdf

Legislation, policy and guidance

8.3.3 The assessment has been undertaken in a manner that reflects the current policy and regulatory framework (see Appendix 8.1) and in accordance with the following guidance:

- DMRB HD 213/11 Rev. 1 Noise and Vibration[82] supported by the SMP Design Guide[83] to reflect the characteristics of SMP schemes;
- Interim Advice Note (IAN) 185/15[84]- Updated traffic, air quality and noise advice on the assessment of link speeds and generation of vehicle data into 'speed-bands' for users of DMRB Volume 11, Section 3, Part 1 'Air Quality and Noise and Part 7 'Noise';
- Guidelines for Environmental Noise Impact Assessment, Institute of Environmental Management and Assessment, October 2014[85];
- BS 5228 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise and Part 2: Vibration, British Standards Institution[86]; and
- Calculation of Road Traffic Noise (CRTN)[87] supplemented by the SMP Design Guide advice.

8.3.4 The Design Guide provides best practice guidance on the delivery of noise barriers, construction noise, noise surveys and noise assessment.

Baseline information and data sources

8.3.5 The following data sources have been examined to determine the baseline acoustic environment:

- The location of the Department for Environment, Food and Rural Affairs (Defra) noise Important Areas taken from Government Open Data;
- Location of existing noise barriers within the motorway boundary using the Environmental Information System (EnvIS); Asset Visualisation and Information System (AVIS); Structures Management Information System (SMIS) databases and imagery from Google Earth Pro (accessed in November 2018);
- A review of the condition of existing noise barriers in December 2018 based on imagery from Google Earth Pro;
- Receptor locations and associated uses and sensitivities from Ordnance Survey (OS) AddressBase Premium September 2018 and the OSMasterMap database September 2018 - Licenced to Highways England;
- The location of Emergency Diversion Routes; and
- An understanding of the existing highway pavement regime from data recorded in Highways England pavement database (HAPMS).

8.3.6 Baseline conditions have been established from:

- Computer noise modelling of the baseline noise levels from road noise sources in the calculation area for the opening and design years;
- Information from Defra's Noise Action Planning Important Areas Round 2 England for noise Important Areas; and
- An online review of the condition of the existing noise barriers (see Table 8.9).

Traffic data and forecasting scenarios

8.3.7 The operational road traffic noise impact assessment of the Proposed Scheme uses traffic data covering an area approximately 1km from the Proposed Scheme and therefore the calculation area in its entirety. All the traffic data used within the noise model falls within the Traffic Reliability Area (see Figure 5.1 in Chapter 5: Air Quality). This term Traffic Reliability Area is defined in paragraph 5.2.4 of Chapter 5: Air Quality.

[82] http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/hd21311.pdf
[83] https://smpbim.withbc.com/bc/bc.cgi/0/429658?op=ui#oid=60112&cid=0&if=bc
[84] http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian185.pdf
[85] https://www.iema.net/event-reports/2016/01/07/Launch-Webinar-IEMA-Guidelines-for-Environmental-Noise-Impact-Assesment-2014/
[86] http://www.legislation.gov.uk/uksi/2015/227/pdfs/uksi_20150227_en.pdf
[87] Department of Transport (1988). Calculation of Road Traffic Noise (CRTN). Welsh Office; HMSO.

8.3.8 There are 7 Highways England schemes and 26 Local Highway Authority schemes that are expected to open within 18 months of each other (see Appendix 8.2 for a full list of these schemes) and these have been taken into consideration in the traffic models.

8.3.9 The assessment of operational road traffic noise impacts involves a comparison of the predicted noise levels using the proprietary software CadnaA for 4 assessment scenarios to facilitate the following 3 comparisons:

- Short-term (difference in noise levels between Do Something 2022 and Do Minimum (2022);
- Long-term Do Minimum (difference in noise levels between Do Minimum 2037 and Do Minimum 2022); and
- Long-term Do Something (difference in noise levels between Do Something 2037 and Do Minimum 2022).

8.3.10 The traffic noise predictions are based on traffic data as described in section 2.6 with speed banded traffic data being used in the noise model. Method 3 of the TRL report 'Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping' has been used for estimating night-time noise. This is based on the predicted 18-hour L_{A10} daytime noise levels and the type of road (i.e. different calculations are applied for motorway and non-motorway roads).

8.3.11 The night-time traffic flows are "unconstrained" and therefore do not increase at the same rate as the daytime flow. Therefore, to calculate the night-time noise levels, the Do Minimum traffic flows have been used on the Do Something alignment for the relevant assessment scenario (e.g. the Do Minimum 2037 flows have been assigned to the Do Something 2037 alignment).

8.3.12 Extensive engagement has been undertaken between the acoustics team, air quality team and traffic modelling team. Further details on traffic data are provided in Appendix 5.4.

Construction noise and vibration

8.3.13 The assessment of construction noise and vibration considers the following:

- **Piling:** Locations where a risk of disturbance being caused to nearby receptors have been identified;
- **Construction compounds:** While the location of construction compounds is determined at Design Fix (DF) 5, the potential for local sensitive receptors to experience significant disturbance has been considered and documented in the OEMP, with appropriate actions for the Delivery Partner;
- **Pavement works:** As works to the pavement involve noisy operations frequently undertaken at night, those locations where temporary mitigation could be required have been recorded in the OEMP;
- **Vegetation clearance:** Areas where vegetation clearance may cause disturbance to local residents have been identified and control measures specified in the OEMP;
- **Noise barrier replacement works:** An assessment of the potential disturbance at adjacent receptors where an existing noise barrier must be removed for an extended duration (see paragraph 8.7.13) has been undertaken and the feasibility of temporary noise attenuation has been addressed in the OEMP;
- **Traffic management options during construction:** Delivery Partners may select a contraflow or narrow lane flows on both carriageways as a means of managing traffic during construction. Traffic speeds will be reduced during the construction works. Therefore, there is the potential for a large change in noise to be perceived by nearby residents when the Proposed Scheme is open and this has been considered to inform traffic management decisions and stakeholder engagement; and

- **Diverted motorway traffic:** Traffic management through the use of contraflow, narrow lane flows and rolling road blocks may be used rather than full motorway closures, thereby avoiding the requirement to divert motorway traffic along the Local Highway Authority diversion routes (except in an emergency). However, in some instances depending on the traffic management proposals, full closures of the motorway may be required. Therefore, an assessment of the environmental sensitivity of the planned diversions has been undertaken, identifying those locations where traffic could give rise to disturbance with potential mitigation recorded in the OEMP.

8.3.14 Potential construction noise and vibration levels have been estimated using typical construction equipment in accordance with the guidance in BS 5228-1 (see assumptions in Appendix 5.3). The method used is that in BS 5228-1 Annex F.

Provision of noise barriers

8.3.15 The following approach has been taken in the assessment of noise barriers:

- Consideration has been given to the existing condition of noise barriers;
- Situations where a noise barrier is required to avoid a significant effect have been identified. These noise barriers would be required for mitigation and thus are not subject to the value for money analysis; and
- For situations where a significant effect is not identified, then the 'candidate' noise barriers have been examined for their engineering deliverability, Value for Money, and constraints arising from other design elements (e.g. ecological or landscape constraints) to determine whether they are to be incorporated into the Proposed Scheme as proposed noise barriers for rectification purposes only.

8.3.16 The Value for Money assessment has been undertaken based upon the December 2017 Department for Transport GDP and discount values, and noise barrier cost data. Further detail on the cost-benefit methodology can be found in Appendix 5.4.

8.3.17 Where multiple barrier heights are viable and where a marginal difference in their Value for Money exists, then the difference in the number of receptors receiving a reduction in noise along with any other non-monetised implications have been considered.

Magnitude of impacts

8.3.18 The magnitude of impact of construction noise on residential receptors is classified in accordance with the descriptors in Table 8.1. Non-residential receptors (e.g. education, health and community facilities) have been assessed in line with the same criteria, but only for those times when the receptors/facilities are sensitive to noise.

Table 8.1 - Construction noise magnitude of impact criteria for residential receptors

Magnitude	Daytime $L_{Aeq,T}$ dB (façade)	Evening and night-time $L_{Aeq,T}$ dB (façade)
Major	> 80	> 60
Moderate	75-80	55-60
Minor	70-75	50-55
Negligible	≤ 70	≤ 50

8.3.19 In terms of construction induced vibration, some effects on human receptors may occur at low levels of vibration and hence the onset of potential adverse effect, the SOAEL, has been taken to be 1mm/s. The magnitude of impact of construction vibration on residential receptors is classified in accordance with the descriptors in Table 8.2.

Table 8.2 - Threshold of adverse effects for construction vibration

Vibration level A), B), C) (PPV)	Effect	Impact magnitude
0.14mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Negligible
0.3mm/s	Vibration might be just perceptible in residential environments.	Minor
1.0mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated with prior warning and explanation has been given to residents.	Moderate
10mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.	Major

A) The vibration levels presented apply to a measurement position that is representative of the point of entry into the recipient.
B) A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available.
C) Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or predicted then an assessment in accordance with BS 6472, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.
Source: BS 5228-2 Table B.1.

8.3.20 The magnitude of operational noise impacts associated with a change in road traffic noise over the short and long-term are presented in Table 8.3.

Table 8.3 - Classification of magnitude of operational noise impacts – short and long-term

Short-term noise change $L_{A10,18h}$ (dB)	Long-term noise change $L_{A10,18h}$ (dB)	Magnitude of impact
0.0	0.0	No change
0.1 – 0.9	0.1 – 2.9	Negligible
1.0 – 2.9	3.0 – 4.9	Minor
3.0 – 4.9	5.0 – 9.9	Moderate
≥5.0	≥10.0	Major

Significance of effects

8.3.21 The EIA significance of the change caused by the Proposed Scheme is predominantly based on the magnitude of impact, but with consideration given to the following:

- Absolute noise levels;
- Characteristics of the existing noise environment;
- Duration of the impact;
- Nature, times of use and design of the receptor (for non-residential receptors); and
- Professional judgement.

8.3.22 Where a minor change in magnitude arises in operational noise, this is unlikely to be significant. Nevertheless, consideration is given to whether changes in behaviour or response may occur such that a significant effect results. In the case of a moderate magnitude of impact, then this is likely to be significant unless it is concluded that there would be no change in behaviour or response to the noise change.

8.3.23 In terms of operational noise, the Noise Policy Statement for England has increased focus on absolute noise levels. Where existing traffic noise levels are high (above the SOAEL as defined in Table 8.4), then small changes in traffic noise levels on scheme opening (1dB or more) may be notable in policy terms, but not under the EIA Directive 2014/52/EU.

Table 8.4 - SOAEL and LOAEL for road traffic noise during day and night-time

Parameter	Value for daytime	Value for night-time
SOAEL	68dB $L_{A10,18h}$ (façade) 63dB $L_{Aeq,16h}$ (free-field)	55dB $L_{night,\ outside}$ (free-field)
LOAEL	55dB $L_{A10,18h}$ (façade) 50dB $L_{Aeq,16h}$ (free-field)	40dB $L_{night,\ outside}$ (free-field)

Sources: Night-noise guidelines for Europe, World Health Organisation (WHO), 2009[88] for night-time values.
Noise Insulation Regulations[89] Relevant Noise Level for daytime SOAEL.
Guidelines for Community Noise, WHO, 1999[90] for daytime LOAEL (from the 50dB $L_{Aeq,16h\ (7\text{-}23),outdoors}$ for the onset of moderate community annoyance).

8.3.24 For construction noise, Table 8.5 shows the noise level thresholds for LOAEL and SOAEL. Where the existing ambient noise level is currently above SOAEL, then higher values could be employed with the agreement of Highways England.

Table 8.5 - Thresholds for potential effects of construction noise at dwellings (dB $L_{Aeq\ T}$)

Period	SOAEL	LOAEL
Daytime weekday (07:00-19:00) and Saturdays (07:00-13:00)	75	70
Evenings weekday (19:00-23:00), Saturdays (13:00-23:00) and Sundays (07:00-23:00)	65	60
Night-time(23:00-07:00)	55	50

Note: Adapted from Table E.1 in BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites – Part 1 Noise', Annex E.

8.3.25 Focusing on the significance of construction vibration on humans, levels of around 1mm/s may give rise to significant adverse effects; therefore, the SOAEL has been defined at this value. A higher threshold of 15mm/s[91] has been adopted to identify significant adverse effects for the onset of cosmetic damage to buildings. However, it is noted that much higher vibration levels would need to be predicted before structural damage would be anticipated to occur.

Table 8.6 - Threshold of effects from construction vibration

Building	Peak Component Particle Velocity	
	4Hz to 15Hz	>15Hz
Reinforced or framed structures – industrial and heavy commercial buildings	50mm/s	50mm/s
Unreinforced or light framed structures - residential or light commercial buildings	15mm/s at 4Hz 20mm/s at 15Hz	20mm/s at 15Hz 50mm/s at >40Hz

8.3.26 For residential and other sensitive receptors, construction noise or vibration constitutes a significant environmental effect if it is above SOAEL thresholds and for 10 or more days (or nights) in any 15 or for more than 40 days (or nights) in any six-month period.

[88] World Health Organization (2009). "Night Noise Guidelines for Europe"
[89] Statutory Instrument, 1975, No. 1763. Building and Buildings. The Noise Insulation Regulations 1975. As amended by Statutory Instrument 1988 No. 2000. Building and Buildings. The Noise Insulation (Amendment) Regulations 1988
[90] World Health Organization, 1999. "Guidelines for Community Noise".
[91] See BS 5228-2: 2009+A1 2014

Assumptions and limitations

8.3.27 The assessment is based on the Proposed Scheme using the latest developed design which has been advanced from the DF2 layout as described in Chapter 2: The Proposed Scheme, with the assumptions and limitations adopted for this noise and vibration assessment presented in Appendix 8.3.

Stakeholder engagement

8.3.28 No stakeholder engagement has been undertaken to date.

8.4 Baseline conditions

8.4.1 The data sources used to establish the existing baseline conditions are outlined in paragraph 8.3.5 and summarised below.

8.4.2 Figure 8.1 shows the location of the noise sensitive receptors within the operational road traffic noise calculation area. Table 8.7 presents the number of receptors by type within the calculation area.

Table 8.7 - Existing baseline receptors

Receptors	Within 600m	Receptors	Within 600m
Residential properties	5062	Community facilities	19
Caravan sites*	1	Public open space/amenity areas	1
Nursery	1	Places of worship	4
Educational facilities	19	Other sensitive premises	16
Health facilities	10	Hotels	4
* The caravan site is considered as a single residential receptor in this assessment.			

Noise Important Areas

8.4.3 The location of the 12 noise Important Areas within the calculation area for the Proposed Scheme is presented in Figure 8.1 with an estimate of the number of residential properties within each noise Important Area provided in Table 8.8.72222/*

Table 8.8 - Estimated number of residential properties within road noise Important Areas

Noise Important Area (ID number)	Authority responsible for noise Important Area	Location	No. of residential properties
4885	Hertfordshire Council	A602 corner of Tates Way	2
4886	Highways England	A1(M) near Fishers Green overbridge	19
4887	Highways England	A1(M) near Symonds Green	110
4882	Hertfordshire Council	A1072 near Symonds Green	30
4888	Highways England	A1(M) near Meadway underbridge	13
4891	Highways England	Chadwell Road, Norton Green	12
4892	Highways England	North Lodge South	2
5439	Highways England	A1(M) near Wych Elm Lane overbridge	4
5440	Highways England	A1(M) near Normans Lane	1
5441	Highways England	A1(M) near Oaklands	139
5442	Highways England	Welwyn Bypass Road	45
6151	Highways England	Maran Avenue	17

Existing noise barriers

8.4.4 The Proposed Scheme currently provides noise attenuation in the form of existing noise barriers at the locations recorded in Table 8.9 and illustrated on Figure 8.1. The condition of the existing barriers has been based on aerial photography (as per paragraph 8.3.5). A more detailed condition survey should be undertaken post Design Fix 3 (DF3).

Table 8.9 - Location of existing noise attenuation

Id	Location	Carriageway	Length (m)	Height (m)	Noise Important Area ID	Condition	Asset owner
ENB1	A1(M) near The Avenue underbridge	Northbound	144	2.5	5441	Neither obvious defects nor totally good condition, some posts appear to be leaning	Private
ENB2	A1(M) near The Brambles, Oaklands	Southbound	416	2	5441	Unknown – mostly covered with vegetation	Highways England
ENB3	A1(M) near Normans Lane	Northbound	107	2.5	5440	No obvious defect on the sections of the barrier that are visible but it is mostly hidden by vegetation	Private
ENB4	A1(M) near Meadway underbridge	Southbound	159	3	4888	In good condition with no obvious defects	Highways England
ENB5	A1(M) near Symonds Green	Southbound	358	3	4887	In good condition with no obvious defects	Highways England

Existing Pavement Conditions

8.4.5 In the Do Minimum Opening Year (Do Minimum 2022), the existing pavement between Junction 6 and Junction 8 has been modelled as an existing low noise surface (LNS) also known as Thin Surface Course, with a road surface correction of -2.5dB where the speed[92] is greater than or equal to 75km/h and -1dB where the speed is less than 75km/h. A 205m section of hot rolled asphalt in Lane 2 of the northbound carriageway is located 274m metres prior to the off-slip at Junction 6. A road surface correction of -1dB has been applied to this section of road as the speed is less than 75km/h.

8.4.6 The local road network, which is included within the calculation area but not within the Proposed Scheme extent, has been modelled as hot rolled asphalt. A road surface correction of -0.5dB has been applied where the speed is greater than or equal to 75km/h and -1dB where the speed is less than 75km/h.

8.4.7 There are no residential receptors within any noise Important Areas in the calculation area where the existing road surface comprises a concrete surface.

Future Baseline Conditions

8.4.8 A search was undertaken of the Planning Register for the neighbouring Local Planning Authorities for submitted or consented development proposals and other sources[93], from August 2013 to January 2019[94], that meet the following criteria:

- Employment developments (B1, B2 and B8 only) within 1km of the Proposed Scheme (criteria for selecting developments are specified in Table 10.2);
- Residential: 200+ dwellings within 1km of the Proposed Scheme;
- Residential: 10+ dwellings within 300m of the Proposed Scheme;
- Major Minerals and Waste applications within 1km of the Proposed Scheme;
- Nationally Significant Infrastructure Projects within 1km of the Proposed Scheme;
- Transport infrastructure proposals within 1km of the Proposed Scheme (trunk roads or motorways only).

8.4.9 Following the above criteria, sufficient environmental data and assessments for the development in question would need to be readily available for the cumulative assessment to be conducted with any confidence. Should such information not be available for any given development, then that development has not been taken into account in the assessment of cumulative effects.

8.4.10 Following the above criteria, developments located greater than 300m from the Proposed Scheme will only be assessed where a valid planning permission has been secured, and for which formal environmental impact assessment or non-statutory environmental impact assessment has been undertaken.

8.4.11 Developments identified as part of the future baseline i.e. currently under construction or committed, are included in Chapter 2: The Proposed Scheme, section 2.6, Land use development proposals.

8.4.12 There are 2 submitted or consented development proposals that meet the above criteria set out in paragraph 8.4.8, as presented in Table 8.10. A comment on the context of these 2 proposals, in terms of whether the proposed dwellings would be exposed to noise levels above the SOAEL and whether any noise attenuation is included within the scheme design, is also presented in the table.

[92] The speeds referred to here are speed banded data provided for the assessment (see paragraph 8.3.10).
[93] A review of major development allocations from Development Plans, Growth Fund Projects, Strategic Housing Land Availability Assessments and Employment Land Availability Assessments has been undertaken on those plans published as of November 2017. A review of all Nationally Significant Infrastructure Projects (NSIP) detailed in the register of applications as of January 2019. Major development sites such as sustainable urban extensions are then captured within the transport modelling uncertainty log.
[94] A review of the planning register from August 2013 to November 2017 was provided by Highways England in May 2018. A review of the Planning Register has been updated up to January 2019.

Table 8.10 - Proposed land use change

Planning application Id	Local Authority	Location	No. of dwellings proposed	Distance from Scheme (m)	Consented
6/2017/1751/OUTLINE	Welwyn Hatfield Borough Council	22, The Avenue, Welwyn, AL6 0PP. Falls within noise Important Area 5441.	12	35	Under appeal
	Context: Noise levels above the daytime SOAEL. However, noise bund and barrier up to an overall height of 4-5m proposed along south-east boundary of the site adjacent to northbound carriageway of A1(M) to reduce noise levels.				
15/00101/FPM	Stevenage Borough Council	Land at Chadwell Road, Norton Green Stevenage, Hertfordshire. Falls within noise Important Area 4891.	14	60	Planning Consent obtained 16th March 2017
	Context: Noise levels above the daytime SOAEL. However, noise barriers up to 2.4-2.8m high proposed along the eastern boundary of site adjacent to northbound carriageway of A1(M) to reduce noise levels.				
Note: the barriers referred to in the context section of Table 8.10 are not Highways England barriers, but are included within the planning application for the committed development.					

8.4.13 With regards to the pavement, by the Do Minimum Design Year (Do Minimum 2037), it is expected that the existing 2 running lanes of the A1(M) would be resurfaced with a new low noise surface. A road surface correction of -3.5dB has therefore been applied where the speed is greater than or equal to 75km/h and -1dB where the speed is less than 75km/h.

8.4.14 Traffic flows are expected to increase between 2022 and 2037, even if the Proposed Scheme does not proceed, resulting in elevated noise levels with all else remaining equal. The long-term changes in traffic noise levels if the Proposed Scheme does not proceed are presented in Table 8.11 and Figures 8.6 and 8.7. A total of 5,063 residential properties are located within the calculation area, with 381 predicted to exceed the SOAEL value and 4,326 predicted to exceed the LOAEL value at 1 or more façades, in 1 or more scenarios.

8.4.15 For the daytime period, 780 residential properties, which are exposed to noise levels above the LOAEL, are predicted to experience noise increases due to traffic growth without the Proposed Scheme, all of which are negligible (within the 0.1 to 2.9dB range). Of these properties, noise at 338 properties is predicted to increase by 1-2dB. The 338 residential properties predicted to experience noise increases of ≥ 1dB are in the vicinity of the Proposed Scheme by Symonds Green, Titmore Green and Knebworth.

8.4.16 For the night-time period, 126 residential properties that exceed the SOAEL are predicted to experience noise increases, all of which are negligible. The 81 residential properties predicted to experience noise increases of ≥ 1dB, ranging from 1.0 to 1.5dB, are in the vicinity of the Proposed Scheme by Symonds Green, Titmore Green and Knebworth.

Table 8.11 - Long-term traffic noise changes (Do Minimum 2022 to Do Minimum 2037)

Change in noise level		Daytime			Night-time
		Number of residential properties between LOAEL and SOAEL	Number of residential properties above SOAEL	Number of other sensitive receptors	Number of residential properties above SOAEL
Increase in noise level, $L_{A10,18h}$	0.1 - 2.9	582	198	12	126
	3 - 4.9	0	0	0	0
	5 - 9.9	0	0	0	0
	≥10	0	0	0	0
No change	= 0	110	5	1	7
Decrease in noise level, $L_{A10,18h}$	0.1 - 2.9	3634	178	57	534
	3 - 4.9	0	0	0	0
	5 - 9.9	0	0	0	0
	≥10	0	0	0	0

8.5 Assessment of construction noise and vibration

8.5.1 The noise and vibration effects of construction activities upon nearby sensitive receptors have been considered in terms of the general operations; site preparations for candidate construction compounds; retaining walls and motorway closures.

8.5.2 Planned construction methods and scheduling will not be known until all relevant surveys, engineering constraints and environmental constraints have been taken into account and a Delivery Partner has been appointed to devise construction methods. A risk based assessment has therefore been undertaken based on typical road construction activities and noise levels reported in BS 5228-1 Annexes C and D, supplemented by prior experience (see Appendix 5.3). These risks will be managed in the Construction Environmental Management Plan (CEMP).

8.5.3 The following activities have been considered as part of the construction phase assessment to ensure that appropriate design and management activities are in place and specified in the OEMP to avoid unnecessary adverse impacts:

- Central reserve phase, including the replacement of existing structures and the construction of the central reserve rigid concrete barrier (RCB);
- Verge phase, including vegetation clearance, stripping out of noise barriers, gantry foundation and emergency area construction;
- Retaining wall construction;
- Resurfacing works, including removal of existing surface and laying of new surface;
- Drainage works;
- Road marking works;
- Signage works; and
- Construction of works compound.

8.5.4 The context of construction noise and vibration as well as the duration of the impact needs to be taken into account when determining the significance of effect with regard to the EIA Directive 2014/52/EU. Construction noise is different in character and more variable in level than road traffic noise. The key aspects, in terms of determining significance, are the predicted construction noise or vibration level and whether this is above the LOAEL or SOAEL (which, in turn, is based on the operating construction plant and the distance to the sensitive receptor), as well as the times and duration of the construction works. These aspects are explored further below.

8.5.5 Indicative noise levels at various distance bands, ranging from 10 to 300m from the Proposed Scheme, have been predicted for each of the key construction activities defined above in accordance with the guidance in BS 5228-1. The predicted noise levels are shown in Table 8.12. A schedule of the equipment assumed for the purposes of this assessment is provided in Appendix 5.3.

8.5.6 The calculations do not take into account existing noise barriers or other screening, such as embankments or buildings. Where properties are completely screened from the works, it would be expected that noise levels could be up to 10dB lower. As the intervening ground cover between the Proposed Scheme and closest receptors is predominantly absorptive in the acoustic sense, the calculations have taken this in to account. It should be noted, however, that the 3D noise model assumes that roads, buildings and water bodies are acoustically reflective.

8.5.7 It is understood that all elements of the construction works have the potential to be undertaken at night for safety reasons (for example to avoid site operatives working close to the live motorway). Therefore, the construction noise assessment has been based on night-time working as a worst case scenario. The noise levels, which are expected to be in excess of the night-time construction SOAEL (55dB $L_{Aeq,8h}$) and therefore non-compliant with the NPSE, are highlighted in Table 8.12. However, it should be noted that receptors including Graveley, Todd's Green, Fishers Green, Symonds Green, Norton Green, Old Knebworth, Knebworth, Rableyheath, Pottersheath, Oaklands, Welwyn and Digswell Park are already subject to ambient noise levels in excess of the SOAEL (the areas which are predicted to be exposed to noise levels above the daytime and night-time SOAEL are shown within the dashed red lines on Figure 8.2 to 8.7).

8.5.8 The distance to the daytime construction SOAEL (75dB $L_{Aeq,12h}$) has also been provided in Table 8.12 should any of the construction activities be undertaken during daytime hours.

8.5.9 In order to facilitate cross-referencing between the EAR and the specific mitigation measures in the OEMP, the identification numbers, which have been assigned for each structure or activity in the OEMP, have been included in the table below.

Table 8.12 - Indicative construction noise levels

Phase	Activity	OEMP ID	Construction noise level dB $L_{Aeq,8h}$ at distance (m) from works						Distance to daytime SOAEL	Distance to night-time SOAEL
			10m	20m	50m	100m	200m	300m		
Central reserve works	Removal of existing structures and installation of rigid concrete barrier (RCB).	NV003-009, NV012-014, NV019-027, NV029-036, NV039, NV041	78	72	62	55	47	43	14m	96m
Verge works	Demolition, clearance and stripping out of noise barriers (if required)	NV003-009, NV012-014, NV019-027, NV029-036, NV039, NV041	83	77	68	60	53	49	27m	165m
	Gantry installation (assumes percussive piling)	NV003-009, NV012-014, NV019-027, NV029-036, NV039, NV041	80	74	65	57	50	45	19m	124m
	Emergency area (assumes percussive piling)	NV003-009, NV012-014, NV017-027, NV029-036, NV039, NV041	83	77	67	60	52	48	26m	158m
Resurfacing works	Removal of existing surface	NV003-009, NV012-014, NV019-027, NV029-036, NV039, NV041	85	79	69	62	54	50	31m	186m
	Laying new surface	NV003-009, NV012-014, NV019-036, NV039, NV041	79	71	62	54	47	43	14m	95m
Drainage works	Drainage works	NV003-009, NV012-014, NV019-027, NV029-036, NV039, NV041	79	73	63	56	48	44	17m	109m

Phase	Activity	OEMP ID	Construction noise level dB $L_{Aeq,8h}$ at distance (m) from works						Distance to daytime SOAEL	Distance to night-time SOAEL
			10m	20m	50m	100m	200m	300m		
Road marking works	Road marking works	NV003-009, NV012-014, NV019-027, NV029-036, NV039, NV041	75	69	59	52	44	40	10m	74m
Signage works	Signage works	NV003-009, NV012-014, NV019-027, NV029-036, NV039, NV041	80	74	64	57	49	45	18m	117m
Notes: Where noise levels are predicted to exceed the night-time SOAEL (55dB $L_{Aeq,8h}$), this is highlighted in grey										

8.5.10 Most of the activities listed in Table 8.12 would be of very short duration at a single location (e.g. gantry installation) or transient in the case of linear activities (e.g. resurfacing/road markings) and therefore should not give rise to significant effects, so have not been considered further. The focus is therefore upon the following:

- Temporary removal of existing noise barriers;
- Piling activities;
- Construction compounds and vehicle recovery areas;
- Traffic management and diversion of motorway traffic at night; and
- Vegetation clearance.

Temporary removal of existing noise barriers

8.5.11 The temporary removal of an existing noise barrier would be required at 2 locations; ENB2 and ENB5.

8.5.12 ENB2 is located near Oaklands and a 50m section will be removed to allow for the construction of a gantry (GA1(M) 26), potentially resulting in a temporary increase in noise levels at 63 residential receptors within 100m of the barrier[95]. ENB5 is located near Symonds Green and a 50m section will be removed to allow for the construction of a gantry (GA1(M) 18), potentially resulting in a temporary increase in noise levels at 49 residential receptors within 100m of the barrier.

8.5.13 Assuming that these receptors are not mitigated by temporary barriers, then 112 dwellings in Oaklands and Symonds Green could be exposed to an increase in noise levels. However, the increase in noise would be offset by a decrease in road traffic noise as a result of the lower traffic speeds on the A1(M) during active traffic management.

8.5.14 The closest receptors to the existing noise barrier (ENB2) near Oaklands are approximately 20m away. At this distance, the noise level associated with construction of the gantry would be 75dB $L_{Aeq,12h}$ during the day and 74dB $L_{Aeq,8h}$ at night (see Table 8.12).

8.5.15 The daytime construction SOAEL is 75dB $L_{Aeq,12h}$, and therefore **no significant effects** are anticipated should the construction of the gantry GA1(M) 26 be undertaken during daytime hours. However, best practicable means (BPM), as presented in the OEMP, should still be employed.

8.5.16 The night-time construction SOAEL is 55dB $L_{Aeq,8h}$. However, receptors in close proximity to the A1(M) are already exposed to night-time noise levels above this level, and therefore a higher construction SOAEL value of 64dB $L_{Aeq,8h}$ is proposed[96] for receptors closest to ENB2 (see paragraph 8.3.24 and Figure 8.2). Consequently, where the construction of the gantry is undertaken at night, there will be an exceedance of the SOAEL by 10dB.

8.5.17 The closest receptors to the existing noise barrier (ENB5) near Symonds Green are approximately 50m away. At this distance, the noise level associated with construction of the gantry would be 65dB $L_{Aeq,T}$ (see Table 8.12). This predicted construction noise level is applicable to both the day and night-time.

8.5.18 The daytime construction SOAEL is 75dB $L_{Aeq,12h}$, and therefore **no significant effects** are anticipated should the construction of the gantry GA1(M) 18 be undertaken during daytime hours. However, best practicable means, as presented in the OEMP, should still be employed.

[95] An assessment of the temporary removal of a 50m section of each existing barrier ENB2 and ENB5 has been undertaken, on the basis that 25m section of barrier either side of the gantry is removed for access. The length of barrier to be removed should be limited and a clause has been added to the OEMP to inform the Delivery Partner to minimise the potential impact of noise on nearby receptors.

[96] Method 3 of the TRL Report *Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping'* has been used to estimate the night-time noise level

8.5.19 The night-time construction SOAEL is 55dB $L_{Aeq,8h}$. However, receptors in close proximity to the A1(M) are already exposed to night-time noise levels above this level, and therefore a higher construction SOAEL value of 60dB $L_{Aeq,8h}$ is proposed for receptors closest to ENB5 (see paragraph 8.3.24 and Figure 8.2). Consequently, where the construction of the gantry is undertaken at night, there will be an exceedance of the SOAEL by 5dB.

8.5.20 The construction works associated with the installation of a new gantry will be undertaken over approximately 1 to 2 weeks and will be limited to less than 10 or more nights in any consecutive 15, via the control measures in the OEMP. Therefore, **no significant adverse effects** are expected as a result of the temporary removal of ENB2 and ENB5. Nevertheless, the construction of the gantries in the vicinity of ENB2 and ENB5 should be undertaken during daytime hours where possible and as above, best practicable means should be employed at all times.

Piling activities

8.5.21 Percussive piling may be used during the installation of gantries as well as during the construction of emergency areas, all of which may require retaining walls.

8.5.22 Receptors near to emergency areas and gantries, as the construction activities most likely to require percussive piling, are presented in Table 8.13. The piling works to construct an emergency area or gantry are anticipated to take 1 to 2 weeks to complete.

Table 8.13 - Sensitive receptor distance bands for potential piling locations

Asset Id	Location	OEMP ID	Approx. chainage	Number of residential properties within distance bands				
				<20 m	20-50m	50-100m	100-200m	200-300m
Emergency areas								
A1(M) EA NB 1	A1(M) near Pottersheath Road overbridge	NV003-009, NV012-014, NV019-027, NV029-036, NV039, NV041	4770 – 4870	0	4	27	63	90
A1(M) EA SB 6	A1(M) near Pottersheath Road overbridge		5210 – 5110	0	0	0	4	16
A1(M) EA SB 5	A1(M) near Spinney Lane overbridge		6350 – 6250	0	0	0	2	43
A1(M) EA NB 2	A1(M) near Spinney Lane overbridge		6335 – 6435	0	0	0	0	29
A1(M) EA SB 4	A1(M) near Park Lane overbridge		7335 – 7235	0	0	1	3	39
A1(M) EA NB 3	A1(M) near Old Knebworth Lane		7760 – 7860	0	0	0	0	0
A1(M) EA SB 3	A1(M) near Old Knebworth Lane		8342 – 8242	0	0	0	0	0
A1(M) EA NB 4	A1(M) near Bessemer Drive underbridge		10725 – 10825	0	0	0	8	7
A1(M) EA SB 2	A1(M) near Bessemer Drive underbridge		11317 – 11217	0	0	0	0	0
A1(M) EA NB 5	A1(M) near Meadway underbridge		11710 – 11810	0	0	0	0	0

Asset Id	Location	OEMP ID	Approx. chainage	Number of residential properties within distance bands				
				<20 m	20-50m	50-100m	100-200m	200-300m
A1(M) EA SB 1	A1(M) near Brighton Way		12917 – 12817	0	1	55	136	190
A1(M) EA NB 6	A1(M) near Brighton Way		2107 – 3488	0	0	17	128	177
Total number of residential properties within distance bands				**0**	**5**	**100**	**344**	**591**
Gantries								
G-A1(M) 01	A1(M) near A1000 underbridge (northbound)	NV003-009, NV012-014, NV019-027, NV029-036, NV039, NV041	2280	0	0	15	83	114
G-A1(M) 02	A1(M) near Great North Road underbridge (northbound)		3375	0	0	0	15	51
G-A1(M) 03	A1(M) near The Avenue underbridge (northbound)		4467	0	1	16	83	135
G-A1(M) 04	A1(M) near Pottersheath Road overbridge (northbound)		5266	0	0	0	0	11
G-A1(M) 05	A1(M) near Spinney Lane overbridge (northbound)		6035	0	0	2	7	8
G-A1(M) 06	A1(M) near Park Lane overbridge (northbound)		7104	0	0	0	9	50
G-A1(M) 07	A1(M) near Lodge Farm		7974	0	0	0	0	0
G-A1(M) 08	A1(M) near Broadhall Way overbridge (northbound)		9425	0	0	0	0	0
G-A1(M) 09	A1(M) near Chadwell Road (northbound)		10625	0	1	3	10	1
G-A1(M) 10	A1(M) near Bessemer Drive underbridge (northbound)		11510	0	0	0	0	0
G-A1(M) 11	A1(M) near Meadway underbridge (northbound)		12163	0	0	0	26	50
G-A1(M) 12	A1(M) near Minehead Way		12867	0	0	8	105	161

Asset Id	Location	OEMP ID	Approx. chainage	Number of residential properties within distance bands				
				<20 m	20-50m	50-100m	100-200m	200-300m
G-A1(M) 13	A1(M) near Fishers Green overbridge (northbound)		13660	0	0	0	20	113
G-A1(M) 14	A1(M) near Graveley Road underbridge (northbound)		14710	0	0	0	0	1
G-A1(M) 15	A1(M) near Graveley Road underbridge (southbound)		14810	0	0	0	0	1
G-A1(M) 16	A1(M) near Fishers Green overbridge (southbound)		13810	0	0	9	70	78
G-A1(M) 17	A1(M) near Brighton Way (southbound)		13117	0	0	15	114	156
G-A1(M) 18	A1(M) near Symonds Green (southbound)		12467	0	1	0	54	168
G-A1(M) 19	A1(M) near Babbage Road (southbound)		11668	0	0	0	0	0
G-A1(M) 20	A1(M) near Bessemer Drive underbridge (southbound)		10971	0	0	0	0	0
G-A1(M) 21	A1(M) near Broadhall Way underbridge (southbound)		9670	0	0	0	0	0
G-A1(M) 22	A1(M) near Old Knebworth Lane underbridge (southbound)		8426	0	0	0	0	0
G-A1(M) 23	A1(M) near Lodge Farm (southbound)		7485	0	0	0	0	1
G-A1(M) 24	A1(M) near Spinney Lane (southbound)		6500	0	0	0	0	27
G-A1(M) 25	A1(M) near Normans Lane (southbound)		5450	0	0	0	1	0
G-A1(M) 26	A1(M) near The Brambles (southbound)		4437	0	4	17	85	135

Asset Id	Location	OEMP ID	Approx. chainage	Number of residential properties within distance bands				
				<20 m	20-50m	50-100m	100-200m	200-300m
G-A1(M) 27	A1(M) near Fishers The Avenue underbridge (southbound)		3750	0	0	0	4	8
G-A1(M) 28	A1(M) near the A1000 underbridge (southbound)		2410	0	0	13	33	98
Total number of residential properties within distance bands				**0**	**7**	**98**	**719**	**1,367**
Note: all distances are to property facades hence gardens may be closer to the works.								

8.5.23 Table 8.14 shows the anticipated vibration levels at different distance bands as a result of percussive piling. The closest properties, up to 50m away, may experience vibration levels up to 4.3mm/s PPV. Under difficult ground conditions, the duration of any piling works may increase to 3 weeks, but it is likely that less time would be spent driving the pile and more time on supporting activities. Where works are continuous, the duration threshold of 10 days out of 15 consecutive days may be exceeded, resulting in a **significant adverse effect**, prior to the implementation of mitigation measures. The potential for significant adverse effects is recognised and the intention is to manage-out any such effects (see section 8.7 and the OEMP).

8.5.24 The need for retaining walls is to be confirmed following ground investigations, hence only a preliminary assessment can be provided at this stage. As the Proposed Scheme evolves and the earthworks solutions are established, the Delivery Partner and/or Design Agent will be responsible for the revisions to the assessment and mitigation measures through to Stage Gate Assessment Review (SGAR) 5 Construction Preparation, with changes and implications captured in the Evaluation of Change PCF product.

8.5.25 Receptors in the vicinity of emergency areas and gantries (construction activities that may require piling), in the following areas, are predicted to experience vibration levels in excess of the SOAEL:

- Todd's Green;
- Fisher Green;
- Symonds Green;
- Norton Green;
- Knebworth;
- Rabley Heath;
- Potters Heath;
- Danesbury;
- Welwyn; and
- Oakland

Table 8.14 - Indicative construction vibration levels – percussive piling

Activity	Vibration level PPV (mm/s) at distance (m)				
	<10	<20	20-50	50-100	160 (SOAEL)
PPV from percussive piling	17.1	11.2	4.3	1.8	1.0
Number of residential properties within distance bands from gantries and emergency areas	0	0	12	198	730
Note: The calculated SOAEL zone distance is outside the prediction range of the calculation in BS:5228-2. However, in order to present a worst-case approach at this stage, the calculated distance has not been limited. Once more detail on the geology of the area and the exact piling technique is known, a more detailed vibration assessment should be undertaken prior to construction works commencing.					

Construction compound and vehicle recovery areas

8.5.26 The preferred location of the construction compounds is not yet known. However, an assessment has been prepared based on the activities likely to cause the greatest noise during the day. In the case of the vehicle recovery areas, however, reversing vehicles and general noise associated with the recovery staff at night could be of greater concern to local residents. Recovery sites are likely to be close to either end of the Proposed Scheme, potentially located beyond the immediate Proposed Scheme area to take advantage of an area of hard standing possibly within a commercial /industrial site. As such, locations are a matter for the Delivery Partner to confirm and therefore, at present, it is not possible to determine whether any significant effects are likely to arise.

8.5.27 As noise levels could be in excess of the daytime SOAEL (75dB $L_{Aeq,12h}$) (see Table 8.15), it is recommended that compounds and recovery areas be located at least 30m from nearby sensitive receptors in order to avoid significant effects during the daytime.

8.5.28 The distance to the night-time SOAEL (55dB $L_{Aeq,8h}$) has also been provided in Table 8.15 below. During site clearance and compound construction, works should be limited to less than 10 nights out of 15 consecutive nights via the control measures presented in the OEMP. Consequently, **no significant adverse effects** are predicted.

Table 8.15 - Indicative noise levels during preparation associated with the construction compound - daytime

Activity	Noise level dB $L_{Aeq,12h}$ at distance (m) from compound site						Distance to night-time SOAEL
	10m	20m	50m	100m	200m	300m	
Site clearance	81	75	66	58	51	46	129m
Compound construction	85	79	69	62	54	50	179m
Compound operation	60	54	45	37	30	25	17m

Note: Where noise levels are predicted to exceed the daytime SOAEL (75dB $L_{Aeq,12h}$), this is highlighted in grey

Traffic management and diversion routes

8.5.29 As stated in paragraph 8.3.13, traffic management (through the use of contraflow, narrow lane flows and rolling road blocks) may be used rather than full motorway closures, thereby minimising the requirement to divert motorway traffic along the Local Highway Authority diversion routes (except in an emergency). This plan, to avoid full closures where possible, has been adopted to minimise the potential noise impact on existing sensitive receptors situated in the vicinity of existing Local Highway Authority diversion routes.

8.5.30 However, in some instances, depending on the traffic management proposals, full closures of the motorway may be required to remove/install gantries and therefore diversion routes may be needed (see Table 8.16). While the diversion routes will require agreement with the Local Highway Authority, the existing Emergency Diversion Routes and receptors[97] within 50m, sensitive to night-time traffic, are presented on Figures 8.8 and 8.9 with a qualitative assessment of sensitivity where:

- **High sensitivity** (red areas) – areas with a high concentration of receptors or particularly sensitive receptors such as a hospice within 50m of the diversion route or signalised junction;
- **Medium sensitivity** (amber areas) – areas with a medium or low concentration of receptors within 50m of the diversion route or signalised junction.

[97] For the purposes of the assessment of diversion routes, which would be used only at night, schools are not considered to be a sensitive receptor.

8.5.31 As potential traffic flows along the diversion routes are not currently known, it is not possible to forecast night-time noise levels beyond recognising that there would be an increase in traffic volume during carriageway closures. It is assumed that some disturbance would inevitably occur at nearby sensitive receptors, which might be exacerbated by the passage of vehicles over an uneven road surface, for example.

8.5.32 Where disturbance is expected to occur for a period of 10 or more working days in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months, then measures would be taken to ensure that **no significant effects** occur.

Table 8.16 - Estimate of the potential for diversion routes to exceed duration threshold

Route description	Motorway closure	noise Important Area on diversion route (Y/N)	Number of sensitive receptors (not dwellings)	Approx. no. of residential properties	Potential number of closures	Potential disturbance	Potential for alternative routes	Potential to exceed BS 5228 duration threshold
Northbound and southbound traffic is diverted onto the B197, using the A1000 to link into Junction 6 and the A602 to link into Junction 7. The diversion route runs through Woolmer Green, Knebworth Village and Oaklands.	J6 to J7	Y	13	626	8	Risk of disturbance to residential properties at Woolmer Green, Knebworth and Oaklands and at Roebuck Nursing Home, Monread Lodge Nursing Home and Candour Care Services.	Unknown	Unlikely
Northbound and southbound traffic is diverted onto the A1072, using the A602 to link into Junction 7 and 8. The diversion route runs through Fishers Green and Symonds Green.	J7 to J8	Y	6	246	9	Risk of disturbance to residential properties at Fishers Green and Symonds Green.	Unknown	Unlikely

Assumptions:

- Two MS4 installations per off-peak carriageway closure.
- Two cantilever gantries installed per single direction carriageway closure.
- One gantry removal per night
- 50m distance from diversion route is adopted for receptor counts.

Vegetation clearance

8.5.33 Vegetation clearance works would normally be undertaken during the day, with operations lasting for a few days at any individual location. Consequently, no significant effect is usually encountered. However, noise from the use of chain saws and other construction plant can give rise to temporary disturbance particularly when the removal of vegetation must be undertaken at night. The location of the vegetation clearance and number of dwellings within 50m and 200m of the clearance works is identified in Table 8.24.

8.5.34 As night-time operations could occur, the OEMP identifies control measures for sensitive locations, as highlighted in Table 8.24 and in particular within Rabley Heath, Old Knebworth, Norton Green, Symonds Green, Oaklands and Welwyn. The OEMP includes a requirement that night-time working is only undertaken in exceptional circumstances with prior notification of residents. When night-time working is unavoidable, then the Delivery Partner shall demonstrate the measures to be taken to ensure there would be **no resultant significant effect**.

Overall construction effects

8.5.35 **Significant temporary adverse effects** could be associated with the construction of emergency areas, retaining walls as well as the temporary removal of existing noise barriers, and diversion routes unless these works are subject to effective management.

8.6 Assessment of operational effects

8.6.1 This section details the following:

- Short-term changes in noise levels; and
- Long-term changes in noise levels.

Short-term changes – Do Minimum 2022 to Do Something 2022

8.6.2 Following the replacement of the existing road surface on all 3 lanes with low noise surface and the introduction of approximately 2.3km of new noise barriers, a perceivable benefit (minor to major) is predicted at approximately 1,176 dwellings that are exposed to noise levels above the LOAEL and SOAEL. In particular, the areas of Welwyn, Oaklands, Fishers Green, Symonds Green and Rabley Heath are expected to experience perceivable reductions in traffic noise (see Figure 8.2 and 8.3).

8.6.3 Table 8.17 records that 164 dwellings that are exposed to noise levels above the LOAEL and SOAEL are predicted to experience a negligible increase in noise level (within the 0.1 to 0.9dB range), with a further 4 predicted to experience a minor increase in noise level ranging from 2.0 to 2.1dB. These 4 residential receptors are located approximately 1km to the west of Junction 8, along Stevenage Road and are not located within a noise Important Area. The predicted increase in noise is as a result of the proposed Little Wymondley bypass, which draws traffic along A602 towards A1(M) Junction 8, which was previously a less attractive route, owing to congestion at A1(M) Junction 7. As the 4 residential receptors are below the SOAEL and only experience a minor change in noise level due to better access to the surrounding local road network, these changes are deemed not significant.

Table 8.17 - Short-term traffic noise changes (Do Minimum 2022 to Do Something 2022)

Change in noise level		Daytime		
		Number of residential properties between LOAEL and SOAEL	Number of residential properties above SOAEL	Number of other sensitive receptors
Increase in noise level, $L_{A10,18h}$	0.1 - 0.9	123	41	9
	1 - 2.9	4	0	0
	3 - 4.9	0	0	0
	≥5	0	0	0
No change	= 0	79	18	2
Decrease in noise level, $L_{A10,18h}$	0.1 - 0.9	2942	196	40
	1 - 2.9	1044	31	14
	3 - 4.9	83	3	5
	≥5	13	2	0

Long-term changes – Do Minimum 2022 to Do Something 2037

8.6.4 The long-term changes in road traffic noise are shown in Figures 8.4 and 8.5. Replacement of the existing road surface on all lanes with low noise surface in the design year and the introduction of approximately 2.3km of new noise barriers would provide a perceivable benefit (minor to major) at approximately 54 dwellings that are exposed to noise levels above the LOAEL and SOAEL.

8.6.5 Table 8.18 records that 1,670 dwellings that are exposed to noise levels above the LOAEL and SOAEL are predicted to experience a negligible increase in noise level (within the 0.1 to 2.9dB range). Of these noise increases, 338 are ≥ 1dB, ranging from 1.0 to 2.0dB. The 338 residential properties predicted to experience noise increases of ≥ 1dB are in the vicinity of the Proposed Scheme by Symonds Green, Titmore Green and Knebworth. However, these predicted increases are due to natural growth as broadly the same magnitude of increase would be experienced if the Proposed Scheme did not go ahead.

8.6.6 For the night-time period, 124 residential properties that are exposed to noise levels above the SOAEL experience noise increases, all of which are predicted to be negligible.

8.6.7 In summary, **no significant adverse effects** as a result of the operation of the Proposed Scheme are predicted, either in the short or long-term.

Table 8.18 - Long-term traffic noise changes (Do Minimum 2022 to Do Something 2037)

Change in noise level		Daytime			Night-time
		Number of residential properties between LOAEL and SOAEL	Number of residential properties above SOAEL	Number of other sensitive receptors	Number of residential properties above SOAEL
Increase in noise level, $L_{A10,18h}$	0.1 - 2.9	1426	244	19	124
	3 - 4.9	0	0	0	0
	5 - 9.9	0	0	0	0
	≥10	0	0	0	0
No change	= 0	467	13	7	16
Decrease in noise level, $L_{A10,18h}$	0.1 - 2.9	2490	105	42	389
	3 - 4.9	40	3	2	24
	5 - 9.9	8	1	0	6
	≥10	1	1	0	2

Traffic noise annoyance

8.6.8 Without the Proposed Scheme, 781 residential properties are predicted to experience increases in traffic noise annoyance, compared to approximately 1,772 residential properties with the Proposed Scheme (see Appendix 8.5).

8.6.9 As part of the Proposed Scheme, most of the existing motorway vegetation would be removed with scope for replanting being determined by the area needed for the Proposed Scheme infrastructure. While the area of vegetation clearance is not confirmed until detailed design, the likely areas of substantive vegetation clearance that could make motorway traffic visible to nearby residents have been identified, as residents may perceive traffic noise differently when they are able to observe moving traffic.

8.7 Design, mitigation and rectification measures

Delivery of Noise Policy Statement for England (NPSE)

8.7.1 The Proposed Scheme delivers the following outcomes in support of the NPSE:

- **Aim 1 - To avoid significant adverse noise effects** (this relates to dwellings exposed to noise levels above the SOAEL): An assessment of new noise barriers located at noise Important Areas (see Table 8.22), and new low noise surface on all 3 lanes in the opening year and the design year, has delivered a benefit to 84 dwellings that would no longer be exposed to levels above the SOAEL in the short-term and 15 dwellings in the long-term[98]. Specifically, in relation to dwellings within a noise Important Area, 41 would no longer be exposed to levels above SOAEL in the short-term (see Table 8.19). However, an additional 8 properties are predicted to be exposed to noise levels above the SOAEL in the opening year in Welwyn, with 1 additional property being exposed to noise levels above the SOAEL in the design year as a result of the Proposed Scheme[99]. The design year change is as a result of natural growth rather than the Proposed Scheme, with the latter contributing less than 1dB. The single property is located in Welwyn. It has not been possible to

[98] The Proposed Scheme will result in 53 fewer properties exposed to noise levels above the SOAEL in the long-term, compared to only 38 if the Proposed Scheme did not go ahead. Hence, overall the Proposed Scheme will result in 15 additional properties exposed to noise levels above the SOAEL by 2037 compared to the 2037 scenario if the Proposed Scheme did not proceed.
[99] The Proposed Scheme will result in 53 additional properties exposed to noise levels above the SOAEL in the long-term, compared to only 52 if the Proposed Scheme did not go ahead. Hence, overall the Proposed Scheme will result in 1 additional property exposed to noise levels above the SOAEL by 2037 compared to the 2037 scenario were the Proposed Scheme did not proceed.

reduce noise levels below SOAEL at all dwellings within the calculation area as other additional rectification measures were found not to provide value for money, and therefore are not in line with the Government's policy on sustainable development (see Table 8.21).

- **Aim 2 - To mitigate[100] and minimise adverse noise effects** (this relates to dwellings exposed to noise levels between the LOAEL and SOAEL): 1,140 dwellings exposed to noise levels between the LOAEL and SOAEL would experience a perceptible (minor to major) reduction in noise levels in the short-term and 49 dwellings in the long-term. However, 4 dwellings exposed to noise levels between the LOAEL and SOAEL would experience a perceptible (minor only) increase in noise levels in the short-term, but no dwellings would experience a perceptible increase in the long-term. Potential off-site measures are identified in Table 8.20.
- **Aim 3 - To improve the noise environment where possible.** As stated above, SMP schemes can consider onsite and offsite measures within the ambit of sustainable development. Measures were considered, but not included for the reasons summarised in Table 8.21.

8.7.2 Isolated or small groups of properties, particularly those not close to the motorway, have not been provided with additional noise barriers due to a poor value for money assessment. Nevertheless, opportunities to provide rectification on third party land have been investigated (see Table 8.20), where the opening year noise levels with the Proposed Scheme would be above the SOAEL, aiding compliance with the second and third of the NPSEs aims. This opportunity would be examined further prior to DF4.

[100] For the avoidance of doubt, 'mitigate' in this paragraph relates to the NPSE and not to significant effects under the EU Directive 2014/52/EU.

Table 8.19 - Noise Important Area – design measures

Noise Important Area Id	No. of dwellings	Design measure	Number of dwellings – Opening Year with Proposed Scheme							Mitigated/Not mitigated*
			Increase		Decrease			Brought below SOAEL	Lowered but above SOAEL	
			>0 to 1 dB	1 to 3 dB	>0 to 1 dB	1 to 3 dB	>3dB			
4885	2	N/A	1	0	1	0	0	0	0	Not mitigated
4886	19	N/A	0	0	19	0	0	8	8	Not mitigated
4887	110	4m high barrier (NNB10)	0	0	20	78	12	0	0	Mitigated, all below SOAEL
4882	30[1]	N/A	0	0	6	0	0	0	0	Not mitigated, dwellings all below SOAEL
4888	13	N/A	0	0	13	0	0	1	0	Not mitigated
4891	12	N/A	0	0	12	0	0	0	3	Not mitigated
4892	2	N/A	2	0	0	0	0	0	0	Not mitigated
5439	4	N/A	0	0	4	0	0	0	4	Not mitigated
5440	1	N/A	0	0	1	0	0	0	1	Not mitigated
5441	139	3m high barrier (NNB3, NNB4, NNB5)	0	0	70	39	30	17	38	Mitigated
5442	45	3m high barrier (NNB1)	0	0	0	42	3	15	18	Mitigated
6151	17	N/A	0	0	17	0	0	0	13	Not mitigated

[1] – 30 dwellings are located within the noise Important Area; however only 6 of these are located within the calculation area.
* – A noise Important Area has been deemed to be mitigated when either all dwellings fall below the SOAEL, or a barrier is erected to protect dwellings that fall within that noise Important Area

8.7.3 The OEMP has set out a requirement for the Handover Environmental Management Plan (HEMP) to advise Highways England's Operations Directorate of areas which require potential noise attenuation measures outside of the Highways England boundary so that discussions can be held on how the Directorate or the Local Highway Authority may respond.

Table 8.20 - Potential locations for offsite noise attenuation measures – by agreement

Id	Location	noise Important Area	Approx. no. of dwellings (within 300m)	Indicative Opening Year noise level
ONAM1	Increase height of existing bund at Fishers Green along southbound carriageway	4886	257	65 dB $L_{A10,18h}$ (free-field)

Management of Operational Noise

8.7.4 There is no requirement for mitigation measures in the form of acoustic barriers along the Proposed Scheme for operational noise as the maximum daytime increase in the opening year is 0.8dB[101]. There is however a need to address stakeholder concerns over the perception of noise where vegetation removal would expose residents to views of traffic, thereby potentially contributing to a perception of increasing noise levels. This is addressed further in the Chapter 7: Landscape and Cultural Heritage and in particular, the consideration of providing temporary visual screens for areas of vegetation removal is discussed in Section 7.6.

8.7.5 Twelve candidate noise barriers identified in the Environmental Scoping Report were examined to determine whether they represent value for money. Of the 12 candidate noise barriers, Table 8.21 records that 7 are being considered no further as the benefits are lower than their costs (see Appendix 8.4).

Table 8.21 - Scoped out rectification measures

Measure	Location	VfM less than 1
CNB2	At Welwyn along dwellings on Roman Road and St Johns Close	Yes
CNB6	Along dwellings on Spinney Lane and Wych Elm Lane	Yes
CNB7	At Knebworth along dwellings on Gipsy Lane	Yes
CNB8	At Norton Green along dwellings on Chadwell Road	Yes
CNB9	At Symonds Green along dwellings on Newlyn Close	Yes

[101] Changes of up to 2.1dB are predicted at 4 properties along Stevenage Road, approximately 1km to the west of Junction 8 of the Proposed Scheme. As per paragraph 8.6.3, as these receptors are below the SOAEL and only experience a minor change in noise level due to better access to the surrounding local road network, these changes are deemed not significant.

Measure	Location	VfM less than 1
CNB11	At Fishers Green and Corey's Mill along dwellings on Kessingland Avenue, Caister Close and Ingleside Drive	The VFM ratio for this 4m high barrier is 1.02, based on standard cost assumptions. Given the location of this barrier and the proposed height of 4m, the costs associated with this barrier are expected to be greater than those included in the analysis as 'standard' and therefore it is considered likely that the barrier would no longer provide value for money and so not be in line with the Government's policy on sustainable development. Increasing the height of an existing off-site bund at this location will be explored post DF3.
CNB12	At Todd's Green along dwellings on Stevenage Road	Yes

8.7.6 It has been determined that 5 barriers amounting to 2,330m in length provide value for money (see Table 8.22 and Appendix 8.4). All 5 barriers are for rectification purposes, and not for mitigation, and are subject to later confirmation that they have been approved for installation.

Table 8.22 - Proposed new noise barriers - Specification

Barrier id	Barrier details	Chainage/ Location	Noise Important Area	Number of dwellings with perceivable benefits (opening year)		Constraints to installation	Value for money (VfM) ratio*
				Daytime	Night-time		
NNB1	Length: 537m Height: 3m Type: Absorptive	2709 – 3226 northbound. At Welwyn along dwellings on Welwyn Bypass Road	5442	227	208	Gantry (G-A1(M) 02) located along north-bound carriageway	6.3
NNB3	Length: 99m Height: 3m Type: Absorptive	4151 – 4250 southbound. At Welwyn along dwellings on The Avenue and Gwynfa Close	5141	15	11	Gantry (G-A1(M) 26) located along south-bound carriageway	1.9
NNB4	Length: 202m Height: 3m Type: Absorptive	4662 – 4864 southbound. At Mardley Hill along dwellings on Canonsfield Road	5141	14	11	None identified	1.4

Barrier id	Barrier details	Chainage/ Location	Noise Important Area	Number of dwellings with perceivable benefits (opening year)		Constraints to installation	Value for money (VfM) ratio*
				Daytime	Night-time		
NNB5	Length: 501m Height: 3m Type: Absorptive	4327 – 4828 northbound. At Codicote along dwellings on The Avenue, Danesbury Park and Pottersheath Road	5141	41	37	Gantry (G-A1(M) 03) and EA (A1(M) EA NB 1) located along north-bound carriageway	1.9
NNB10	Length: 991m Height: 4m Type: Absorptive	12715 – 13706 southbound. At Fishers Green and Corey's Mill along dwellings on Kessingland Avenue, Caister Close and Ingleside Drive	4887	400	336	G-A1(M) 17, A1(M) EA SB 1 located along south-bound carriageway	1.7

* The costs used to inform the value for money ratio may be revised post DF3, based on a review by the Delivery Partner. Therefore, it is possible that some barriers may no longer provide value for money and may be excluded from the design

8.7.7 It is proposed that there would be no changes to the existing acoustic barriers based on the current review of their condition (see Table 8.9). A more detailed condition survey should be undertaken post DF3.

8.7.8 An initial assessment has been undertaken of those properties that may meet the following 4 conditions to qualify for noise insulation under the Noise Insulation Regulations (NIR) 1975 (as amended 1988):

- Be within 300m of the Proposed Scheme;
- Show a relevant noise level of at least 68dB $L_{A10,18h}$ (façade);
- Show a noise increase between the relevant noise level and the prevailing noise level of at least 1dB(A); and
- The contribution to the increase in the relevant noise level from the Proposed Scheme must be at least 1dB(A).

8.7.9 This initial assessment indicates that 12 properties may qualify under the NIR. These 12 properties are located within Welwyn, Knebworth and Old Knebworth.

Replacement of existing noise barriers

8.7.10 Delivery of the Proposed Scheme will require the temporary removal of 2 existing noise barriers located near Oaklands and Symonds Green (see Table 8.233) affecting approximately 112 receptors. It is anticipated that the existing barriers will be temporarily removed for a period of up to 8 weeks. A method statement will be drawn up by the Delivery Partner to illustrate how the works will be undertaken so that disturbance to the residents would be minimised. This statement will include the following:

- The manner in which the works necessitating temporary barrier removal can be undertaken based upon a sequence of work using normally attenuated standard plant such that disturbance to residents is reduced in terms of the magnitude of noise and its duration;
- A maximum length of noise barrier that would be removed before sequential replacement follows;
- Outline construction options that could lead to a reduced environmental impact while not causing undue disruption or impact upon the construction works;
- Deployment of a temporary noise barrier, where space permits; and
- A requirement to notify the affected residents of the construction activity prior to the barrier being removed.

Table 8.23 - Temporary removal of existing noise barriers

Barrier Id	Barrier details	Location	noise Important Area	No of dwellings within 100m	Noise critical works activity	Feasibility of temporary noise barrier	Expected period without noise barrier
ENB2	Length: 416m Height: 2m	Oaklands Southbound carriageway chainage: 4250-4650	5441	63	Construction of gantry GA1(M) 26	Unknown	8 weeks
ENB5	Length: 358m Height: 3m	Symonds Green Southbound carriageway chainage: 12330-12720	4887	49	Construction of gantry GA1(M) 18	Unknown	8 weeks

Noise and vibration generating activities e.g. Piling

8.7.11 The construction of retaining walls in the vicinity of emergency areas, gantries, CCTV, EI cabinets and stopped vehicle detection systems (SVD) have the potential to require percussive piling, which is likely to affect individual receptors for the longest duration. Not only does piling generate noise, but preparatory works involving vegetation clearance and construction of a crushed stone piling mat also generate noise and extend the duration of the works.

8.7.12 An alternative approach to sheet piles, is the use of H sections sunk with panels inserted between the H sections, resulting in fewer piling events and less disturbance. Apart from the construction technique, there may be an opportunity to use different piling equipment such as extended reach piling which removes the need for a piling mat and reduced vegetation removal. Other potential mitigation measures may include temporary noise barriers or the offer to residents of alternative accommodation during peak disruption.

8.7.13 While efforts have been made to locate emergency areas and select geotechnical solutions that minimise the need for piling activities near residential areas, road safety design considerations reduce the flexibility to avoid these areas. Opportunities to adopt low disturbance solutions such as modular construction would be explored post DF3. Based upon current geotechnical information, the locations potentially generating high noise levels could affect approximately 449 dwellings that lie within 200m of an emergency area (see Table 8.23).

8.7.14 To avoid potential significant adverse effects, the Delivery Partner would look to enhance the initial method statement for the above works by considering:

- Use of alternative quieter piling methods (e.g. rotary bored or hydraulic press-in) where ground conditions permit and use of temporary noise barriers and piling shrouds;
- Agreement of noise/vibration control limits for the undertaking of significantly noisy or vibration-causing operations near to sensitive locations with local Environmental Health officers;
- Managing the timing and duration of working such that noise sensitive receptors are not exposed to noise levels in excess of the SOAEL for more than 10 days in any 15 consecutive day periods; and
- Engage with the local community to arrive at the preferred working method; to ensure they are aware of the works to be undertaken; are notified well in advance of the works commencing and are kept informed of the progress of the works.

Vegetation clearance

8.7.15 Vegetation clearance involving the use of chain saws and other power tools may occasionally occur at night causing disturbance to nearby residents. The Delivery Partner would provide timely advanced notification to nearby residents of the works at those locations identified in Table 8.24.

Table 8.24 - Construction activities at risk of disturbing local residents

Id	Chainage (CH)/ Location	Noise Important Area	No of dwellings within 50m	No of dwellings within 200m	Noise critical works activity*	Feasibility of modular solution*	Feasibility of temporary noise barriers	Feasibility of other solutions
Emergency areas (likely to require retaining walls)								
A1(M) EA NB 1	CH 2107 – 3488 A1(M) northbound near Pottersheath Road overbridge	5441	4	94	To be confirmed at DF4	Available for at grade and cut situations	Unknown	Yes
A1(M) EA SB 6	CH 5210 – 5110 - A1(M) southbound near Pottersheath Road overbridge	N/A	0	4	To be confirmed at DF4	Available for at grade and cut situations	Unknown	Yes
A1(M) EA SB 5	CH 6350 – 6250 - A1(M) southbound near Spinney Lane overbridge	N/A	0	2	To be confirmed at DF4	Available for at grade and cut situations	Unknown	Yes
A1(M) EA NB 2	CH 6335 – 6435 - A1(M) northbound near Spinney Lane overbridge	N/A	0	0	To be confirmed at DF4	Available for at grade and cut situations	Unknown	Yes
A1(M) EA SB 4	CH 7335 – 7235 - A1(M) southbound near Park Lane overbridge	N/A	0	4	To be confirmed at DF4	Available for at grade and cut situations	Unknown	Yes
A1(M) EA NB 3	CH 7760 – 7860 - A1(M) northbound near Old Knebworth Lane	N/A	0	0	To be confirmed at DF4	Available for at grade and cut situations	Unknown	Yes
A1(M) EA SB 3	CH 8342 – 8242 - A1(M) southbound near Old Knebworth Lane	N/A	0	0	To be confirmed at DF4	Available for at grade and cut situations	Unknown	Yes
A1(M) EA NB 4	CH 10725 – 10825 A1(M) northbound near Bessemer Drive underbridge	N/A	0	8	To be confirmed at DF4	Available for at grade and cut situations	Unknown	Yes
A1(M) EA SB 2	CH 11317 – 11217 - A1(M) southbound near Bessemer Drive underbridge	N/A	0	0	To be confirmed at DF4	Available for at grade and cut situations	Unknown	Yes
A1(M) EA NB 5	CH 11710 – 11810 - A1(M) northbound near Meadway underbridge	N/A	0	0	To be confirmed at DF4	Available for at grade and cut situations	Unknown	Yes
A1(M) EA SB 1	CH 12917 – 12817 - A1(M) southbound near Brighton Way	4887	1	192	To be confirmed at DF4	Available for at grade and cut situations	Unknown	Yes

Id	Chainage (CH)/ Location	Noise Important Area	No of dwellings within 50m	No of dwellings within 200m	Noise critical works activity*	Feasibility of modular solution*	Feasibility of temporary noise barriers	Feasibility of other solutions
A1(M) EA NB 6	CH 12970 -13070 A1(M) northbound near Brighton Way	4887	0	145	To be confirmed at DF4	Available for at grade and cut situations	Unknown	Yes
Gantries (likely to require retaining walls)								
G-A1(M) 01 (collocated with SVD_1)	CH 2280 - A1(M) northbound near A1000 underbridge	N/A	0	98	To be confirmed at DF4			
G-A1(M) 02	CH 3375 - A1(M) northbound near Great North Road underbridge	N/A	0	15	To be confirmed at DF4			
G-A1(M) 03 (collocated with SVD_8)	CH 4467 - A1(M) northbound near The Avenue underbridge	5441	1	100	To be confirmed at DF4			
G-A1(M) 04	CH 5266 - A1(M) northbound near Pottersheath Road overbridge	N/A	0	0	To be confirmed at DF4			
G-A1(M) 05 (collocated with SVD_13)	CH 6035 - A1(M) northbound near Spinney Lane overbridge	5439	0	9	To be confirmed at DF4			
G-A1(M) 06 (collocated with SVD_17)	CH 7104 - A1(M) northbound near Park Lane overbridge	N/A	0	9	To be confirmed at DF4			
G-A1(M) 07	CH 7974 - A1(M) northbound near Lodge Farm	N/A	0	0	To be confirmed at DF4			
G-A1(M) 08 (collocated with SVD_26)	CH 9425 - A1(M) northbound near Broadhall Way overbridge	N/A	0	0	To be confirmed at DF4			
G-A1(M) 09	CH 10625 - A1(M) northbound near Chadwell Road	4891	1	14	To be confirmed at DF4			
G-A1(M) 10 (collocated with SVD_35)	CH 11510 - A1(M) northbound near Bessemer Drive underbridge	N/A	0	0	To be confirmed at DF4			

Id	Chainage (CH)/ Location	Noise Important Area	No of dwellings within 50m	No of dwellings within 200m	Noise critical works activity*	Feasibility of modular solution*	Feasibility of temporary noise barriers	Feasibility of other solutions
G-A1(M) 11 (collocated with SVD_37)	CH 12163 - A1(M) northbound near Meadway underbridge	N/A	0	26	To be confirmed at DF4			
G-A1(M) 12 (collocated with SVD_40)	CH 12867 - A1(M) northbound near Minehead Way	4887	0	113	To be confirmed at DF4			
G-A1(M) 13 (collocated with SVD_43)	CH 13660 - A1(M) northbound near Fishers Green overbridge	N/A	0	20	To be confirmed at DF4			
G-A1(M) 14 (collocated with SVD_48)	CH 14710 - A1(M) northbound near Graveley Road underbridge	N/A	0	0	To be confirmed at DF4			
G-A1(M) 15	CH 14810 - A1(M) southbound near Graveley Road underbridge	N/A	0	0	To be confirmed at DF4			
G-A1(M) 16 (collocated with SVD_44)	CH 13810 - A1(M) southbound near Fishers Green overbridge	4886	0	79	To be confirmed at DF4			
G-A1(M) 17	CH 13117 - A1(M) southbound near Brighton Way	4887	0	129	To be confirmed at DF4			
G-A1(M) 18 (collocated with SVD_38)	CH 12467 - A1(M) southbound near Symonds Green	N/A	1	55	To be confirmed at DF4			
G-A1(M) 19	CH 11668 - A1(M) southbound near Babbage Road	N/A	0	0	To be confirmed at DF4			
G-A1(M) 20 (collocated with SVD_33)	CH 10971 - A1(M) southbound near Bessemer Drive underbridge	N/A	0	0	To be confirmed at DF4			

Id	Chainage (CH)/ Location	Noise Important Area	No of dwellings within 50m	No of dwellings within 200m	Noise critical works activity*	Feasibility of modular solution*	Feasibility of temporary noise barriers	Feasibility of other solutions
G-A1(M) 21 (collocated with SVD_28)	CH 9670 - A1(M) southbound near Broadhall Way underbridge	N/A	0	0	To be confirmed at DF4			
G-A1(M) 22	CH 8426 - A1(M) southbound near Old Knebworth Lane underbridge	N/A	0	0	To be confirmed at DF4			
G-A1(M) 23 (collocated with SVD_19)	CH 7485 - A1(M) southbound near Lodge Farm	N/A	0	0	To be confirmed at DF4			
G-A1(M) 24 (collocated with SVD_15)	CH 6500 - A1(M) southbound near Spinney Lane	N/A	0	0	To be confirmed at DF4			
G-A1(M) 25 (collocated with SVD_11)	CH 5450 - A1(M) southbound near Normans Lane	N/A	0	1	To be confirmed at DF4			
G-A1(M) 26	CH 4437 - A1(M) southbound near The Brambles	5441	4	106	To be confirmed at DF4			
G-A1(M) 27	CH 3750 - A1(M) southbound near Fishers The Avenue underbridge	N/A	0	4	To be confirmed at DF4			
G-A1(M) 28 (collocated with SVD_2)	CH – 2410 A1(M) southbound near the A1000 underbridge	6151	0	46	To be confirmed at DF4			
CCTV, Cabinets and SVD (likely to require retaining walls)								
CCTV_01	CH 2275 - A1(M) northbound near A1000 underbridge	N/A	0	116	To be confirmed at DF4			
CCTV_02	CH 2405 - A1(M) southbound near A1000 underbridge	N/A	0	50	To be confirmed at DF4			
CCTV_03	CH 3369- A1(M) northbound near Great North Road underbridge	N/A	1	23	To be confirmed at DF4			

Id	Chainage (CH)/ Location	Noise Important Area	No of dwellings within 50m	No of dwellings within 200m	Noise critical works activity*	Feasibility of modular solution*	Feasibility of temporary noise barriers	Feasibility of other solutions
CCTV_04 (collocated with SVD_6)	CH 3755 - A1(M) northbound near The Avenue underbridge	N/A	0	5	To be confirmed at DF4			
CCTV_05	CH 4462 - A1(M) northbound near The Avenue underbridge	5441	0	87	To be confirmed at DF4			
CCTV_06	CH 4750 - A1(M) northbound near The Avenue underbridge	5441	0	39	To be confirmed at DF4			
CCTV_07	CH 5264 - A1(M) southbound near Pottersheath Road underbridge	N/A	0	0	To be confirmed at DF4			
CCTV_08	CH 5630 - A1(M) southbound near Spinney Lane overbridge	N/A	0	1	To be confirmed at DF4			
CCTV_09	CH 6040 - A1(M) northbound near Spinney Lane overbridge	5439	0	11	To be confirmed at DF4			
CCTV_10	CH 6495 - A1(M) southbound near Spinney Lane overbridge	N/A	0	0	To be confirmed at DF4			
CCTV_11 (collocated with SVD_16)	CH 6900 - A1(M) southbound near Park Lane overbridge	N/A	0	3	To be confirmed at DF4			
CCTV_12	CH 7480 - A1(M) southbound near Lodge Farm	N/A	0	0	To be confirmed at DF4			
CCTV_13	CH 7969 - A1(M) northbound near Lodge Farm	N/A	0	0	To be confirmed at DF4			
CCTV_14 (collocated with SVD_21)	CH 8150 - A1(M) southbound near Old Knebworth Lane underbridge	N/A	0	0	To be confirmed at DF4			
CCTV_15	CH 8451 - A1(M) southbound near Old Knebworth Lane underbridge	N/A	0	0	To be confirmed at DF4			
CCTV_16 (collocated with SVD_24)	CH 9160 - A1(M) southbound near Broadway Hall overbridge	N/A	0	1	To be confirmed at DF4			

Id	Chainage (CH)/ Location	Noise Important Area	No of dwellings within 50m	No of dwellings within 200m	Noise critical works activity*	Feasibility of modular solution*	Feasibility of temporary noise barriers	Feasibility of other solutions
CCTV_17	CH 9420 - A1(M) northbound near Broadway Hall overbridge	N/A	1	2	To be confirmed at DF4			
CCTV_18 (collocated with SVD_27)	CH 9565 - A1(M) southbound near Broadway Hall overbridge	N/A	0	1	To be confirmed at DF4			
CCTV_19	CH 9675 - A1(M) southbound near Broadway Hall overbridge	N/A	0	0	To be confirmed at DF4			
CCTV_20 (collocated with SVD_30)	CH 10030 - A1(M) southbound near Broadway Hall overbridge	N/A	0	0	To be confirmed at DF4			
CCTV_21 (collocated with SVD_31)	CH 10495 - A1(M) northbound near Chadwell Road	4891	0	16	To be confirmed at DF4			
CCTV_22	CH 10900 - A1(M) northbound near Chadwell Road	N/A	0	0	To be confirmed at DF4			
CCTV_23	CH 11505 - A1(M) northbound near Bessemer Drive underbridge	N/A	0	0	To be confirmed at DF4			
CCTV_24	CH 11673 - A1(M) southbound near Bessemer Drive underbridge	N/A	0	0	To be confirmed at DF4			
CCTV_25	CH 11967 - A1(M) northbound near Meadway underbridge	N/A	0	0	To be confirmed at DF4			
CCTV_26	CH 12158 - A1(M) northbound near Bessemer Drive underbridge	4888	0	24	To be confirmed at DF4			
CCTV_27	CH 12472 - A1(M) southbound near Symonds Green	4887	0	59	To be confirmed at DF4			
CCTV_28 (collocated with SVD_41)	CH 12862 - A1(M) northbound near Symonds Green	4887	0	112	To be confirmed at DF4			

Id	Chainage (CH)/ Location	Noise Important Area	No of dwellings within 50m	No of dwellings within 200m	Noise critical works activity*	Feasibility of modular solution*	Feasibility of temporary noise barriers	Feasibility of other solutions
CCTV_29 (collocated with SVD_42)	CH 13100 - A1(M) northbound near Fishers Green	N/A	0	99	To be confirmed at DF4			
CCTV_30	CH 13350 - A1(M) northbound near Symonds Green overbridge	4887	0	49	To be confirmed at DF4			
CCTV_31	CH 13815 - A1(M) southbound near Symonds Green overbridge	4887	0	80	To be confirmed at DF4			
CCTV_32	CH 14160 - A1(M) northbound near Graveley Road	N/A	0	15	To be confirmed at DF4			
CCTV_33	CH 14715 - A1(M) northbound near Graveley Road	N/A	0	0	To be confirmed at DF4			
CCTV_34	CH 14805 - A1(M) junction 8 southbound slip road	N/A	0	0	To be confirmed at DF4			
CCTV_35	CH 2810 - A1(M) northbound near Welwyn Roman Baths	5442	0	48	To be confirmed at DF4			
CCTV_36	CH 2600 - A1(M) junction 6 southbound slip road	6151, 5442	0	21	To be confirmed at DF4			
EI 01	CH 2521 - A1(M) near A1000	6151	0	49	To be confirmed at DF4			
EI 02	CH 3557 - A1(M) near Great North Road	N/A	0	0	To be confirmed at DF4			
EI 03	CH 4174 - A1(M) near The Avenue	5441	4	69	To be confirmed at DF4			
EI 04	CH 5099 - A1(M) near Mardley Heath Nature Reserve	N/A	0	8	To be confirmed at DF4			
EI 05	CH 6368 - A1(M) near Gipsy Lane	N/A	0	0	To be confirmed at DF4			
EI 06	CH 7163 - A1(M) near Park Lane	N/A	0	7	To be confirmed at DF4			
EI 07	CH 8929 - A1(M) near North Lodge (residential property) in Langley	4892	2	2	To be confirmed at DF4			

Id	Chainage (CH)/ Location	Noise Important Area	No of dwellings within 50m	No of dwellings within 200m	Noise critical works activity*	Feasibility of modular solution*	Feasibility of temporary noise barriers	Feasibility of other solutions
EI 08	CH 9523 - A1(M) near Broadhall Way	N/A	0	0	To be confirmed at DF4			
EI 09	CH 10582 - A1(M) near Chadwell Road	4891	1	15	To be confirmed at DF4			
EI 10	CH 12039 - A1(M) near Shepherds Lane	4888	0	0	To be confirmed at DF4			
EI 11	CH 13029 - A1(M) near Brighton Way	4887	0	143	To be confirmed at DF4			
EI 12	CH 13831 - A1(M) near Fishers Green	4886	0	68	To be confirmed at DF4			
EI 13	CH 14532 - A1(M) near Hitchin Road	N/A	0	2	To be confirmed at DF4			
SVD_5	CH 3316 - A1(M) northbound near Great North Road	5442	2	29	To be confirmed at DF4			
SVD_7	CH 4229 - A1(M) northbound near The Avenue	5441	2	70	To be confirmed at DF4			
SVD_14	CH 6330 - A1(M) northbound near Gipsy Lane	5439	0	0	To be confirmed at DF4			
SVD_18	CH 7235 - A1(M) northbound near Park Lane	N/A	0	5	To be confirmed at DF4			
SVD_20	CH 7750 - A1(M) northbound near Old Knebworth	N/A	0	0	To be confirmed at DF4			
SVD_22	CH 8348 - A1(M) southbound near Old Knebworth Lane	N/A	0	0	To be confirmed at DF4			
SVD_23	CH 8700 - A1(M) southbound near Old Knebworth Lane	N/A	0	0	To be confirmed at DF4			
SVD_25	CH 9380 - A1(M) northbound near Knebworth park	N/A	1	2	To be confirmed at DF4			
SVD_29	CH 9700 - A1(M) southbound near Gunnels Wood Park	N/A	0	0	To be confirmed at DF4			
SVD_32	CH 10720 - A1(M) northbound near Chadwell Road	4891	0	8	To be confirmed at DF4			

Id	Chainage (CH)/ Location	Noise Important Area	No of dwellings within 50m	No of dwellings within 200m	Noise critical works activity*	Feasibility of modular solution*	Feasibility of temporary noise barriers	Feasibility of other solutions
SVD_34	CH 11300 - A1(M) northbound near Dyes Lane	N/A	0	0	To be confirmed at DF4			
SVD_36	CH 11840 - A1(M) northbound near Kitching Lane	N/A	0	0	To be confirmed at DF4			
SVD_39	CH 12606 - A1(M) northbound near Symonds Green	N/A	0	68	To be confirmed at DF4			
SVD_45	CH 14097 - A1(M) southbound near Ingleside Drive	N/A	1	42	To be confirmed at DF4			
SVD_46	CH 14400 - A1(M) northbound near junction 8	N/A	0	0	To be confirmed at DF4			
SVD_47	CH 14425 - A1(M) northbound near junction 8	N/A	0	0	To be confirmed at DF4			
SVD_49	CH 14883 - A1(M) southbound near junction 8	N/A	0	0	To be confirmed at DF4			
Vegetation Clearance (excluding design elements above)								
1	CH 1880 – 2160 A1(M) northbound near junction 6 slip road	6151	17	149	To be confirmed at DF4			
2	CH 2450 – 2760 northbound A1(M) near Maran Avenue, Welwyn	6151, 5442	7	123	To be confirmed at DF4			
3	CH 4960 – 5270 northbound A1(M) near Pottersheath bridge	5441	0	12	To be confirmed at DF4			
4	CH 5620 – 6070 northbound A1(M) near Normans lane	5439, 5440	2	17	To be confirmed at DF4			
5	CH 6600 – 7100 northbound near Homewood	N/A	0	16	To be confirmed at DF4			
6	CH 7150 – 7770 northbound near Park Lane Overbridge	N/A	0	6	To be confirmed at DF4			
7	CH 7850 –7980 northbound near Knebworth Park	N/A	0	0	To be confirmed at DF4			
8	CH 9960 – 10560 northbound A1(M) Knebworth Park	4891	0	16	To be confirmed at DF4			

Id	Chainage (CH)/ Location	Noise Important Area	No of dwellings within 50m	No of dwellings within 200m	Noise critical works activity*	Feasibility of modular solution*	Feasibility of temporary noise barriers	Feasibility of other solutions
9	CH 13130 – 13420 southbound A1(M) near Brighton Way, Symonds Green Ward	4887	0	186	To be confirmed at DF4			
10	CH 14050 – 14380 northbound A1(M_ near Todds Green Railway Underbridge	4886	0	42	To be confirmed at DF4			
11	CH 14340 – 14520 northbound near junction 8 slip road	4886	0	0	To be confirmed at DF4			
12	CH 14630 – 14640 northbound near junction 8 slip road	N/A	0	0	To be confirmed at DF4			
13	CH 14650 – 14720 northbound near junction 8 slip road	N/A	0	0	To be confirmed at DF4			
14	CH 12360- 12790 southbound A1(M) near Symonds Green	4887, 4888	16	239	To be confirmed at DF4			
15	CH 11680 – 11990 southbound near Cavendish Road	N/A	0	0	To be confirmed at DF4			
16	CH 7500 – 7930 southbound northbound A1(M) near Park Lane Overbridge	N/A	0	0	To be confirmed at DF4			
17	CH 3760 – 4010 southbound A1(M) near Great North Road	5441	2	43	To be confirmed at DF4			
18	CH 2900 – 3320 southbound A1(M) near Welwyn Roman Baths	5442	0	82	To be confirmed at DF4			
22	CH 8740 – 9330 northbound	4892	2	4	To be confirmed at DF4			
*The assessment has been based on a worst case scenario where percussive piling is required to deliver retaining walls for emergency areas, gantries, CCTVs, cabinets and stop vehicle detection (SVD) locations.								

Construction and recovery compounds

8.7.16 Recovery compounds operate 24 hours a day for the entire duration that traffic management is in operation. As a result, night-time impacts associated with reversing vehicles, lights and general site noise can be a cause of disturbance to local residents. However, the location of recovery and construction compounds will not be determined until DF5 and so it is impossible at to determine at this stage whether any significant effects are likely to arise. An assessment of recovery and construction compounds will be undertaken by the delivery partner at the appropriate time as outlined in the OEMP.

Diversion routes

8.7.17 Figure 8.8 and 8.9 illustrate the current emergency diversion routes and the location of sensitive receptors within 50m of each route. Table 8.25 provides an estimate of the number of carriageway or full motorway closures that may be required. The CEMP would record consideration of the following management measures:

- Reduce the need for closures by increasing the construction work undertaken per closure;
- Use of contraflows, narrow lane flows and rolling road blocks to minimise the need for diversion routes;
- Identify an alternative route for some or all of the closures;
- Visual inspection of the route prior to the start of works to identify locations where the current pavement condition suggests that body rattle could be an issue;
- Liaison with local highway authorities to ensure that the planned use of diversions does not conflict with other planned maintenance works and to explore localised pavement resurfacing or temporary re-phasing of traffic lights;
- Advanced notification for the communities along the proposed diversion routes; and
- Advertising of full motorway closures reducing the amount of night time traffic.

Table 8.25 - Estimate of number of carriageway or full motorway closures

Motorway closure	No. superspan removals	No. new superspan gantries	Carriageway	New MS4	No. cantilever gantry removals	No. new cantilever gantries	Potential closures
J6 to J7	0	0	Northbound	6	0	1	4
		0	Southbound	6	0	2	4
J7 to J8	0	0	Northbound	6	0	1	4
		0	Southbound	5	1	1	5

- Two MS4 installations per off-peak carriageway closure.
- Two cantilever gantries installed per single direction carriageway closure.
- One cantilever gantry removal per single direction carriageway closure.

Stakeholder engagement

8.7.18 The extent to which construction noise gives rise to disturbance is a function of the nature of the works, the proximity to noise sensitive receptors and the awareness of the receptors. Hence, a key mitigation measure is to provide enhanced engagement with local residents in close proximity to noise generating works. Table 8.26 sets out the stakeholder engagement levels, beyond Public Information Exhibitions for SMP schemes. Based upon an appreciation of how the Proposed Scheme would be constructed, 8 red and amber engagement level areas have been identified (see Table 8.27).

8.7.19 In those areas identified as red engagement level areas, an acoustic performance envelope has been specified in the OEMP. This envelope will be used by the Delivery Partner to demonstrate in the noise and vibration plan element of the CEMP that works would be undertaken in accordance with the OEMP to ensure that there are **no significant effects**. Noise and vibration monitoring locations and limits will then be identified in the CEMP, to enable the Delivery Partner to monitor and amend working practices where there is a risk of noise or vibration significance limits being breached (in combined level and duration).

Table 8.26 - Levels of additional stakeholder engagement

Engagement Level	Area definition	Stakeholder engagement activities
Red Level	Locations where sensitive receptors are within approx. 100m of motorway boundary fence during the following operations: • Night-time vegetation clearance; • Percussive piling activities; • Demolition of structures; • Temporary removal of existing noise barriers; • Deep reconstruction of pavement; • Movement of plant and activities at construction compounds**.**	• Highways England to host specific local engagement meetings; • Delivery Partner to secure views of residents and other stakeholders in advance of deciding on working method; • Delivery Partner to maintain awareness of residents close to intrusive work activities timetable using multiple media[102]; • Notice to be provided to residents 14 days in advance of the intrusive works commencing; • Notice to be provided to residents 14 days in advance of changes to traffic management activities where a >3dB change in noise levels at receptors would occur; • Notice to be provided to residents 14 days in advance of commencement of All Lane Running (ALR); • A management process shall be put in place so that issues raised by residents within the Red Level area are immediately conveyed to the site manager for those works giving rise to disturbance for the duration of those works only; • Feedback from residents to be sought on completion of intrusive works.
Amber Level	Locations where sensitive receptors are within approx. 50m of motorway boundary fence during of the following operations: • Night time diverted motorway traffic; • Re-surfacing works; • Hydraulic piling activities; • Night time works; • Movement of vehicles at recovery compounds	• Delivery Partner to maintain awareness of residents close to intrusive work activities timetable using multiple media[103]; • Notice to be provided to residents 14 days in advance of the intrusive works commencing; • Notice to be provided to residents 14 days in advance of changes to traffic management activities where a >3dB change in noise levels at receptors would occur; • Notice to be provided to residents 14 days in advance of commencement of All Lane Running;

[102] The Delivery Partner is to respect the equality, diversity and inclusion principles in engagement with neighbouring residents.
103 ibid.

Engagement Level	Area definition	Stakeholder engagement activities
	• Construction of central reserve Rigid Concrete Barrier.	• A management process shall be put in place so that issues raised by residents within the Amber Level area are within 24 hours are conveyed to the site manager for those works giving rise to disturbance for the duration of those works only; • Feedback from residents to be sought on completion of works.
Green Level	Locations within night time SOAEL envelope during the construction works.	• Notice to be provided to residents 14 days in advance of changes to traffic management activities where a >3dB change in noise levels at receptors would occur; • Notice to be provided to residents 14 days in advance of commencement of All Lane Running; • A resident's hotline to be provided to stakeholder engagement manager.

Table 8.27 - Location of tiered stakeholder engagement areas

Stakeholder Id	Location	Approx. no. of dwellings within 100m	Critical works activities
Red engagement level areas			
RELA1	Oaklands	63	Removal of existing barrier ENB2
RELA2	Symonds Green	49	Removal of existing barrier ENB5
RELA3	Todds Green, Fishers Green, Symonds Green, Norton Green, Knebworth, Rabley Heath, Potters Heath, Oaklands, Danesbury and Welwyn	210	Noise associated with construction of gantries and emergency areas
RELA4	Todds Green, Fishers Green, Symonds Green, Norton Green, Knebworth, Rabley Heath, Potters Heath, Oaklands, Danesbury and Welwyn	730 (within 160m)	Vibration associated with construction of gantries and emergency areas
RELA5	Todds Green, Fishers Green, Rabley Heath, Old Knebworth, Knebworth, Norton Green, Symonds Green, Oaklands, Danesbury and Welwyn	33 (within 50m)	Vegetation clearance
Amber engagement level areas			
AELA1	Woolmer Green, Knebworth and Oaklands	626	Junction 6 to 7 diversion route
AELA2	Fishers Green and Symonds Green	246	Junction 7 to 8 diversion route
AELA3	The Avenue, Welwyn and Chadwell Road, Norton Green	26	Potential cumulative construction effects*
*See section 8.10 for further details			

8.8 Residual effects

8.8.1 Based on adoption of the mitigation measures outlined in Section 8.7, there are **no predicted permanent significant adverse residual effects** resulting from the operation of the Proposed Scheme.

8.8.2 During the operational phase, 1,176 dwellings in the calculation area that are exposed to noise levels above the LOAEL and SOAEL (out of a total of 5,063 dwellings) are predicted to experience short-term daytime minor to major noise decreases. Four dwellings are predicted to experience a minor increase in noise in the opening year; however, as the 4 residential receptors are below the SOAEL and only experience a minor change in noise level due to better access to the surrounding local road network, these changes are deemed **not significant**. The noise changes at the remaining sensitive receptors are shown to be negligible or have no change.

8.8.3 Over the long-term, 54 dwellings in the calculation area that are exposed to noise levels above the LOAEL and SOAEL are predicted to experience long-term daytime minor to major noise decreases. The noise changes at the remaining sensitive receptors are shown to be negligible or have no change.

8.8.4 The Proposed Scheme is in general considered to have a beneficial effect for dwellings located within a noise Important Area, with perceptible decreases predicted at 204 dwellings.

8.8.5 The construction phase has the potential to cause significant noise effects; however the Delivery Partner shall demonstrate, through provision of method statements and mitigation measures in the CEMP, that **no significant effects** will arise, especially at the following key locations:

- Todds Green;
- Fishers Green;
- Symonds Green;
- Norton Green;
- Knebworth;
- Rabley Heath;
- Potters Heath;
- Oaklands;
- Old Knebworth;
- Danesbury; and
- Welwyn.

8.9 Summary

8.9.1 The Proposed Scheme is envisaged to give rise to some **temporary adverse effects** during construction activities that would principally be focused upon the areas identified in paragraph 8.8.5 due to the temporary removal of 2 existing noise barriers, percussive piling relating to the construction of gantries and emergency areas, and vegetation clearance at night. Best practice management measures have been proposed within the OEMP and these will be translated into the Works Information as appropriate. The key management measures detailed in the OEMP comprise:

- A noise and vibration management plan shall demonstrate that no significant effect will result, both at sensitive receptors along the Proposed Scheme and along diversion routes;
- If required following consultation with the local authority, an application under Section 61 of The Control of Pollution Act 1974 shall be made to the relevant Local Authority Environmental Health Department with conditions applied to the approval shall being complied with;
- A variety of management measures shall be taken to avoid disturbance caused along diversion routes;
- The construction traffic management plan shall demonstrate consideration of the effects of night time noise levels at residential properties where noise barriers have been removed;
- A schedule for removal, deployment of temporary barriers and replacement of existing barriers to reduce impact in high sensitive areas is to be provided to the Highways England Project Manager;
- Replacement of existing barriers shall precede installation of new barriers;

- Where existing barriers are found to be unfit for purpose, the Highways England Project Manager shall be notified and no action taken until advised;
- Works with a risk of causing disturbance are to be time limited and supported by mitigation measures;
- Method statements shall demonstrate low noise generating plant has been selected for works within 100m of dwellings supported by acoustic screens etc. with forecast noise levels being provided for key receptors;
- Ambient noise levels shall be recorded in noise Important Areas and other noise sensitive locations prior to commencement of works;
- Plant and working methods shall be selected to minimise noise and vibration, particularly at night, with monitoring at properties less than 20m from the works and liaise with residents;
- Evidence that the Handover Environmental Management Plan details whether there are locations where an increase in noise levels above SOAEL arises on the Affected Road Network is to be collated and provided to the Highways England Project Manager;
- Details of best practicable means to be employed by the Delivery Partner should be set out in the CEMP and method statements and provided to the Highways England Project Manager; and
- Evidence that consultation has been undertaken with the shared sensitive receptors in the vicinity of the Proposed Scheme at The Avenue and Chadwell Road and that the amber level requirements have been implemented.

8.9.2 The Proposed Scheme is predicted **not to cause a significant effect** as a result of operational road traffic noise and overall is considered to be beneficial, delivering perceivable benefits to 1,176 dwellings in the short-term and 54 dwellings in the long-term. For dwellings located within a noise Important Area, 41 will no longer be exposed to noise levels above the SOAEL as a result of the 5 new noise barriers and new low noise surface on all 3 lanes in the opening year and the design year.

8.10 Cumulative effects

8.10.1 There are 2 submitted or consented development projects planned that would introduce new receptors in the vicinity of the Proposed Scheme (see Table 8.10). There is the potential for cumulative construction effects as a result of temporary construction activities at receptors within the vicinity of the 2 committed schemes. Noise and vibration associated with construction activities will usually only cause significant adverse effects at receptors immediately surrounding a site, and only when the construction works coincide.

8.10.2 As stated in paragraph 8.8.5, through the implementation of the management measures set out within the OEMP, no significant adverse effects are anticipated as a result of the Proposed Scheme. In order to minimise any cumulative adverse construction effects at receptors in the vicinity of schemes at The Avenue and Chadwell Road, the Delivery Partner will liaise with the construction managers of the committed schemes to minimise overlapping construction works. The Delivery Partner will also liaise with the shared sensitive receptors in the vicinity of schemes at The Avenue and Chadwell Road in line with the amber level requirements of the stakeholder engagement activities as presented in Table 8.26. With the above mitigation measures in place, which will also be included in the OEMP, **no significant adverse cumulative construction effects** are anticipated.

8.10.3 The traffic model includes the development-generated road traffic from the committed schemes listed in Appendix 8.2. Therefore, the acoustic assessment inherently provides a cumulative assessment of all activity associated with road traffic and thus no further assessment is required.

8.10.4 In any case, with regards to the potential impact of operational road traffic, the 2 committed schemes are of such a small scale that they would not influence the traffic data upon which the noise assessment has been based upon. Consequently, with regards to the operational road traffic changes as a result of the Proposed Scheme affecting the 2 committed schemes, **no significant adverse cumulative operational effects** are predicted as can be seen from Figures 8.2 to 8.5.

9. Road Drainage and the Water Environment

Key features for this topic:

- The Proposed Scheme crosses 1 main river (the River Mimram) and 1 significant ordinary watercourse (Ash Brook).
- The Proposed Scheme passes through designated groundwater source protection zones including zone 1 (inner zone) at junction 6 and zone 2 (outer zone) at Knebworth, Symonds Green and Fishers Green.
- There are no Priority A, B or Not Determined outfalls or culverts for the baseline condition. However, the cumulative HAWRAT assessment of discharge to the Ash Brook indicates the potential for a Priority B outfall, both in the Do Minimum and Do Something scenario, which would need ratification prior to formal designation as a Priority Outfall.
- Traffic flow is predicted to increase by more than 20% as a result of the Proposed Scheme on certain links triggering requirements for assessment. The Proposed Scheme is not predicted to change the risk to the water environment compared to baseline conditions and Do Minimum 2037 design scenario.

9.1 Introduction

9.1.1 This chapter sets out the findings of the road drainage and water environment assessment for both the construction and operational phases of the Proposed Scheme.

9.1.2 Consideration has been given to potential impacts associated with increased surface water runoff, amendments to existing drainage systems, changes to traffic flow, works in close proximity to surface water and groundwater receptors, and works in areas identified to at risk of flooding.

9.1.3 Where required, the chapter provides a summary of measures to be included in the construction, design and operation of the Proposed Scheme to manage identified risks.

9.1.4 The chapter provides:

- A summary of the assessment methodology;
- A summary of relevant legislation, policy and guidance;
- A summary of baseline conditions with regards to surface water receptors, groundwater receptors and flood risk; and
- An assessment of potential impacts of the Proposed Scheme on identified receptors and a summary of proposed and recommended mitigation.

9.1.5 This chapter is supported by:

- Appendix 9.1 – HAWRAT Assessment Summary.

9.1.6 The following figures support this chapter:

- Figure 9.1 – Water Constraints Maps.

9.1.7 The professional competency of the topic lead for this chapter is detailed in Appendix 1.1. This information is provided to fulfil the requirement of EU Directive 2014/52/EU.

9.2 Scoping

9.2.1 This chapter builds on the findings and recommendations of the A1(M) Junction 6 to 8 Environmental Scoping Report (MP0135-HEX-EGN-ZZ-AS-KK-0001) and incorporates new information that has become available since the Environmental Scoping Report was produced.

9.2.2 This includes updates made within the Highways Agency Drainage Data Management System (HADDMS) database since the Environmental Scoping Report was prepared, and further information regarding the proposed surface water drainage strategy and predicted changes to traffic flow.

9.2.3 A brief summary of changes that have been made to identified baseline conditions and receptors since the preparation of the Environmental Scoping Report is presented below:

Table 9.1 - Review of Environmental Scoping Report baseline conditions

Environmental Scoping Report Review	Comparison with Environmental Assessment Report (EAR)
Describes Ippollitts Brook as a main river.	A review of Environment Agency mapping identifies Ippollitts Brook as an ordinary watercourse, and this designation has therefore been used within this assessment.
States Ippollitts Brook is monitored against the results of the Water Framework Directive. A review of the Environment Agency Catchment Data Explorer indicates that it is not monitored and it is unclear from where the Water Framework Directive data provided in the Environmental Scoping Report has been sourced.	Reference to Water Framework Directive monitoring of Ippollitts Brook removed. The downstream River Purwell is monitored and this has been included in the assessment for information.
Identifies 11 Not Determined Priority Outfalls.	HADDMS was updated in 2018 and is now showing no Not Determined Outfalls or Soakaways. This chapter concludes no further assessment is required unless triggered by a change to traffic flow, as per below.
Information in the Environmental Scoping Report regarding the number of groundwater abstractions within 0.5km of the Proposed Scheme was unclear, suggesting either one or two.	Consultation with the Environment Agency has confirmed there are five licenced groundwater abstractions within 0.5km of the Proposed Scheme. The location of these abstractions has been illustrated on the Water Constraints Maps (Figure 9.1).
Made no reference to surface water abstractions.	Additional information added to the assessment to confirm no licensed surface water abstractions.
Provided no information regarding designated sites.	A summary of designated sites within 0.5km of Proposed Scheme with relevance to water environment has been included in the assessment.

9.2.4 The Environmental Scoping Report advised of specific elements to be scoped in or scoped out of the Road Drainage and Water Environment assessment. For the most part, this assessment complies with the recommendations of the Environmental Scoping Report as summarised below, with amendments to the scope identified in Table 9.2.

Table 9.2 - Review of Environmental Scoping Report recommendations and comparison with EAR

Environmental Scoping Report Review	Comparison with EAR
Impacts to groundwater during construction scoped out.	Given the sensitivity of underlying groundwater resources, risks to groundwater during construction has been **scoped in.** The summary of the assessment is presented in the EAR and used to inform the OEMP.
Impacts to loss of floodplain storage associated with gantries, emergency areas and related infrastructure scoped in.	**Scoped in**.
Potential impact of future sea level rise scoped out.	**Scoped out**.
Pollution of watercourses during construction scoped in, with any specific measures included in the Outline Environmental Management Plan (OEMP).	**Scoped in**. The summary of assessment is presented in this chapter and used to inform the OEMP.
Identifies the potential requirement for a Water Framework Directive compliance assessment to support any consent or approvals from the Environment Agency or Lead Local Flood Authority if works are being undertaken within 8m of a watercourse.	**Scoped in**. The summary of works within 8m and likely need for Water Framework Directive compliance assessment is provided.
Potential operational effects associated with changes to surface water discharge volume scoped out as long as the site-specific conditions allow this to be achieved.	**Scoped out**, although confirmation of drainage strategy is provided in the EAR.
Potential operational effects associated with pollutant loading at outfalls scoped in until such a time that it has been determined if there is an increase in traffic of more than 20% that may cause effects upon main river catchments.	**Scoped in**.
Impacts to groundwater scoped out as the Environmental Scoping Report stated there are to be no changes to the existing outfalls, and thus no effect upon source protection zones.	Traffic flow data indicates potential for greater than 20% increase in traffic flow in catchments that drain to soakaways, some of which are located in the source protection zones. Impacts to groundwater are therefore **scoped in**.
Identifies that assessment of priority outfalls should be scoped out.	**Scoped out**. A review of HADDMS indicates no Priority A, B or Not Determined outfalls.

9.3 Methodology

9.3.1 This section summarises the following:

- The study area;
- Legislation, policy and guidance;
- Baseline information and data sources;
- Assessment criteria;
- Stakeholder engagement; and
- Assumptions and limitations

Study area

9.3.2 The study area for the road drainage and water environment assessment comprises the following:

- Surface water features and groundwater features that are located within 0.5km of the Proposed Scheme that could be at risk of direct effect, for example through migration of overland flow;
- Sensitive surface water features that are hydraulically connected to features within 0.5km of the Proposed Scheme that could be at risk of indirect effect, for example pollutants that are conveyed downstream. Typically features up to 1km from the Proposed Scheme will be considered; and
- Areas identified to be at risk of fluvial and surface water flooding within or adjacent to the Proposed Scheme, and land elsewhere that could be affected by the Proposed Scheme.

9.3.3 The study area has been selected based on the findings of the Environmental Scoping Report and through informed judgement of an appropriate professional.

9.3.4 The ecological sensitivity of surface water receptors and other features such as ponds is assessed in Chapter 6: Biodiversity.

Legislation, policy and guidance

9.3.5 The management of water resources is governed by a range of legislation, policy and guidance set out at the international, national and local scales. The assessment will be prepared whilst taking these into account. A summary of relevant legislation, policy and guidance is provided below.

9.3.6 The coordination of policies for the water environment is managed by the Department for Environment, Food and Rural Affairs (Defra). Many flood risk and water quality requirements are set at European level, which are then transposed into UK law. The enforcement of flood risk and water quality requirements in England is managed by the Environment Agency.

European Legislation

Water Framework Directive (2000/60/EC)

9.3.7 The overall objective of the Water Framework Directive is to bring about the effective co-ordination of water environment policy and regulation across Europe. The main aims of the legislation are to ensure that all surface water and groundwater reach 'good' status (in terms of ecological and chemical quality and water quantity, as appropriate), promote sustainable water use, reduce pollution and contribute to the mitigation of flood and drought.

9.3.8 The Water Framework Directive also contains provisions for controlling discharges of dangerous substances to surface waters and groundwater and includes a 'List of Priority Substances'. Various substances are listed as either List I or List II substances, with List I substances considered the most harmful to human health and the aquatic environment. The purpose of the directive is to eliminate pollution from List I substances and reduce pollution from List II substances. Highway runoff typically includes substances that are on the priority lists.

Groundwater Directive (2006/118/EC)

9.3.9 The Groundwater Directive aims to set groundwater quality standards and introduce measures to prevent or limit pollution of groundwater, including those listed within the 'List of Priority Substances'. The Directive has been developed in response to the requirements of Article 17 of the Water Framework Directive, specifically the assessment of chemical status of groundwater and objectives to achieve 'good' status.

National Legislation

Floods and Water Management Act 2010

9.3.10 The Floods and Water Management Act 2010 was prepared following the Pitt Review in 2007. The Act created the role of the Lead Local Flood Authority typically the unitary authority or country council, as applicable) to take responsibility for leading the co-ordination of local flood risk management in their areas.

Environmental Permitting (England And Wales) Regulations 2010

9.3.11 Under the Environmental Permitting (England and Wales) Regulations 2010, it is an offence to cause or knowingly permit a water discharge activity, including the discharge of polluting materials to freshwater, coastal waters, relevant territorial waters or groundwater, unless complying with an exemption or an environmental permit. An environmental permit is obtained from the Environment Agency. The Environment Agency sets conditions which may control volumes and concentrations of particular substances or impose broader controls on the nature of the effluent, taking into account any relevant water quality standards from the relevant EU Directives.

9.3.12 The Regulations also assist in the management of flood risk and, as of 6 April 2016, any activity which has the potential to impact on a main river (which typically means any works in the vicinity of a main river, flood defence structure and sea defence, or in a floodplain) will require a Flood Risk Activities Permit (previously referred to as Flood Defence Consent) to be granted by the Environment Agency and specifies the appropriate conditions to ensure works do not increase flood risk or damage flood defences.

Land Drainage Act 1991

9.3.13 The Land Drainage Act 1991 sets out rights and responsibilities for all parties in relation to land drainage, including responsibilities for maintenance and works in the vicinity of ordinary watercourses. The Act requires that an ordinary watercourse be maintained by its owner in such a condition that free flow of water is not impeded. The Act also states that any works in the vicinity of ordinary watercourses that have the potential to obstruct or alter the flow of water will require appropriate consent from the Local Authority or Internal Drainage Board. This is usually obtained as Land Drainage Consent or Ordinary Watercourse Consent.

National Policy

National Policy Statement for National Networks

9.3.14 The National Policy Statement for National Networks recognises that infrastructure development can have adverse effects on the water environment. It states that the Government's planning policies make clear that the planning system should contribute to and enhance the natural and local environment by, amongst other things, preventing both new and existing development from contributing to, or being put at unacceptable risk from, or being adversely affected by, water pollution. The Government has issued guidance on water supply, wastewater and water quality considerations in the planning system.

9.3.15 It also states that for those projects that are improvements to the existing infrastructure, such as road widening, opportunities should be taken, where feasible, to improve upon the quality of existing discharges where these are identified and shown to contribute towards Water Framework Directive commitments.

9.3.16 The National Policy Statement for National Networks also advises applicants for projects that may be affected by or may add to flood risk to seek sufficiently early pre-application discussions with the Environment Agency, and where relevant other flood risk management bodies.

National guidance

Environment Agency Groundwater Protection Guides (2017)

9.3.17 The Environment Agency is the statutory body responsible for the protection and management of groundwater resources in England. The Environment Agency Groundwater Protection Guide sets out the Environment Agency's recommendations and requirements for works that could affect groundwater resources, replacing the Environment Agency's previous guide Groundwater Protection: Principles and Practice GP3. Section C 'Infrastructure' of the Environment Agency's approach to groundwater protection guidance document is of key importance to transport proposals. In summary, Section C sets out the Environment Agency's position statements and approach to managing and protecting groundwater in relation to transport developments as follows:

- **C2 - Non-nationally significant infrastructure schemes:** In source protection zone 1 and source protection zone 2, the Environment Agency will only agree to proposals for infrastructure developments of non-national significance where they do not have the potential to cause pollution or harmful disturbance to groundwater flow or where these risks can be reduced to an acceptable level via Environmental Permitting (England and Wales) Regulations 2010, if applicable;
- **C3 - On-going groundwater monitoring:** Where a new infrastructure development presents a significant risk to groundwater, the Environment Agency may require a programme of groundwater monitoring to be designed, agreed, installed and undertaken to give early warning of any developing groundwater pollution and/or interference to groundwater flow. This programme may include off-site locations if necessary to identify pollution and to allow monitoring in the event that the site becomes inaccessible; and
- **C4 - Transport developments:** When planning proposals are brought forward for major new road, rail or airport developments the Environment Agency will require that drainage is via sustainable drainage systems (SuDS) designed and maintained to current good practice standards, including the provision of suitable treatment or pollution prevention measures. The point of discharge of such systems should normally be outside source protection zone 1 and ideally outside source protection zone 2. Where there is an existing or unavoidable need to discharge in source protection zone 1, the Environment Agency requires a detailed risk assessment to demonstrate that pollution of groundwater will not occur.

Design Manual for Roads and Bridges

9.3.18 The Design Manual for Roads and Bridges (DMRB) provides standards, advice notes and other documents relating to the design, assessment and operation of trunk and motorways. Of key importance to this section is Volume 11, Section 3, Part 10 'Road Drainage and Water Environment' (HD 45/09) that provides guidance on the assessment and management of impacts that road projects may have on the water environment.

Baseline information and data sources

9.3.19 Information regarding baseline conditions has been sourced from the following locations:

- Highways England Environmental Scoping Report, A1(M) Junction 6-8, dated May 2018;
- Highways Agency Drainage Data Management System (HADDMS) database, accessed December 2018;
- Environment Agency Catchment Data Explorer, accessed December 2018;
- British Geological Survey (BGS) Geology of Britain Viewer accessed December 2018;
- Highways England Smart Motorways Programme Portal, accessed December 2018;

- Groundsure Enviro-Insight Report, dated August 2018;
- Defra MAGIC Maps, accessed December 2018;
- Environment Agency online mapping for flood risk, accessed November 2018;
- Stevenage Borough Council Level 1 Strategic Flood Risk Assessment, dated June 2016;
- Welwyn Hatfield Council Level 1 and 2 Strategic Flood Risk Assessment, dated May 2016;
- Hertfordshire County Council Local Flood Risk Management Strategy, dated 2011;
- Hertfordshire's Draft Local Transport Plan dated November 2017; and
- Correspondence with the Environment Agency and Hertfordshire County Council as Lead Local Flood Authority.

Assessment criteria

9.3.20 The assessment has been undertaken in accordance with DMRB HD 45/09. The methodology and scope of the assessment has been informed by the Environmental Scoping Report (A1(M) Junction 6 to 8 Environmental Scoping Report, May 2018, Highways England). Potential impacts that are considered within this chapter include:

- Flood risk impacts associated with permanent works comprising emergency areas, gantry locations and other construction within the existing highway boundary of the A1(M) junction 6 to 8;
- Risks to surface water and groundwater quality during operation, specifically those associated with a potential increase in traffic flow; and
- Risks to surface water and groundwater quality during construction, including designated sites in hydraulic connectivity to watercourses crossed by the A1(M).

9.3.21 Impacts associated with an increase in surface water runoff attributable to increased areas of impermeable surface that could lead to increased flood risk have been scoped out of the assessment, as discussed in the Environmental Scoping Report and summarised in Table 9.2.

9.3.22 The assessment also identifies where, if anywhere, it may be necessary to undertake a Water Framework Directive compliance assessment to support any consent or approvals from the Environment Agency or Lead Local Flood Authority.

9.3.23 The assessment comprises a predominantly qualitative approach informed by desk-based sources of information and information provided by the highway drainage engineering team. Where traffic flows are predicted to increase by more than 20%, a quantitative approach has been adopted (where this is directly attributable to the installation of a SMP regime) to assess potential implications to surface water and groundwater quality using the Highways Agency Water Risk Assessment Tool (HAWRAT) methods promoted within DMRB HD 45/09 (namely Method A (Routine Runoff), Method C (Groundwater Assessment) and Method D (Spillage Assessment)).

9.3.24 DMRB promotes the following approach when considering beneficial and adverse impacts to flood risk and the water environment:

- Estimation of the importance of the receptor;
- Estimation of the magnitude of the impact; and
- Assessment of the significance of the effect based on the importance of the receptor and the magnitude of the impact.

9.3.25 The importance of potential receptors is set out in Table 9.3 as set out in DMRB HD 45/09.

Table 9.3 - Criteria for estimating the importance of water environment attributes[104]

Importance	Criteria	Example
Very High	Attribute has a high quality and rarity on regional or national scale	**Surface Water:** - Water Framework Directive Class 'High' - Site protected/designated under EC or UK habitat legislation (SAC, SPA, SSSI, WPZ, Ramsar site, salmonid water) - Species protected by EC legislation **Groundwater:** - Principal aquifer providing a regionally important resource or supporting site protected under EC and UK habitat legislation - Source protection zone 1 **Flood Risk:** - Floodplain or defence protecting more than 100 residential properties from flooding
High	Attribute has a high quality and rarity on local scale	**Surface Water:** - Water Framework Directive Class 'Good' - Species protected under EC or UK habitat legislation **Groundwater:** - Principal aquifer providing locally important resource or supporting river ecosystem - Source protection zone 2 **Flood Risk:** - Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding
Medium	Attribute has a medium quality and rarity on local scale	**Surface Water:** - Water Framework Directive Class 'Moderate' **Groundwater:** - Aquifer providing water for agricultural or industrial use with limited connection to surface water - Source protection zone 3 **Flood Risk:** - Floodplain or defence protecting 10 or fewer industrial properties from flooding
Low	Attribute has a low quality and rarity on local scale	**Surface Water:** - Water Framework Directive Class 'Poor' **Groundwater:** - Unproductive strata **Flood Risk:** - Floodplain with limited constraints and a low probability of flooding of residential and industrial properties

9.3.26 The criteria for assessing the potential magnitude of an impact is summarised in Table 9.4 from DMRB HD 45/09.

[104] DMRB Volume 11, Section 3, Part 10 'Road Drainage and Water Environment' (HD 45/09).

Table 9.4 - Criteria for assessing the potential magnitude of an impact[104]

Importance	Criteria	Example
Major Adverse	Results in loss of attribute and / or quality and integrity of the attribute, or major improvement of attribute quality	**Surface Water:** - Failure of both soluble and sediment-bound pollutants in HAWRAT (Method A) and compliance failure with environmental quality standard values (Method B) - Calculated risk of pollution from a spillage >2% annually (Method D) - Loss or extensive change to a fishery - Loss or extensive change to a designated Nature Conservation Site **Groundwater:** - Loss of, or extensive change to, an aquifer - Potential high risk of pollution to groundwater from routine runoff – risk score >250 (Method C) - Calculated risk of pollution from spillages >2% annually (Method D) - Loss of, or extensive change to, groundwater supported designated wetlands **Flood Risk:** - Increase in peak flood level (1% annual probability) >100 mm (Methods E and F)
Moderate Adverse	Results in Impact on integrity of attribute, or loss of part of attribute, or moderate improvement of attribute quality	**Surface Water:** - Failure of both soluble and sediment-bound pollutants in HAWRAT (Method A) but compliance with environmental quality standard values (Method B) - Calculated risk of pollution from spillages >1% annually and <2% annually (Method D) **Groundwater:** - Partial loss or change to an aquifer - Potential medium risk of pollution to groundwater from routine runoff – risk score 150-250 (Method C) - Calculated risk of pollution from spillages >1% annually (Method D) **Flood Risk:** - Increase in peak flood level (1% annual probability) >50 mm (Methods E and F)
Minor Adverse	Results in some measurable change in attribute's quality or vulnerability, or an increased or reduced risk of an effect occurring	**Surface Water:** - Failure of either soluble or sediment-bound pollutants in HAWRAT (Method A) - Calculated risk of pollution from spillages >0.5% annually and <1% annually (Method D) **Groundwater:** - Potential low risk of pollution to groundwater from routine runoff – risk score <150 - Calculated risk of pollution from spillages >0.5% annually and <1% annually - Minor effects on groundwater supported wetlands **Flood Risk:** - Increase in peak flood level (1% annual probability) >10mm

Importance	Criteria	Example
Negligible	Results in impact on attribute, but of insufficient magnitude to affect the use or integrity	The Proposed Scheme is unlikely to affect the integrity of the water environment **Surface Water:** - No risk identified by HAWRAT (Pass both soluble and sediment-bound pollutants) (Method A) - Risk of pollution from spillages <0.5% (Method D) **Groundwater:** - No measurable impact upon an aquifer - Risk of pollution from spillages <0.5% (Method D) **Flood Risk:** - Negligible change in peak flood level (1% annual probability) <+/- 10 mm (Methods E and F)

9.3.27 The overall significance of effect considers both the magnitude of the impact against the importance of the receptor as demonstrated in Table 9.5. Effects with a significance of moderate or above are considered significant.

Table 9.5 - Criteria for assessing the significance of the effect

		Magnitude of Impact			
		Negligible	**Minor**	**Moderate**	**Major**
Importance of Receptor	Very High	Neutral	Moderate to Large	Large to Very Large	Very Large
	High	Neutral	Slight to Moderate	Moderate to Large	Large to Very Large
	Medium	Neutral	Slight	Moderate	Large
	Low	Neutral	Neutral	Slight	Slight to Moderate

9.3.28 Mitigation measures incorporated into the design and that are considered standard good practice have been considered prior to undertaking the assessment of effects. Any residual effects following these measures have been identified. The need for further mitigation to be considered further at detailed design is summarised within this assessment.

Stakeholder engagement

9.3.29 Engagement has been undertaken with the following stakeholders to inform this assessment:

Table 9.6 - Summary of engagement

Authority	Date	Summary of Consultation
Hertfordshire County Council	17/10/2018	Request made to Hertfordshire County Council for information regarding the following: • Any records of any relevant surface water related historical flooding within Proposed Scheme boundary, as well as flooding originating from overland flow from adjacent areas; • Known issues with water quality within watercourses that receive discharge from the A1(M) within Proposed Scheme boundary; and • Knowledge of attenuation ponds downstream of the motorway and their control and operation Hertfordshire County Council replied to confirm that they are not aware of any water quality issues within watercourses that receive discharge from the A1(M). Hertfordshire County Council identified a historical flooding issue believed to be associated with an attenuation pond at Knebworth that serves the existing A1(M).
Environment Agency	12/11/2018	Request made to Environment Agency for information regarding the following: • Any known issues with water quality within watercourses that receive discharge from the Proposed Scheme that are likely to be attributable to this discharge; • Records of any relevant historical flooding that may be attributable to the Proposed Scheme including culverts that pass beneath the Proposed Scheme;

Authority	Date	Summary of Consultation
		• Abstraction licenses within approximately 1km of the Proposed Scheme The Environment Agency replied to confirm that they hold no records of flooding incidents along the Proposed Scheme. The Environment Agency also provided licensed groundwater and impoundment licenses within 1km of the Proposed Scheme.

Assumptions and limitations

9.3.30 The assessment of potential effects to the water environment and flood risk has been informed by information obtained from desk-based sources and information regarding the Proposed Scheme layout available at the time of preparing this report. No site visit, on-site survey or monitoring has been undertaken to inform this assessment.

9.3.31 Information regarding groundwater levels will be determined during on-site ground investigation works proposed during design freeze 5 (DF5). The risk of groundwater resources occurring at depths shallower than those assumed has been considered within the assessment.

9.3.32 The detailed design of structures such as gantries that will require piled foundations has not yet been undertaken and as such, the required depth of piling works and construction method is unknown. It is considered unlikely that piles will extend more than 10-15m below ground level, but the risk of deeper piles or piles that may extend to below the groundwater table has been considered within this assessment.

9.3.33 At the time of preparing this report it has not been possible to identify / ratify the location of all outfalls that serve the Proposed Scheme, principally to confirm if outfalls discharge to ground, a surface water feature or adjacent piped drainage network. Where this has not been possible, assumptions have been made using professional judgement and review of adjacent features that are deemed likely to receive runoff. Some uncertainty has also been identified regarding drainage catchment areas – particularly around junction 8 and extending north noting that this may affect the assessment of risks to water quality to the Ash Brook during operation of the Proposed Scheme. A more detailed description of the existing surface water drainage system and assumptions that have been made regarding outfall locations and drainage catchments is provided within the Drainage Strategy Report (HE551539-WSP-HDG-SG-RP-CD-00001).

9.3.34 A number of sites that hold a UK ecological designation are located within 1km of the Proposed Scheme, as discussed in Section 9.4 and in Chapter 6: Biodiversity. Given the uncertainty regarding outfall discharge locations as discussed above, it is currently uncertain if the ditches and minor watercourses that flow through these sites receive discharge from the Proposed Scheme.

9.3.35 The 24-hour Annual Average Daily Traffic (AADT) traffic flows are predicted to increase by more than 20% for the 'do minimum' and 'do something' design year scenarios (2037) at the following locations:

- Junction 6 northbound through road;
- Junction 6 northbound on-slip;
- Junction 6 southbound off-slip;
- Between Junction 6 and Junction 7 northbound and southbound;
- Junction 7 northbound through road;
- Between Junction 7 and Junction 8 northbound; and
- Junction 8 northbound off-slip.

9.3.36 A qualitative assessment of the potential implications of this increase in traffic flow on the quality of the receiving water environment is considered further below. Where further analysis is recommended, including completion of a HAWRAT assessment, this has been undertaken and a summary of the analysis presented within this chapter.

9.3.37 Details for geotechnical interventions e.g. retaining walls, have yet to be finalised/agreed with the Highways England geotechnical team and therefore a worst case assumption has been made.

9.4 Baseline conditions

9.4.1 A summary of water environment features that have the potential to be affected by the Proposed Scheme is provided below.

Surface water features

Main rivers

9.4.2 The majority of the Proposed Scheme is located within the Thames River Basin District. The northern extent of the Proposed Scheme is located within the Anglian River Basin District.

9.4.3 There are 2 main rivers under the jurisdiction of the Environment Agency and a further 2 notable ordinary watercourses under the jurisdiction of Hertfordshire County Council within 0.5km of the Proposed Scheme, as summarised in Table 9.7.

Table 9.7 - Summary of notable rivers within study area

River	Summary of Watercourse
River Mimram	Main river under the jurisdiction of the Environment Agency. Located in the Thames River Basin District. Flows in an easterly direction towards Hertford and crosses the Proposed Scheme at chainage 2900 at junction 6. Chalk stream with a number of springs and high groundwater level. River Mimram Catchment Partnership states that the Mimram supports populations of water vole and otters. Birds such as green sandpiper, little egret and kingfisher have also been spotted along the river.
Ippollitts Brook	Ordinary watercourse under the jurisdiction of Hertfordshire County Council. Located in the Anglian River Basin District and flows in a northerly direction parallel to the west of the Proposed Scheme. The brook is a tributary of the River Purwell which is stated to be predominately groundwater fed. The upstream extent of the brook is located approximately 200m west of junction 7 in Newton Wood (with the upstream extents of the watercourse known as Langley Brook). A minor tributary of Ippollitts Brook crosses the Proposed Scheme at chainage 13400.
Stevenage Brook	Main river under the jurisdiction of the Environment Agency. Located in the Thames River Basin District. Major tributary of the River Beane located approximately 0.5km to the east of the Proposed Scheme at its nearest point. The brook flows in a southerly direction through the centre of Stevenage and contributes a large percentage of flow in the River Beane. A minor tributary of Stevenage Brook is assumed to cross the Proposed Scheme from west to east between chainage 8500 to 8600.
Ash Brook	Ordinary watercourse under the jurisdiction of Hertfordshire County Council. Located in the Anglian River Basin District. The brook is a tributary of the River Purwell which is stated to be predominately groundwater fed. The brook flows in an easterly direction and crosses the Proposed Scheme at chainage 14300.

9.4.4 The location of these watercourses is illustrated on the Water Constraints Maps (Figure 9.1).

9.4.5 The River Mimram and Stevenage Brook are monitored against the objectives of the Water Framework Directive. The Ippollitts Brook and Ash Brook are not monitored against the Water Framework Directive, but the River Purwell located approximately 4km downstream of the Proposed Scheme is monitored against the Water Framework Directive. As this watercourse receives discharge from the Ippollitts Brook and the Ash Brook, its Water Framework Directive monitoring results have been included within this assessment.

9.4.6 A summary of current water quality (Cycle 2 results - 2016) is provided in Table 9.8. All 3 watercourses are reported to have Good chemical quality.

9.4.7 Stevenage Brook is reported to have a Poor overall status attributable to poor ecological quality. The inability to achieve Good ecological status is indicated to be associated with diffuse source pollution and physical modifications impacting invertebrate populations of the waterbody. Other pressures such as groundwater abstraction impacting hydrological regime and physical modifications impacting the waterbodies ability to support fish populations are also listed. The River Purwell is shown to be facing similar pressures to that of the Stevenage Brook.

9.4.8 The Moderate ecological quality of the predominantly chalk fed River Mimram is indicated to be associated with low flow issues due to groundwater abstraction pressures in the catchment. This has influenced the diversity of plant, invertebrate and fish species currently found within the river.

Table 9.8 - Summary of Water Framework Directive status of watercourses

River	Watercourse ID	Status	2015 Cycle	Objectives
River Mimram (flowing east)	GB106038033270	Overall Water Body	Moderate	Good by 2021
		Ecological	Moderate	
		Chemical	Good	
River Purwell (flowing north)	GB105033037690	Overall Water Body	Poor	Good by 2027
		Ecological	Poor	
		Chemical	Good	
Stevenage Brook (flowing south)	GB106038033410	Overall Water Body	Poor	Moderate by 2027
		Ecological	Poor	
		Chemical	Good	

Other surface water features

9.4.9 A review of Ordnance Survey mapping indicates that there are approximately 12 unnamed ordinary watercourses within the study area. Their water quality and ecological value is unknown. A review of Ordnance Survey mapping indicates that many of the unnamed ordinary watercourses serve as agricultural drainage ditches.

9.4.10 A review of information provided by the Environment Agency and information contained within the Groundsure report indicates no licensed surface water abstractions within 1km of the Proposed Scheme.

Designations

9.4.11 A review of sites within 1km of the Proposed Scheme that hold a UK or European ecological designation is presented in Chapter 6: Biodiversity. There are no surface water features within 1km of the Proposed Scheme that hold statutory designation, although there are several designated sites that have water features within them as summarised below:

- SherrardsPark Wood Site of Special Scientific Interest (SSSI), located to the east of the Proposed Scheme between chainage 0 and 1400 (south of junction 6). Drainage ditches and minor watercourses that flow through the SSSI may receive discharge of runoff from the Proposed Scheme although this is currently uncertain;
- Two local nature reserves, Singlers Marsh and Danesbury Park Local Nature Reserves, immediately to the west of the Proposed Scheme between chainage 3000 and 4000 (north of junction 6). The River Mimram flows between the boundary of Singlers Marsh and Danesbury Park Local Nature Reserves upstream of the watercourse's crossing beneath the Proposed Scheme. It is unlikely that discharge of runoff from the Proposed Scheme will pass through these sites;
- Mardley Heath Local Nature Reserve, immediately to the east of the Proposed Scheme between chainage 4800 and 5500 (junction 6 to 7). Drainage ditches and minor watercourses that flow through the site may receive discharge of runoff from the Proposed Scheme, although this is currently uncertain; and
- Knebworth Woods SSSI, immediately to the west of the Proposed Scheme between chainage 7500 and 9100 (junction 7). A tributary of Stevenage Brook flows within the south of Knebworth Woods SSSI upstream of its assumed crossing of the Proposed Scheme between chainage 8500 to 8600. Several drainage ditches that flow through the middle and north of Knebworth Woods SSSI flow in a north-westerly direction away from the Proposed Scheme to form Langley Brook and subsequently Ippollitts Brook. It is unlikely that discharge of runoff from the Proposed Scheme will pass through this site as ground levels rise from the Proposed Scheme towards the site.

Outfalls to surface water

9.4.12 A full description of the existing and proposed drainage systems, including confirmed and assumed outfall locations and uncertainties with HADDMS data, is provided within the Drainage Strategy Report (HE551539-WSP-HDG-SG-RP-CD-00001).

9.4.13 Review of HADDMS reports that there are no Priority A, B or Not Determined outfalls to surface water features that serve the Proposed Scheme. There are however outfalls that currently hold no priority status. The number of these outfalls cannot be quantified given the uncertainty and poor clarity of data within HADDMS.

9.4.14 Runoff from the south and north of the Proposed Scheme is known to discharge to the River Mimram and Ash Brook respectively, currently with no known attenuation or treatment. HADDMS indicates that the runoff from outfalls in close proximately to the River Mimram and Ash Brook also discharge to these watercourses via existing drainage systems or ditches, although this has not yet been confirmed as HADDMS data for these outfalls is incomplete.

9.4.15 The majority of runoff from the centre of the Proposed Scheme discharges to ground via infiltration basins, currently with no known upstream treatment.

9.4.16 The majority of runoff in the vicinity of Stevenage is assumed to discharge to existing drainage systems that serve Stevenage and ultimately convey runoff to Stevenage Brook, although this has not yet been confirmed as HADDMS data for these outfalls is incomplete. One outfall is assumed to discharge to a tributary of the Ippollitts Brook.

Groundwater resources

9.4.17 Bedrock geology underlying the entirety of the Proposed Scheme comprises White Chalk. The chalk bedrock geology is classified as a Principal aquifer which is typically described as layers of rock that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. A review of information provided by the Environment Agency indicates that groundwater is abstracted for potable supply, as discussed below. A review of Water Framework Directive information also indicates that groundwater in this area provides baseflow to rivers, maintaining quality and surface water dependent ecosystems.

9.4.18 The majority of the Proposed Scheme is underlain by superficial deposits comprising glacial sand and gravels, with further review of boreholes indicating that this material is variable with a high clay and silt content. A thin layer of clay superficial deposits overlays the chalk bedrock between junction 6 and junction 7, although the chalk outcrops along this section of the Proposed Scheme.

9.4.19 The sand and gravels superficial deposits are classified as Secondary A and Secondary (Undifferentiated) aquifers. A Secondary A aquifer is defined by the Environment Agency as 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. Secondary (Undifferentiated) aquifers are assigned in cases where it has not been possible to attribute either category A or B to a rock type. The clay deposits are classified as unproductive strata with negligible significance for water supply or river baseflow.

9.4.20 Much of the Proposed Scheme is underlain by a designated groundwater source protection zone associated with the bedrock geology, with the Proposed Scheme passing through areas defined as Zone 1 (chainage 1750 to 3100), Zone 2 (chainage 8550 to 8850; 10800 to 11650; 13350 to 13750; and 14200 to 14200) and Zone 3 (chainage 4600 to 5800; 6050 to 7200; 10700 to 10800; 11650 to 13350; 13750 to 14200; and 14400 to 15400). The location of these zones is illustrated on the Water Constraints Maps.

9.4.21 Source protection zones are defined by the following categories:

- Zone 1: Defined as the inner zone. Pollutants released within this zone are predicted to travel to the source of the abstraction within 50 days. This zone has a minimum radius of 50m around the source.
- Zone 2: Defined as the outer zone. Pollutants released within this zone are predicted to travel to the source of the abstraction within 400 days.
- Zone 3: Defined as the total catchment. All of this area is predicted to ultimately serve the abstraction and provide the abstraction recharge area.

9.4.22 A review of selected boreholes available through the BGS indicates that groundwater is typically in excess of 20m below ground level. A summary of reviewed boreholes along the alignment of the Proposed Scheme is provided in Table 9.9. Where several groundwater levels were recorded at different times, the highest recorded level has been summarised.

Table 9.9 - Summary of BGS borehole records

Borehole Ref	Coordinates	Ground Level (mAOD)	Depth to Groundwater (m)
TL22NW112	523405, 215704	79.80	Dry at 32.30
TL22NW133	523551, 216458	74.30	Dry at 32.50
TL22NW150	524352, 219206	126.40	Dry at 30.45
TL22NW98	524223, 219842	107.60	Dry at 30.05
TL22SW262	523814, 221650	95.00	22.20
TL22SW283	523585, 222264	91.50	17.90
TL22SW268	523459, 222587	95.80	20.80
TL22SW277	522120, 224560	109.10	Dry at 31.60
TL22NW272	522219, 226175	96.80	24.70
TL22NW274	522319, 226536	96.00	20.50
TL22NW278	522472, 227056	91.20	Dry at 38.2

9.4.23 Groundwater resources within the study area are monitored against the objectives of the Water Framework Directive. The Proposed Scheme falls within 2 groundwater catchments: the Ouse Upper Bedford Chalk groundwater body in the north and the Upper Lee Chalk groundwater body in the south. Both catchments are reported to have Poor overall status, comprising Poor quantitative quality and Poor chemical quality (2016 data).

9.4.24 Consultation with the Environment Agency has confirmed 5 licenced groundwater abstractions within 0.5km of the Proposed Scheme as shown in Table 9.10. The purpose of 4 of these abstractions is for public potable water supply overseen by Affinity Water, and one private licence for spray irrigation by a commercial farm. The location of these abstractions is illustrated on the Water Constraints Maps, along with the mapped source protection zones associated with the public potable water supplies.

Table 9.10 - Summary of licensed abstractions

Name of Abstraction	Coordinates	Licence Holder Name	Use
Borehole - Little Wymondley	521500, 227000	Affinity Water Limited	Public Water Supply
Borehole at Todds Green	522030, 226730	F T Gearing Landscape	Agriculture-Spray Irrigation
Broomin Green Pumping Station	523000, 224100	Affinity Water Limited	Public Water Supply
Digswell Pumping Station - Point 'c'	523960, 215360	Affinity Water Limited	Public Water Supply
School Lane Pumping Station	522400, 215800	Affinity Water Limited	Public Water Supply

Outfalls to groundwater

9.4.25 A review of HADDMS reports that there are no Priority or Not Determined outfalls that discharge to ground that serve the Proposed Scheme. A review of HADDMS indicates there may be outfalls that don't have priority status. This is discussed further in the drainage strategy.

9.4.26 Runoff from much of the centre of the Proposed Scheme (approximate chainage 11700 to 12900 and approximate chainage 6000 to 8700) is known to discharge to ground via infiltration, with treatment assumed to be limited to the receiving infiltration pond or basin. Outfalls within this area are indicated to be within Zones 2 and 3 of the source protection zone. Runoff from other areas of the Proposed Scheme may also discharge to ground, although this has not yet been confirmed as discussed within the Drainage Strategy Report.

Flood risk

Fluvial Flood Risk

9.4.27 A review of the Environment Agency's Flood Map for Planning indicates that the vast majority of the Proposed Scheme is located in the low risk Flood Zone 1105. The only areas of the Proposed Scheme identified to be at fluvial flood risk are at junction 6 associated with the River Mimram and to the south of junction 8 associated with Ash Brook. The A1(M) is located on embankment at both of these locations and is therefore unlikely to be at risk of flooding. However, the A1000 main road that forms part of junction 6 is shown to be within the mapped Flood Zone 3.

9.4.28 The mapped extent of fluvial flooding (as informed by Environment Agency mapping) is illustrated on the Water Constraints Maps.

9.4.29 Correspondence with the Environment Agency has confirmed no recorded flood events from main rivers along the Proposed Scheme.

Surface Water Flood Risk

[105] Flood Zone 1 is defined as land with less than a 1 in 1000 (0.1%) and 1 in 100 (1%) annual probability of fluvial flooding. Flood Zone 2 is defined as land with between a 1 in 1000 (0.1%) and 1 in 100 (1%) annual probability of fluvial flooding. Flood Zone 3 is defined as land with greater than a 1 in 100 (1%) annual probability of fluvial flooding.

9.4.30 A review of the Environment Agency's Risk of Flooding from Surface Water map indicates that much of the Proposed Scheme is at risk of surface water flooding, either attributable to: fluvial flow in smaller unmodeled watercourses; overland flow that is indicated to pond against the Proposed Scheme that forms a barrier to this flow; or surface water that is indicated to flow or pond within natural depressions in topography including within the carriageway of the Proposed Scheme. The methods by which surface water flood maps are generated do not accurately consider flood management measures such as the carriageway drainage system or culverts that convey flow beneath the carriageway.

9.4.31 The mapped extent of surface water flooding (as informed by Environment Agency mapping) is illustrated on the Water Constraints Maps.

9.4.32 Consultation with Hertfordshire County Council highlighted a recorded flood event in February 2014 when 18 properties flooded internally in Knebworth. Hertfordshire County Council believes this may be attributable to reduced infiltration potential through motorway attenuation ponds. Hertfordshire County Council undertook infiltration testing and found a thick layer of silt in the tested pond, surmising that silt is likely to be affecting the performance of the ponds that serve the motorway in the Knebworth area.

9.4.33 Hertfordshire County Council also confirmed that there have been flooding events within the study area to roads and external areas of properties in 1978, 1987, 8 August 2014, 19 September 2014 and 13 October 2014. They were unable to comment on the mechanisms of these flood events and it is therefore unknown if any of these events are related to the Proposed Scheme.

9.4.34 The Welwyn Garden City Strategic Flood Risk Assessment states that Hertfordshire experienced significant recorded surface water flooding during June 2007 as the result of series of intense, short duration rainfall events. Hertfordshire County Council was unable to comment on the mechanisms of these flood events and it is therefore unknown if any of these events are related to the existing A1(M).

HADDMS flooding information

9.4.35 An assessment has been undertaken of historic flooding events that are recorded within HADDMS. HADDMS indicates a total of 5 recorded flood events with a severity class of 7-10 (with 10 being the highest score allocated and 0 being the lowest score allocated). A summary of events that have occurred with the extent of the Proposed Scheme is provided in the Drainage Strategy Report. No events classified as 'high impact floods' have been recorded. The recorded flooding events with a severity class of 7-10 are not located in areas that are deemed to be at high risk from fluvial or surface water sources as mapped on the Environment Agency's Flood Map for Planning and Risk of Flooding from Surface Water map.

9.4.36 A review of HADDMS indicates no Priority A, B or Not-determined culverts within the Proposed Scheme.

Importance of resources

9.4.37 The importance of the resources discussed in Section 9.4 that have the potential to be affected by the Proposed Scheme have been assessed against the criteria presented in Table 9.3. This is summarised in Table 9.11.

Table 9.11 - Summary of receptor importance

Feature(s)	Key attributes	Importance
River Mimram	Main River of moderate Water Framework Directive status under abstraction pressures. No known statutory designations although flows through Local Nature Reserves upstream of Proposed Scheme. Supports otter, water vole and notable bird species. Of local amenity value and flows in close proximity to residential homes.	High

Feature(s)	Key attributes	Importance
Ippollitts Brook	Ordinary watercourse, not Water Framework Directive assessed. Unknown ecological and water quality. Downstream River Purwell has poor Water Framework Directive status. Of local amenity value and flows in close proximity to residential homes.	Medium
Stevenage Brook	Main River of poor Water Framework Directive status, unknown ecological and water quality. Of local amenity value and flows in close proximity to residential homes.	Medium
Ash Brook	Ordinary watercourse, not Water Framework Directive assessed. Unknown ecological and water quality. Downstream River Purwell has poor Water Framework Directive status. Of local amenity value and flows in close proximity to residential homes.	Medium
Unnamed Ordinary watercourses	Ordinary watercourses crossed or located within close proximity of Proposed Scheme. Unknown ecological value and water quality. Likely to be of local value.	Low
Groundwater abstractions	Principal aquifer and source protection zones (SPZ) 1, 2 and 3. Potable and non-potable abstractions identified.	Source protection zone 1: Very High Source protection zone 2: High Source protection zone 3: Medium Outside of Source protection zone: Medium
Flood risk receptors	Mixture of residential, agricultural and industrial land within vicinity of Proposed Scheme.	Residential: High - Non-residential: Medium

Future baseline

9.4.38 The most significant change in the baseline conditions is likely to be associated with an increase in peak river flows and peak rainfall intensity associated with the potential effects of climate change. The Environment Agency provides guidance on a range of potential climate change allowances dependant on the relevant river basin district and climate change probability. The Proposed Scheme is located within the Thames and Anglian River Basin Districts. In the Thames River Basin District, it is predicted that by 2115 peak river flows could increase by 25% (central allowance), 35% (higher central allowance) and 70% (upper end allowance). In the Anglian River Basin District, it is predicted that by 2115 peak river flows could increase by 25% (central allowance), 35% (higher central allowance) and 65% (upper end allowance). This may increase the frequency of flood risk to identified receptors and increase the extent of Flood Zones 2 and 3, resulting in a greater area of the study area at risk of fluvial flooding. However, as the Proposed Scheme is located on an embankment in areas of mapped fluvial flooding, the risk to the Proposed Scheme is not considered significant. There may however be increased risk to the adjacent A1000 at junction 6.

9.4.39 Peak rainfall intensity may also increase as a result of climate change, which could potentially increase the risk of surface water flooding to the Proposed Scheme. The Environment Agency provides guidance on the central and upper end allowances for all of England. The total potential change anticipated up to 2115 is 20% (central allowance) and 40% (upper end allowance). The drainage strategy proposed to manage surface water runoff from new impermeable surfaces and areas being hardened within the existing highway alignment (the central reserve, for example) will be designed to accommodate a 20% increase in rainfall intensity to allow for climate change in accordance with DMRB Volume 4, Section 2, Part 3 (HD 33/16) and IAN 161/15.

9.5 Assessment of construction effects

9.5.1 The implementation of an OEMP and (subsequently) a Construction Environmental Management Plan (CEMP) will assist in reducing the likely risks associated with increased sediment load and other pollutants contained in surface water runoff that may affect both surface water and groundwater resources. The OEMP and CEMP will include measures such as maintaining control of site boundaries, preventing uncontrolled runoff from the site during the works and protecting existing drainage lines.

9.5.2 As the Proposed Scheme does not propose any works to existing river crossing structures or amendment to outfall structures, the risks to surface water features associated with the construction of the Proposed Scheme are considered to pose negligible adverse impact to adjacent and downstream surface water features, with an overall significance of effect of neutral. Impacts during construction are likely to be temporary and treated through natural processes such as settlement and dilution.

9.5.3 Where water features are crossed or located immediately adjacent to the Proposed Scheme it will be difficult to fully eliminate potential risks associated with direct runoff to these features given their proximity to the Proposed Scheme and the difficulty capturing all sediment-laden runoff. Works crossed by or immediately adjacent to the water features will include activities such as replacement of existing drainage systems, resurfacing of the carriageway, replacement of the central reservation and cross carriageway duct cabling. However, potential impacts to these features are still predicted to have neutral overall significance with the implementation of the OEMP and CEMP. A summary of key receptors and features considered to be at greatest risk from linear works along the Proposed Scheme alignment is provided in Table 9.12.

Table 9.12 - Summary of potential impacts to watercourses

Feature	Significance of effect
River Mimram	Watercourse crosses the Proposed Scheme. May receive temporary discharge during construction with higher pollutant loading due to proximity to works, however supports significant flow and unlikely to experience notable impact to water quality during construction due to dilution. No impact to the watercourse's use, integrity or WFD status is expected. Temporary impact of **negligible adverse** magnitude and overall significance of effect of **neutral**.
Ippollitts Brook	Watercourse located approximately 200m east of Proposed Scheme although at slightly higher elevation and therefore unlikely to receive direct discharge. May receive temporary discharge during construction from minor tributary that crosses Proposed Scheme with higher pollutant loading due to proximity to works. However, Ippollitts Brook supports significant flow and pollutants likely to settle/dilute prior to reaching watercourse. Temporary impact of **negligible adverse** magnitude and overall significance of effect of **neutral**.

Feature	Significance of effect
Stevenage Brook	Watercourse flows approximately 0.5km from the Proposed Scheme. Not expected to receive discharge with higher pollutant loading due to proximity to works. Receives discharge from tributaries that pass beneath the Proposed Scheme but pollutants unlikely to be notable and likely to settle/dilute prior to reaching Stevenage Brook. Temporary impact of **negligible adverse** magnitude and overall significance of effect of **neutral.**
Ash Brook	Watercourse crosses the Proposed Scheme. May receive temporary discharge during construction with higher pollutant loading due to proximity to works, however supports significant flow and unlikely to experience notable impact to water quality during construction due to dilution. No impact to the watercourse's use or integrity is expected. Temporary impact of **negligible adverse** magnitude and overall significance of effect of **neutral.**
Unnamed ordinary watercourses	Unnamed watercourses or drains adjacent or crossed by the Proposed Scheme may experience minor adverse impact to water quality due to proximity to works. Temporary impact of **minor adverse** magnitude and overall significance of effect of **neutral**.

9.5.4 Construction works will be required within the designated source protection zone. The implementation of the OEMP and CEMP should adequately manage risks to groundwater quality, noting that specific care must be taken within the source protection zone and during any deep excavation or piling works, as discussed within the OEMP. As also discussed within the OEMP, consultation with the Environment Agency must be undertaken to agree the most appropriate construction methodology and any site-specific mitigation requirements.

9.5.5 The detailed design of structures such as gantries that will require piled foundations cannot be undertaken at this time, although it is considered likely that these will not extend to depths greater than 10-15m below ground level. Groundwater resources are likely to be in excess of 20m below ground level, although there is a possibility that groundwater investigation works undertaken during DF5 may identify that groundwater levels are higher than those indicated by boreholes records. Impacts to groundwater quality during construction are considered to have **negligible adverse** impact magnitude and **neutral** overall significance of effect even if piling works extend to below the groundwater table, assuming appropriate implementation of the OEMP and CEMP as agreed with the Environment Agency. The construction methodology for piling works must be informed by the results of the ground investigation (and confirmation of groundwater depths) and take the sensitivity of groundwater resources into account.

9.5.6 If a spillage to groundwater resources were to occur during construction the impacts could be long term to permanent depending on the scale of the impact, given the difficulty associated with removing pollutants or remediating contaminated soils following a significant pollution incident. This will be addressed via detailed design, engagement with the Environment Agency and the preparation of comprehensive construction management interventions as part of the detailed design process to avoid or manage any potential issues.

9.6 Assessment of operational effects

9.6.1 The assessment of potential effects that may occur during the operational phase of the Proposed Scheme is summarised below. This assessment has been undertaken whilst taking into account mitigation measures[106] that are proposed to form part of the design of the Proposed Scheme.

9.6.2 Works that have been considered in the operational effects assessment comprise:

[106] All measures required are detailed in the Highways England 2018: A1(M) J6 to J8 Smart Motorway OEMP Report, HE551539-WSP-EGN-SG-RP-LE-00023

- Potential increased flood risk associated with the construction of emergency areas and other works that may displace or interrupt the flow of flood waters; and
- Potential increased risk to water quality associated with increased traffic flow.

9.6.3 In summary, the assessment presented below demonstrates that the proposed works are not predicted to have an adverse effect on flood risk. The works are also assessed to not pose increased risk to water quality associated with an increase in traffic flow. A summary of these assessments is provided below.

9.6.4 The Proposed Scheme will introduce additional areas of hardstanding. However, the surface water drainage system will be designed to receive runoff from these areas in accordance with DMRB and IAN 161/15 requirements/design standards, limiting discharge to the existing discharge rate up to the 1 in 100 (1%) annual probability event and with new attention and/or flow control measures installed where required. A detailed description of the proposed drainage strategy and assessment of any existing sources of flooding within the carriageway is provided within the Drainage Strategy Report.

Flood risk associated with emergency areas and other works

9.6.5 Emergency areas will comprise of additional hard standing located adjacent to the carriageway and, in some cases, will require re-profiling of land and embankments. Other works included in this assessment include the construction of proposed gantries and off-network access routes.

9.6.6 None of the proposed emergency areas, gantries and off-network access routes are located within the high and medium risk Flood Zones 2 and 3 and therefore there is no predicted adverse effect to fluvial flooding. The significance of effect to potential flood risk receptors associated with fluvial flooding is considered to be neutral.

9.6.7 None of the proposed emergency areas, gantries, and off-network access routes are located in areas of high risk or medium risk surface water flooding areas. Where proposed emergency areas, gantries and off-network access routes are indicated to be located within or adjacent to areas at low risk of surface water flooding (where the annual probability of flooding is between 1 in 1000 (0.1%) and 1 in 100 (1%)) review of Environment Agency mapping indicates that the identified risks are associated with ponding or overland flow that follows topography, and not with fluvial flows from smaller watercourses. The significance of effect to potential flood risk receptors associated with surface water flooding is considered to be neutral.

Risks to water quality associated with increased traffic flow

9.6.8 A review of predicted traffic flow for the Do Minimum and Do Something scenarios for the design year (2037) indicates that traffic flows with certain sections of the Proposed Scheme (as summarised below) may increase by more than 20% as a result of the Proposed Scheme. The Proposed Scheme is predicted to have a **neutral** significance of effect to surface water and groundwater quality when compared to baseline conditions and the 2037 Do Minimum scenario. A summary of this assessment is presented below.

9.6.9 A review of all outfalls that drain the Proposed Scheme was undertaken to identify where an assessment of potential risks to water quality is recommended. This review identified that HAWRAT was not considered necessary or appropriate for all outfalls, namely where:

- The two-way 24-hour annual average daily traffic (AADT) for the main carriageway/proportion of road that drains to the outfall does not increase by more than 20% and there is no change to the AADT banding between the 2037 Do Minimum and 2037 Do Something scenarios;
- The two-way 24-hour AADT for all sections of road draining to the outfall is less than 10,000;
- The increase in traffic flow does not change the current AADT banding and an existing HAWRAT assessment is available in HADDMS with Priority X Risk Addressed status; and

- The location of the outfall cannot be confirmed and there is too much uncertainty to inform a meaningful HAWRAT assessment. This applies to outfalls that are believed (but not confirmed) to discharge to the wider drainage network serving Stevenage.

9.6.10 Potential risks to surface water and groundwater quality have been assessed using the HAWRAT methods promoted within DMRB HD 45/09 - namely Method A (Routine Runoff), Method C (Groundwater Assessment) and Method D (Spillage Assessment).

9.6.11 For potential risks to surface water features, the assessments have included single outfall assessments and cumulative outfall assessments where single outfalls drain to the same watercourse reach within 1km. For the cumulative assessments in accordance with DMRB HD 45/09, all outfalls within 1km have been considered for the assessment of soluble pollutants and only outfalls within 100m have been considered for the assessment of sediment accumulation.

9.6.12 Table 9.13 summarises the outfalls that have been assessed using the DMRB methods and the sections of road that are drained by these outfalls. Table 9.14 summarises the assessment of outfalls discharging to surface waters and Table 9.15 summarises the assessment of outfalls discharging to ground.

9.6.13 The assessments conclude that:

- All individual outfalls draining (and assumed to drain) to the River Mimram and Ash Brook pass both the Method A (Routine Runoff) and Method D (Spillage) assessments. Effects on the River Mimram and Ash Brook are therefore assessed as being of **neutral** significance;
- The cumulative assessment of all outfalls draining (and assumed to drain) to the River Mimram also pass the Method A (Routine Runoff) assessment. Effects on the River Mimram are therefore assessed as being of **neutral** significance;
- The cumulative assessment of all outfalls draining (and assumed to drain) to the Ash Brook indicates failure of the soluble acute impact assessment for copper and failure of the sediment impact assessment. Effects on the Ash Brook are therefore assessed as being of moderate adverse significance, although further comparison against the baseline condition concludes **neutral** significance, as discussed below;
- All outfalls discharging to ground are assessed to pose medium risk to underlying groundwater resources. Taking the importance of the underlying receptor into account (i.e. the source protection zone classification), effects on groundwater quality are assessed as being of moderate to large adverse significance, although further comparison against the baseline condition concludes **neutral** significance, as discussed below; and
- All outfalls discharging to ground pass the Method D (Spillage) assessments.

9.6.14 Where the assessments presented above indicate potential for adverse effect, further analysis of baselines conditions was undertaken to determine the likely magnitude of impact attributable to the Proposed Scheme.

9.6.15 With regard to the cumulative assessment of outfalls draining to the Ash Brook, a comparison to the present-day baseline condition and the 2037 Do Minimum scenario has been undertaken to better understand the implications of the Proposed Scheme. The assessment indicates that the cumulative assessment for these two scenarios would also indicate failure of the soluble acute impact assessment for copper and failure of the sediment impact assessment – i.e. the overall conclusions of the assessment are the same as that for the 2037 Do Something scenario. The effect of the Proposed Scheme on water quality in the Ash Brook is therefore considered to be of **neutral** significance when compared against the baseline and 2037 Do Minimum scenario. The assessment indicates that the greatest contributing area to the identified pollution risk to the Ash Brook is associated with the catchment draining to Outfall 25 to the south of junction 8 and (more so) to the catchments draining to Outfalls 28 and 29 to the north of junction 8.

9.6.16 With regard to the identified Medium Risk to groundwater resources, a review of outfalls discharging to ground indicates that there would be an increase in traffic flow between the 2037 Do Minimum and 2037 Do Something scenarios that would change the AADT traffic banding from '≥50,000 to <100,000' to '≥100,000'. However, the findings of the 2037 Do Minimum assessment do not change from that reported here – i.e. the Method C assessment of the 2037 Do Minimum scenario also identified a Medium Risk to underlying groundwater quality. Whilst the assessment undertaken to support the Proposed Scheme therefore indicates a moderate to large adverse significance of effect to groundwater quality, this is also the significance posed to groundwater in the 2037 Do Minimum scenario. The magnitude of impact of the Proposed Scheme on groundwater quality is therefore considered to be **negligible** when compared to the 2037 Do Minimum scenario, with an overall significance of effect of **neutral**.

9.6.17 Consideration has also been given to the likely priority status classification of the affected outfalls by applying the methods used for HADDMS Priority Outfall classification – namely the Priority Registers Priority Outfalls Verification User Guide (2010) and Priority Soakaways Verification User Guide (2012).

9.6.18 The Priority Outfalls Verification User Guide uses the same methods as promoted within DMRB HD 45/09, with priority status determined by review of the Method A and Method D assessments. This assessment indicates that all individual outfalls draining (and assumed to drain) to the River Mimram and Ash Brook would be allocated Priority X (Risk Addressed) status, as would the cumulative assessment of outfalls draining to the River Mimram.

9.6.19 The Priority Outfalls Verification User Guide assessment indicates that the cumulative assessment of outfalls draining to the Ash Brook would be allocated a Priority B (High) status. Comparison against the present-day baseline condition and the 2037 Do Minimum scenario indicates that the priority status of the cumulative outfalls draining to the Ash Brook would also be allocated a Priority B (High) status if the same catchment areas are used as presented within the assessment. Review of HADDMS indicates that the previous HAWRAT cumulative assessment undertaken for outfalls discharging to Ash Brook did not include the catchment draining to Outfalls 25, 28 and 29 (i.e. the HAWRAT assessment only included Outfall 26 and Outfall 27). If this wider catchment is removed from the assessment, the cumulative assessment for Outfall 26 and Outfall 27 passes all aspects of HAWRAT for the 2037 Do Something scenario and would therefore still maintain a Priority X (Risk Addressed) status as currently indicated by HADDMS.

9.6.20 The Priority Soakaways Verification User Guide uses a slightly different method to determine risk to the quality of underlying groundwater resources to the Method C promoted by DMRB HD 45/09. The findings of this slightly amended Method C assessment are combined with the Method D assessment. Application of this method indicates that all individual outfalls draining (and assumed to drain) to ground would be allocated Priority X (Risk Addressed) status.

Table 9.13 - Summary of outfalls assessed using DMRB HD45/09 methods due to predicted traffic flow increases of greater than 20% between 2037 Do Minimum and Do Something scenarios

Outfall	Section of Road Drained to Outfall	Predicted Increase in Traffic Flow Between 2037 DM-DS Scenario	Receiving Waterbody	Baseline Priority Status	Additional Comments	DMRB HD 45/09 Assessment Methods
Outfall 1 – TL2315_4971d	J6 onslip southbound	-20%	Assumed to ultimately discharge to River Mimram	No priority status	AADT banding remains less than 10,000	No single outfall assessment. Included in cumulative assessment.
	J6 offslip southbound	37%				
Outfall 2 – TL2316_5310e	J6 offslip southbound	37%	Direct discharge to River Mimram	Priority X Risk Addressed	AADT banding remains less than 10,000	No single outfall assessment. Included in cumulative assessment.
Outfall 3 - TL2316_5312d	J6 through southbound	19%	Direct discharge to River Mimram	Priority X Risk Addressed	Change to AADT banding for J6-J7 SB	Methods A and D single outfall assessment. Cumulative assessment required
	J6-J7 southbound	21%				
Outfall 4 - TL2316_4616b	J6 through northbound	20%	Direct discharge to River Mimram	No priority status		Methods A and D single outfall assessment. Cumulative assessment required
Outfall 5 – TL2316_4517b	J6 through northbound	20%	Direct discharge to River Mimram	Priority X Risk Addressed		Methods A and D single outfall assessment. Cumulative assessment required
Outfall 6 - TL2316_5147b	J6 onslip northbound	25%	Assumed to ultimately discharge to River Mimram	No priority status		Methods A and D single outfall assessment. Cumulative assessment required

Outfall	Section of Road Drained to Outfall	Predicted Increase in Traffic Flow Between 2037 DM-DS Scenario	Receiving Waterbody	Baseline Priority Status	Additional Comments	DMRB HD 45/09 Assessment Methods
Outfall 7 - TL2316_7078b	J6-J7 southbound	21%	Assumed to ultimately discharge to River Mimram	Priority D	Change to AADT banding for J6-J7 SB	Methods A and D single outfall assessment. Cumulative assessment required
Outfall 8 - TL2317_7600a	J6-J7 northbound	24%	Assumed to ultimately discharge to River Mimram	Priority D	Change to 2-way AADT banding	Methods A and D single outfall assessment. Cumulative assessment required
	J6-J7 southbound	21%				
Outfall 9 - TL2417_0161c	J6-J7 northbound	24%	Discharge via infiltration	Priority D	Change to 2-way AADT banding	Methods C and D single outfall assessment.
	J6-J7 southbound	21%				
Outfall 10 - TL2418_3158d	J6-J7 northbound and southbound	22%	Assumed to discharge via infiltration	Priority X Risk Addressed	Change to 2-way AADT banding	Methods C and D single outfall assessment.
Outfall 11 - TL2418_3786e	J6-J7 northbound and southbound	22%	Assumed to discharge via infiltration	Priority D	Change to 2-way AADT banding	Methods C and D single outfall assessment.
Outfall 12 - TL2419_3544b	J6-J7 northbound and southbound	22%	Discharge via infiltration	Priority D	Change to 2-way AADT banding	Methods C and D single outfall assessment.
Outfall 13 - TL2419_3086a	J6-J7 northbound and southbound	22%	Discharge via infiltration	Priority D	Change to 2-way AADT banding	Methods C and D single outfall assessment.
Outfall 14 - TL2321_9506d	J6-J7 northbound and southbound	22%	Assumed to discharge via infiltration	Priority X Risk Addressed	Change to 2-way AADT banding	Methods C and D single outfall assessment.

Outfall	Section of Road Drained to Outfall	Predicted Increase in Traffic Flow Between 2037 DM-DS Scenario	Receiving Waterbody	Baseline Priority Status	Additional Comments	DMRB HD 45/09 Assessment Methods
Outfall 15 - TL2321_8562l	J6-J7 northbound and southbound	22%	Discharge via infiltration	Priority D	Change to 2-way AADT banding	Methods C and D single outfall assessment.
Outfall 18 - TL2322_3685c	J7-J8 northbound	22%	Assumed to discharge via infiltration	No priority status	Change to 2-way AADT banding	Methods C and D single outfall assessment.
Outfall 21 - TL2224_1656c	J7-J8 northbound and southbound	19%	Discharge via infiltration	Priority D		Single outfall assessment not required but Methods C and D included for completeness.
Outfall 25 – TL2226_4471b	J7-J8 northbound and southbound	19%	Assumed to ultimately discharge to Ash Brook	No priority status		No single outfall assessment. Included in cumulative assessment.
Outfall 26 - TL2226_3977e	J7-J8 northbound	22%	Direct discharge to Ash Brook	Priority X Risk Addressed	Change to J7-J8 NB AADT banding	Methods A and D single outfall assessment. Cumulative assessment required
	J8 offslip northbound	48%				
Outfall 27 – TL2226_3978f	J8 offslip northbound	48%	Direct discharge to Ash Brook	Priority X Risk Addressed		Methods A and D single outfall assessment. Cumulative assessment required
Outfall 28 – TL2227_5704d	J8 offslip southbound	-4%	Assumed to ultimately discharge to Ash Brook via local drainage network	No priority status		No single outfall assessment. Included in cumulative assessment.
	J8 onslip northbound	-1%				

Outfall	Section of Road Drained to Outfall	Predicted Increase in Traffic Flow Between 2037 DM-DS Scenario	Receiving Waterbody	Baseline Priority Status	Additional Comments	DMRB HD 45/09 Assessment Methods
	J8 through northbound and southbound	16%	although alignment unclear			
	J8-J9 northbound	10%				
Outfall 29 - TL2226_3977e	J8-J9 southbound	8%	Assumed to ultimately discharge to Ash Brook via local drainage network although alignment unclear	No priority status	Change to J8-J9 SB AADT banding	No single outfall assessment. Included in cumulative assessment.
	J8 offslip southbound	48%				

Table 914 - Summary of Method A and Method D assessments for outfalls discharging to surface waters

Outfall	Receiving Waterbody	Method A	Method D	Significance of Effect	Comments
Outfall 3 - TL2316_5312d	Direct discharge to River Mimram	Step 2 passed for acute, chronic and environmental quality standard assessments when dilution of receiving watercourse taken into account	Spillage assessment passed with risk less than 0.5%	**Negligible** magnitude of impact to River Mimram with **neutral** significance of effect. No change from assessment of Do Minimum scenario	Priority Outfalls Verification indicates Priority X - Risk Addressed status
Outfall 4 - TL2316_4616b	Direct discharge to River Mimram	Step 2 passed for acute, chronic and environmental quality standard assessments when dilution of receiving watercourse taken into account	Spillage assessment passed with risk less than 0.5%	**Negligible** magnitude of impact to River Mimram with **neutral** significance of effect. No change from assessment of Do Minimum scenario	Priority Outfalls Verification indicates Priority X - Risk Addressed status

Outfall	Receiving Waterbody	Method A	Method D	Significance of Effect	Comments
Outfall 5 – TL2316_4517b	Direct discharge to River Mimram	Step 2 passed for acute, chronic and environmental quality standard assessments when dilution of receiving watercourse taken into account	Spillage assessment passed with risk less than 0.5%	**Negligible** magnitude of impact to River Mimram with **neutral** significance of effect. No change from assessment of Do Minimum scenario	Priority Outfalls Verification indicates Priority X - Risk Addressed status
Outfall 6 - TL2316_5147b	Assumed to ultimately discharge to River Mimram	Step 2 passed for acute, chronic and environmental quality standard assessments when dilution of receiving watercourse taken into account	Spillage assessment passed with risk less than 0.5%	**Negligible** magnitude of impact to River Mimram with **neutral** significance of effect. No change from assessment of Do Minimum scenario	Priority Outfalls Verification indicates Priority X - Risk Addressed status
Outfall 7 - TL2316_7078b	Assumed to ultimately discharge to River Mimram	Step 2 passed for acute, chronic and environmental quality standard assessments when dilution of receiving watercourse taken into account	Spillage assessment passed with risk less than 0.5%	**Negligible** magnitude of impact to River Mimram with **neutral** significance of effect. No change from assessment of Do Minimum scenario	Priority Outfalls Verification indicates Priority X - Risk Addressed status
Outfall 8 - TL2317_7600a	Assumed to ultimately discharge to River Mimram	Step 2 passed for acute, chronic and environmental quality standard assessments when dilution of receiving watercourse taken into account	Spillage assessment passed with risk less than 0.5%	**Negligible** magnitude of impact to River Mimram with **neutral** significance of effect. No change from assessment of Do Minimum scenario	Priority Outfalls Verification indicates Priority X - Risk Addressed status
Cumulative assessment for River Mimram	All outfalls assumed to discharge to River Mimram	Step 2 passed for acute, chronic and environmental quality standard assessments when dilution of receiving watercourse taken into account	Spillage assessment passed with risk less than 0.5%	**Negligible** magnitude of impact to River Mimram with **neutral** significance of effect. No change from assessment of Do Minimum scenario	Priority Outfalls Verification indicates Priority X - Risk Addressed status
Outfall 26 - TL2226_3977e	Direct discharge to Ash Brook	Step 2 passed for acute, chronic and environmental quality standard assessments when dilution of receiving watercourse taken into account	Spillage assessment passed with risk less than 0.5%	**Negligible** magnitude of impact to Ash Brook with **neutral** significance of effect. No change from assessment of Do Minimum scenario	Priority Outfalls Verification indicates Priority X - Risk Addressed status

Outfall	Receiving Waterbody	Method A	Method D	Significance of Effect	Comments
Outfall 27 – TL2226_3978f	Direct discharge to Ash Brook	Step 2 passed for acute, chronic and environmental quality standard assessments when dilution of receiving watercourse taken into account	Spillage assessment passed with risk less than 0.5%	**Negligible** magnitude of impact to Ash Brook with **neutral** significance of effect. No change from assessment of Do Minimum scenario	Priority Outfalls Verification indicates Priority X - Risk Addressed status
Cumulative assessment for Ash Brook	All outfalls assumed to discharge to Ash Brook	Failure of acute, environmental quality standard and chronic impact assessment	Spillage assessment passed with risk less than 0.5%	**Moderate adverse** magnitude of impact to Ash Brook with **moderate adverse** significance of effect. Same significance identified for baseline and Do Minimum scenarios, therefore the Proposed Scheme is considered to have a **negligible** magnitude of impact and a **neutral** significance of effect	Priority Outfalls Verification indicates Priority B Status. Review of baseline and 2037 Do Minimum scenario indicates no change to risk addressed for 2017 Do Something scenario

Table 9.92 - Summary of Method C and Method D assessments for outfalls discharging to ground

Outfall	Receiving Waterbody	Method C	Method D	Significance of Effect	Comments
Outfall 9 - TL2417_0161c	Discharge via infiltration in source protection zone 3	Medium Risk – Score 245	Spillage assessment passed with risk less than 0.5%	**Moderate adverse** magnitude of impact to groundwater resources with **moderate adverse** significance of effect. Same significance identified for Do Minimum scenario, therefore the Proposed Scheme is considered to have a **negligible** magnitude of impact and a **neutral** significance of effect	No change to risk when baseline traffic flows are considered. Priority Soakaways Verification indicates Priority X - Risk Addressed status
Outfall 10 - TL2418_3158d	Assumed to discharge via infiltration in source protection zone 3	Medium Risk – Score 245	Spillage assessment passed with risk less than 0.5%	**Moderate adverse** magnitude of impact to groundwater resources with **moderate adverse** significance of effect. Same significance identified for Do Minimum scenario, therefore the Proposed Scheme is considered to have a **negligible** magnitude of impact and a **neutral** significance of effect	No change to risk when baseline traffic flows are considered. Priority Soakaways Verification indicates Priority X - Risk Addressed status
Outfall 11 - TL2418_3786e	Assumed to discharge via infiltration	Medium Risk – Score 245	Spillage assessment passed with risk less than 0.5%	**Moderate adverse** magnitude of impact to groundwater resources with **moderate adverse** significance of effect. Same significance identified for Do Minimum scenario, therefore the Proposed Scheme is considered to have a **negligible** magnitude of impact and a **neutral** significance of effect	No change to risk when baseline traffic flows are considered. Priority Soakaways Verification indicates Priority X - Risk Addressed status

Outfall	Receiving Waterbody	Method C	Method D	Significance of Effect	Comments
Outfall 12 - TL2419_3544b	Discharge via infiltration in source protection zone 3	Medium Risk – Score 245	Spillage assessment passed with risk less than 0.5%	**Moderate adverse** magnitude of impact to groundwater resources with **moderate adverse** significance of effect. Same significance identified for Do Minimum scenario, therefore the Proposed Scheme is considered to have a **negligible** magnitude of impact and a **neutral** significance of effect	No change to risk when baseline traffic flows are considered. Priority Soakaways Verification indicates Priority X - Risk Addressed status
Outfall 13 - TL2419_3086a	Discharge via infiltration in source protection zone 3	Medium Risk – Score 245	Spillage assessment passed with risk less than 0.5%	**Moderate adverse** magnitude of impact to groundwater resources with **moderate adverse** significance of effect. Same significance identified for Do Minimum scenario, therefore the Proposed Scheme is considered to have a **negligible** magnitude of impact and a **neutral** significance of effect	No change to risk when baseline traffic flows are considered. Priority Soakaways Verification indicates Priority X - Risk Addressed status
Outfall 14 - TL2321_9506d	Assumed to discharge via infiltration in source protection zone 2	Medium Risk – Score 210	Spillage assessment passed with risk less than 0.5%	**Moderate adverse** magnitude of impact to groundwater resources with **moderate to large adverse** significance of effect. Same significance identified for Do Minimum scenario, therefore the Proposed Scheme is considered to have a **negligible** magnitude of impact and a **neutral** significance of effect	No change to risk when baseline traffic flows are considered. Priority Soakaways Verification indicates Priority X - Risk Addressed status

Outfall	Receiving Waterbody	Method C	Method D	Significance of Effect	Comments
Outfall 15 - TL2321_8562l	Discharge via infiltration in source protection zone 2 and source protection zone 3	Medium Risk – Score 210	Spillage assessment passed with risk less than 0.5%	**Moderate adverse** magnitude of impact to groundwater resources with **moderate to large adverse** significance of effect. Same significance identified for Do Minimum scenario, therefore the Proposed Scheme is considered to have a **negligible** magnitude of impact and a **neutral** significance of effect	No change to risk when baseline traffic flows are considered. Priority Soakaways Verification indicates Priority X - Risk Addressed status
Outfall 18 - TL2322_3685c	Assumed to discharge via infiltration	Medium Risk – Score 215	Spillage assessment passed with risk less than 0.5%	**Moderate adverse** magnitude of impact to groundwater resources with **moderate adverse** significance of effect. Same significance identified for Do Minimum scenario, therefore the Proposed Scheme is considered to have a **negligible** magnitude of impact and a **neutral** significance of effect	No change to risk when baseline traffic flows are considered. Priority Soakaways Verification indicates Priority X - Risk Addressed status
Outfall 21 - TL2224_1656c	Discharge via infiltration in source protection zone 3	Medium Risk – Score 230	Spillage assessment passed with risk less than 0.5%	**Moderate adverse** magnitude of impact to groundwater resources with **moderate adverse** significance of effect. Same significance identified for Do Minimum scenario, therefore the Proposed Scheme is considered to have a **negligible** magnitude of impact and a **neutral** significance of effect	No change to risk when baseline traffic flows are considered. Priority Soakaways Verification indicates Priority X - Risk Addressed status

Requirement for Water Framework Directive assessment

9.6.21 There are no known works outside of the existing carriageway that are within c.8m of a watercourse that would require a Water Framework Directive compliance assessment.

9.6.22 Whilst the amendments to the carriageway and existing drainage systems will be within 8m of a watercourse given that the Proposed Scheme traverses a number of watercourses as discussed within Section 9.4, these works will be undertaken within the existing highway alignment and will not require any works to the watercourses or to their adjacent banks. If works are located within the highway boundary but outside the carriageway and are within c.8m of a watercourse, the appointed contractor should contact the relevant authority to establish need for consent (and supporting Water Framework Directive compliance assessment) based on the proposed works methodology and scope.

9.7 Design and mitigation measures

Construction

9.7.1 During the construction phase, potential impacts to surface water and groundwater features that are located in close proximity of the Proposed Scheme, or water features that are hydraulically linked to the Proposed Scheme (including identified statutory designated sites), will be managed through the implementation of an OEMP and (subsequently) a CEMP. The OEMP and CEMP will detail the procedures and methods that must be followed to manage the risk of pollutants entering the drainage system or discharging directly to surface water and groundwater features. The OEMP and CEMP will also describe the procedures in the event of an environmental emergency such as a fuel or chemical spillage.

Operation

9.7.2 Impacts that may occur during the operational phase will be managed through measures that are intrinsic to the design of the Proposed Scheme. This will include a robust surface water drainage system that will collect, attenuate and convey surface water runoff from all new areas of hard standing pavement – principally associated with emergency areas and the hardening of the central reserve. It is intended that the proposed drainage system will reuse all existing outfalls to surface water or to ground, with no amendments to these outfalls or new outfalls required. Where new impermeable areas are introduced to the Proposed Scheme, the drainage system will be designed to attenuate runoff to existing discharge rates up to the 1 in 100 (1%) annual probability event and, for all new areas, accommodate a 20% increase in rainfall intensity to allow for climate change.

9.7.3 As a result of no significant adverse effects associated with the Proposed Scheme on surface water and groundwater quality when compared to the 2037 Do Minimum scenario, no mitigation is required. However, the HAWRAT assessments presented in Section 9.6 and as summarised in Table 9.14 and Table 9.15 indicate existing risks to surface water and groundwater quality in the baseline and 2037 Do Minimum scenarios (and therefore opportunity for betterment to the treatment of runoff prior to discharge), specifically to the quality of the Ash Brook and to groundwater associated with the discharge of runoff via infiltration associated with the outfalls assessed in Table 9.15.

9.8 Residual effects

9.8.1 The Proposed Scheme is not expected to give rise to significant residual effects during either the construction or operational phases.

9.9 Summary

9.9.1 Potential impacts to surface water and groundwater features during construction will be managed through the implementation of a CEMP. The OEMP (HE551539-WSP-EGN-SG-RP_LE-00014) is available to accompany this EAR. It will be difficult to fully mitigate impacts when works are undertaken immediately adjacent to surface water features, although residual effects are likely to be temporary and treated through natural processes such as settlement and dilution. The overall significance of effect to surface water and groundwater features during construction is considered to be neutral. The construction methodology for piling works must be informed by the results of the ground investigation (and confirmation of groundwater depths) and take the sensitivity of groundwater resources into account, and must be agreed in consultation with the Environment Agency.

9.9.2 The Proposed Scheme is predicted to have an effect of **neutral** significance to flood risk for the Proposed Scheme and surrounding area.

9.9.3 Traffic flow in certain sections of the Proposed Scheme is predicted to increase by more than 20% as a result of the Proposed Scheme between the 2017 Do Minimum scenario and 2037 Do Something scenario. The application of the HAWRAT assessment methods indicates that the Proposed Scheme will have an effect of **neutral** significance when compared to the assessment of the 2017 Do Minimum scenario.

10. Assessment of Combined and Cumulative Effects

Key features for this topic:

- All topics reported within this Environmental Assessment Report (EAR) have been scoped in and considered within the combined effects assessment.
- Biodiversity, Landscape and Cultural Heritage have been scoped into the cumulative effects assessment.
- Two committed developments have been assessed including: 22 The Avenue, Welwyn AL6 0PP and Land at Chadwell Road, Norton Green, Stevenage Hertfordshire.
- No significant adverse residual combined effects are expected on any of the individual or group of sensitive receptors identified in the A1(M) Junction 6 to 8 EAR assessment during construction or operation.
- No significant adverse residual cumulative effects are expected as a result of the Proposed Scheme and identified committed developments.

10.1 Introduction

10.1.1 There are principally two types of effects covered in this section:

- **Combined effects** are those caused only by the Proposed Scheme which arise when an individual receptor or group of receptors would experience multiple effects as a result of the Proposed Scheme; for example, an individual property experiencing combined noise, air quality and visual amenity effects. These are also referred to as intra-project effects.
- **Cumulative effects** are those caused by the Proposed Scheme acting with other relevant schemes. These are also referred to as inter-project effects.

10.1.2 In both cases, combined or cumulative effects may be of greater significance than the significance of any of the identified individual effects. In combination and cumulative effects result from multiple actions on receptors and resources. The effects can be additive or interactive (synergistic) in nature and can result from incremental changes caused by other past, present, reasonably foreseeable actions[107], together with those of the Proposed Scheme.

10.1.3 In accordance with Interim Advice Note (IAN) 125/15[108], the assessments cover the main likely significant combined and cumulative effects, rather than trying to report every interaction.

10.1.4 This chapter is supported by:

- Appendix 10.1 – Relevant Developments Proposals for the Cumulative Effects Assessment.

10.1.5 The following figures also support this chapter.

- Figure 10.1 – Committed Developments

10.1.6 The professional competency of the topic lead for this chapter is detailed in Appendix 1.1. This information is provided to fulfil the requirement of EU Directive 2014/52/EU.

[107] With reference to DMRB Volume 11, Section 2, Part 5 (HA 205/08) (Ref 16-1), 'reasonably foreseeable' is interpreted to include other projects that are 'committed'. These should include but will not necessarily be limited to (i) Trunk road and motorway projects which have been confirmed (i.e. gone through the statutory processes), and (ii) Development projects with valid planning permissions as granted by the Local Planning Authority, and for which formal EIA is a requirement or for which non-statutory environmental impact assessment has been undertaken. In addition, this assessment has also considered applications for consent which have been made, but which have not yet been granted.
[108] Highways England (2015) Interim Advice Note 125/15 Environmental Assessment Update.

10.2 Scoping

10.2.1 This assessment has been undertaken with regard to the Environmental Scoping Report[109] provided by Highways England.

10.2.2 All topics reported within this EAR have been scoped in and considered within the combined effects assessment.

10.2.3 The following topics have been **scoped in** to the cumulative assessment based on Table 9-3 and Section 9.6 of the Environmental Scoping Report:

- **Biodiversity:** The cumulative assessment for biodiversity will focus on nitrogen deposition and potential hydrological impact pathways upon Knebworth Woods Site of Special Scientific Interest (SSSI), direct and indirect effects on ancient woodland and loss of deciduous woodland priority habitat.
- **Landscape and cultural heritage:** The cumulative assessment will focus on visual effects.

10.2.4 The following topics have been **scoped out** of the cumulative assessment based on Table 9-3 and Section 9.6 of the Environmental Scoping Report, and professional judgement following the completion of the environmental assessment for the Proposed Scheme:

- **Air Quality:** Scoped out on the basis that cumulative developments are considered within the traffic model and therefore cumulative effects for air quality are already considered within Chapter 5: Air Quality. The assessment has not been repeated here. However, CD1 and CD2 have been assessed within this chapter as they were not considered within the traffic model.
- **Noise and vibration:** Scoped out on the basis that cumulative developments are considered within the traffic model. Further, the cumulative effects with CD1 and CD2 which are not included within the traffic model are also reported within Chapter 8: Noise and Vibration. The assessment has not been repeated here.
- **Climate change:** Climate change is associated with a variety of health outcomes both beneficial and adverse. The uncertainties of how such change would interact locally with the health of residents neighbouring the Proposed Scheme (whose population is in itself dynamic) is subject to many uncertainties, preventing a meaningful assessment at the opening year or at the design year.
- **Road drainage and the water environment:** Scoped out on the basis the Proposed Scheme does not introduce adverse changes to the quality and/or quantity of highway drainage outfalls. Further, there is no predicted significant effect on floodplains, with major infrastructure items such as gantries and emergency areas not located within floodplains.

10.2.5 The Environmental Scoping Report stated that population and human health had the potential to be scoped out of the cumulative assessment. This was on the basis of the low accidents rates on motorways and the low likelihood of an adverse noise or severance impact on local health. However, the decision on whether to include population and human health was deferred at the scoping stage, pending the results of the noise and air quality assessments.

10.2.6 No significant effects on human health receptors have been identified in the noise or air quality assessments, therefore it is not evident that there would be significant cumulative effects on human health receptors.

[109] Document reference: MP0135-HEX-EGN-ZZ-AS-KK-0001, P01.1

10.2.7 Furthermore, it is considered that effects on populations along the currently proposed diversion routes (for example; Oaklands, Symonds Green, Todds Green, Fishers Green, Norton Green, Rabley Heath, Potters Heath, Danesbury and Welwyn) through closures of the motorway would be low. Gantries are assumed to be erected in batches between junctions to minimise the number of closures required with an estimated total of 17 night time northbound or southbound carriageway closures. All closures will take place overnight and will be short term in nature, therefore having a limited impact on journeys. As such, population and human health has been scoped out of the cumulative assessment.

10.2.8 The study area and criteria for the cumulative assessment deviates from the Environmental Scoping Report. Agreement was sought and agreed with Highways England regarding this deviation on 07 January 2019.

10.3 Methodology

Legislation, policy and guidance

10.3.1 The requirement for combined and cumulative effects assessment is set out in Article 4(3) and Article 5(1) of EU Directive 2014/52/EU. However, there are no legislative or policy requirements that set out how the assessment for combined and cumulative effects should be undertaken. Therefore, the assessment of the combined and cumulative effects has been undertaken by using professional judgement and in accordance with, but not limited to, the following:

- DMRB Volume 11, Section 2, Part 5[110], 'Assessment and Management of Environmental Effects'; and
- Interim Advice Note 125/15, 'Environmental Assessment Update'.

Assessment methodology

Combined Effects (Intra-Project Effects)

10.3.2 The assessment methodology for combined effects identifies interactions associated with the Proposed Scheme upon separate environmental receptors, to better understand the overall environmental effects.

10.3.3 The significance of construction and operational phase environmental effects is brought forward from the preceding chapters of the EAR into matrices, providing an overview of the potential effects on individual receptors. The assessment considers adverse residual effects, after mitigation measures have been taken into account.

10.3.4 The significance of combined effects upon each environmental receptor group is then identified, based upon the balance of scores and using professional judgement derived from experience of similar schemes. Justification for the conclusions reached is given in this chapter.

10.3.5 There is potential for an individual receptor, or groups of receptors, to be affected by adverse effects under one topic and beneficial effects under another, sometimes as a result of the same feature of the Proposed Scheme. In such cases, it is necessary to determine the balance between the two.

10.3.6 The study area for the 'in-combination' effects for both construction and operation, is defined by the study areas of each of the individual environmental topic assessments for the Proposed Scheme, which are discussed in the relevant topic chapters of this EAR (Chapters 5 to 9).

Cumulative effects (Inter-project effects)

10.3.7 The assessment methodology for cumulative effects involves the identification of incremental changes likely to be caused by other potential relevant future developments together with the Proposed Scheme.

[110] Highways England (2008) DMRB Volume 11 Section 2 Part 5 HA 205/08 Assessment and Management of Environmental Effects.

10.3.8 The first step in identifying inter-project effects is the identification of other relevant projects using a selection criteria methodology.

10.3.9 Major development sites within 1km[111] of the Proposed Scheme have been captured through a review of the Local Planning Authority's Planning Register and other sources[112] over the period August 2013 to January 2019[113] using the following criteria:

- Employment developments (B1, B2 and B8 only) within 1km of the Proposed Scheme;
- Residential: 200 + dwellings within 1km of the Proposed Scheme;
- Residential: 10 + dwellings within 300m of the Proposed Scheme;
- Major Minerals and Waste applications within 1km of the Proposed Scheme;
- Nationally Significant Infrastructure Projects within 1km of the Proposed Scheme;
- Transport infrastructure proposals within 1km of the Proposed Scheme (trunk roads or motorways only);

10.3.10 Following the above criteria, sufficient environmental data and assessments for the development in question would need to be readily available for the cumulative assessment to be conducted with any confidence. Should such information not be available for any given development, then that development has not been taken into account in the assessment of cumulative effects.

10.3.11 Following the above criteria, developments located greater than 300m from the Proposed Scheme will only be assessed where a valid planning permission has been secured, and for which formal environmental impact assessment or non-statutory environmental impact assessment has been undertaken.

10.3.12 The criteria above covers the two types of development projects recommended for assessment by DMRB, Volume 11, Section 2, Part 5 (HA205/08), which are:

- Trunk road and motorway projects that have been confirmed (have gone through the relevant statutory process). It should be noted that in the main these projects have been taken account of in the traffic model. As a result of this, the Air Quality, Noise and Vibration and part of the Road Drainage and the Water Environment assessments are inherently cumulative; and
- Development projects with valid planning permissions, for which a formal EIA is a requirement or for which a non-statutory environmental effects assessment has been undertaken.

10.3.13 The traffic model uncertainty log also has been used to help inform the list of developments assessed in the cumulative assessment. The criteria detailed above, aligns with the criteria used for the uncertainty log (as shown in Table 10.1). Where developments identified in the uncertainty log have been considered to be significant, either in their location or their size, they have been included in the traffic model. As the purpose of the uncertainty log was to select the developments to be included in the forecasting model for the Air Quality and Noise and Vibration assessments, the developments included within the log have already been assessed in Chapters 5 and 8 respectively. This assessment has not been repeated in this chapter.

[111] This study area reflects the study area generally adopted for the specialist topics. It is noted some study areas are greater than 1km, for example European Designated Sites within 30km of the Proposed Scheme. However, this is considered a deviation from the general study area considered for the Proposed Scheme across specialist topics.
[112] A review of major development allocations from Development Plans, Growth Fund Projects, Strategic Housing Land Availability Assessments and Employment Land Availability Assessments has been undertaken on those plans published as of November 2017. A review of all Nationally Significant Infrastructure Projects (NSIP) detailed in the register of applications as of January 2019. Major development sites such as sustainable urban extensions are then captured within the transport modelling uncertainty log.
[113] A review of the planning register from August 2013 to November 2017 was provided by Highways England in May 2018. A review of the Planning Register will be updated up to January 2019.

Table 10.93 - Criteria for selecting developments for inclusion in the Uncertainty Log

Land use	Criteria within 10km	Criteria more than 10km
Dwellings	200	1,000
Office development (m^2)	10,000	50,000
Industrial Estate (m^2)	1,500	7,500
Warehousing (m^2)	5,000	25,000
B1/B2 Mixed Use	5,750	28,750
B2/B8 Mixed Use	3,250	16,250
B1/B2/B8 Mixed Use	5,500	27,500

Development which are classified as 'Near Certain' or 'More Than Likely' (as described in Table 10.2) have been included in the Uncertainty Log.

10.3.14 The scoping criteria shown in Table 10.2 is used to identify which potential major developments are included within the cumulative effects assessment. Those developments considered to be 'near certain' and 'more than likely' have been considered within the cumulative effects assessment.

Table 10.94 - Certainty of outcome and development status

Certainty of outcome	Development status
Near Certain: The outcome will happen or there is a high probability of it occurring.	Intent announced by proponent to regulatory agencies; Approved development proposals; and Projects under construction.
More Than Likely: The outcome is likely to happen but some uncertainty.	Development application within the consent process and in accordance with development plan.
Reasonably Foreseeable: The outcome may happen but significant uncertainty.	Includes projects that are committed. Identified within a development plan and, although not directly associated with the project, may occur if the project is implemented.
Hypothetical: There is considerable uncertainty whether the outcome would ever happen.	Conjecture based upon currently available information; Discussed on a conceptual basis; and One of a number of possible inputs in an initial consultation process.

Source: Based on DMRB Volume 11 Section 2 Part 5 and professional judgement

10.3.15 The entire list of committed developments is detailed in Appendix 10.1. Using the approach described above, the following developments have been scoped into the cumulative effects assessment:

- **CD1** - 6/2017/1751/OUTLINE 22 The Avenue, Welwyn AL6 0PP – Outline planning permission for erection of up to 12 dwellings with all matters except access reserved, to include demolition of existing dwelling and industrial building. At the time of writing (January 2019), this planning application has been refused. However, it is being considered under appeal.
- **CD2** – 15/00101/FPM Land at Chadwell Road, Norton Green, Stevenage Hertfordshire. Erection of 14 dwellings (2 four bedroom, 6 three bedroom and 6 two bedroom dwellings) with associated landscaping and pond.

Significance of effects

10.3.16 The assessment of significance of the combined and cumulative effects is based upon the definitions within Table 10.3. An effect that is moderate or above (adverse or beneficial), is deemed to be significant. An effect that is minor or below (adverse or beneficial), is deemed to be not significant.

Table 10.95 - Significance of combined and cumulative effects[114]

Significance	Effect
Severe	Effects that the decision-maker must take into account as the receptor/resource is irretrievable compromised.
Major	Effects that may become a key decision-making issue.
Moderate	Effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performance.
Minor	Effects that are locally significant.
Not significant	Effects that are beyond the current forecasting ability or are within the ability of the resource to absorb such change.

Stakeholder engagement

10.3.17 Information regarding planning applications has been gathered from local authority websites; however, no consultation with local authorities has taken place to confirm this development schedule. It is assumed that the planning information on the council's website are up to date.

10.4 Potential effects

Combined effects (Intra-project effects)

10.4.1 Where there is no potential for combined effects due to lack of interaction between topics, these have been noted in Table 10.4 and Table 10.5, as 'no interrelationship'. The topics listed below have been assessed as having no interrelationship for the following reasons:

Air quality

10.4.2 Air quality residual adverse impacts could not affect:

- **Noise and vibration** e.g. changes in CO_2, NO_x and NO_2 concentrations could not affect noise and vibration levels; and

Biodiversity

10.4.3 Biodiversity residual adverse impacts could not affect:

- **Air quality** e.g. a loss of protected species could not affect CO_2, NO_x and NO_2 concentrations;
- **Cultural heritage** e.g. a loss of protected species could not affect the setting of a scheduled monument or listed building;
- **Noise and vibration** e.g. the temporary loss of habitat due to vegetation clearance to enable construction could not affect noise; and
- **Road drainage and the water environment** e.g. the loss of a protected species could not affect surface water flooding.

Cultural heritage

10.4.4 Cultural heritage residual adverse impacts could not affect:

- **Air quality** e.g. the setting of a scheduled monument or listed building could not affect changes in CO_2, NO_x and NO_2 concentrations;
- **Biodiversity** e.g. the setting of a scheduled monument or listed building could not affect habitat loss;
- **Noise and vibration** e.g. the setting of a scheduled monument listed building could not affect noise; and
- **Road drainage and the water environment** e.g. the setting of a scheduled monument or listed building could not affect road drainage or the water environment.

[114] DMRB, Volume 11 Section 2 Part 5 Table 2.6

Landscape

10.4.5 Landscape residual adverse impacts could not affect:

- **Air quality** e.g. the loss of trees could not affect nitrogen deposition levels;
- **Road drainage and the water environment** e.g. the loss of vegetation for SMP schemes is minimal and therefore could not affect surface water flooding**.**

Noise and vibration

10.4.6 Noise and vibration residual adverse impacts could not affect:

- **Air quality** e.g. an increase in noise levels could not affect changes in CO_2, NO_x and NO_2 concentrations; and
- **Road drainage and the water environment** e.g. an increase in noise levels could not affect flooding.

Road drainage and the water environment

10.4.7 Road drainage and the water environment residual adverse impacts could not affect:

- **Air quality** e.g. an increase water surface flooding could not affect changes in CO_2, NO_x and NO_2 concentrations;
- **Cultural heritage** e.g. an increase water surface flooding could not affect the setting of a scheduled monument or listed building;
- **Landscape** e.g. an increase water surface flooding could not affect the visual amenity at sensitive receptors; and
- **Noise and vibration** e.g. an increase risk to water quality could not affect noise levels.

10.4.8 The following interrelationships and therefore potential for combined effects have been identified and are assessed in Table 10.4 and Table 10.5 below:

- **Air quality** could affect biodiversity (nitrogen deposition on sensitive habitats), cultural heritage (decrease in air quality) and road drainage and the water environment nitrogen (deposition on sensitive aquatic habitats);
- **Biodiversity** could affect landscape (loss of trees or vegetation would have visual effects);
- **Cultural heritage** could affect landscape (loss of heritage features could have visual effects);
- **Landscape** could affect cultural heritage (loss of trees could affect the setting of assets), biodiversity (loss of trees would be loss of habitat) and noise (loss of trees could cause perception of increase noise levels);
- **Noise and Vibration** could affect landscape (tranquillity and setting), cultural heritage (installation of noise barriers, loss of trees/vegetation could affect the setting of assists) and biodiversity (disturbance of species); and
- **Road drainage and the water environment** could affect biodiversity (aquatic or water dependent habitats)

Table 10.96 - Combined residual construction phase effects

Receptor	Lead Topic						
	Air Quality	**Biodiversity**	**Cultural Heritage**	**Landscape**	**Noise and Vibration**	**Road Drainage and the Water Environment**	**Significance of combined effects as defined in Table 10.3**
Air Quality	N/A	No Interrelationship	No Interrelationship	No Interrelationship	No Interrelationship	No Interrelationship	**Not Significant**
Biodiversity	**Not Significant**	N/A	No Interrelationship	**Not Significant** Loss of priority and notable habitat. 0.1ha of lowland mixed deciduous woodland is anticipated to be lost at Watery Grove (Knebworth Woods SSSI boundary).	**Not Significant** Disturbance of species: 14 structures surveyed are considered to have negligible potential to support roosting bats.	**Not Significant** on water quality or riparian species	**Not Significant**
Cultural Heritage	**Slight Adverse** There is potential for a decrease in air quality near Dicket Mead Roman Villa, due to the presence of construction vehicles and the potential for stationary traffic or traffic closer to the asset due to the needed road work safety procedures.	No Interrelationship	N/A	**Slight Adverse** Potential effects to overall character of Grade II: Registered Park and Garden of Knebworth and Grade II: Registered Park and Garden of Homewood due construction activities.	**Slight Adverse** There is potential for an increase in noise during construction near Dicket Mead Roman Villa, Grade II: Registered Park and Garden of Knebworth, Grade II: Registered Park and Garden, Grade II: The Dairy at Stebbing Farm, The Old Farmhouse Stebbing Farm and the Tudor House at Stebbing Farm and Grade II: Thatched Cottage.	No Interrelationship	**Minor Adverse**

Receptor	Lead Topic						
	Air Quality	**Biodiversity**	**Cultural Heritage**	**Landscape**	**Noise and Vibration**	**Road Drainage and the Water Environment**	**Significance of combined effects as defined in Table 10.3**
Landscape	**Not Significant**	**Slight Adverse** visual effect due to loss of lowland mixed deciduous habitat at Knebworth Woods SSSI.	**Not Significant**	N/A	**Slight Adverse** Visual effect, where existing noise barriers are to be removed and replaced. Located at The Avenue, Cannonfield Drive, Symonds Green.	No Interrelationship	**Not Significant**
Noise and Vibration	No Interrelationship	No Interrelationship	No Interrelationship	**Not Significant** Vegetation clearance could lead to perception of increased noise levels.	N/A	No Interrelationship	**Not Significant**
Road Drainage & the Water Environment	No Interrelationship	No Interrelationship	No Interrelationship	No Interrelationship	No Interrelationship	N/A	**Not Significant**
Overall significance of combined effects during construction (on balance): **Not Significant**							

Table 10.97 - Combined residual operational phase effects

Receptor	Lead Topic						
	Air Quality	**Biodiversity**	**Cultural Heritage**	**Landscape**	**Noise and Vibration**	**Road Drainage and the Water Environment**	**Significance of combined effects**
Air Quality	N/A	No Interrelationship	No Interrelationship	No Interrelationship	No Interrelationship	No Interrelationship	**Not Significant**
Biodiversity	**Not Significant** Nitrogen deposition within Knebworth Woods SSSI is unlikely to lead to a significant effect on the qualifying features of the site.	N/A	No Interrelationship	**Not Significant**	**Not Significant**	**Not Significant** Hydrological impact-effect pathways to any SSSI designations (Knebworth Woods and Sherradspark Wood), the Proposed Scheme would not alter the volume of water or quality of runoff.	**Not Significant**
Cultural Heritage	No Interrelationship	No Interrelationship	N/A	**Slight Adverse** landscape character of LCA 208 Knebworth Parkland after 1 year. After 15 years, it is **Not Significant**, when mitigation planting has matured.	**Not Significant** The installation of a new noise barrier (NNB1) is expected to have no impact on Scheduled Monument: Dicket Mead Roman Villa, provided the vegetation is not reduced or removed.	No Interrelationship	**Not Significant**
Landscape	**Not Significant**	**Not Significant**	**Not Significant**	N/A	**Not Significant**	No Interrelationship	**Not Significant**

Receptor	Lead Topic						
	Air Quality	**Biodiversity**	**Cultural Heritage**	**Landscape**	**Noise and Vibration**	**Road Drainage and the Water Environment**	**Significance of combined effects**
	As detailed in Chapter 6: Biodiversity, nitrogen deposition within Knebworth Woods SSSI is unlikely to lead to a significant effect on the qualifying features of the site, thus will not affect the visual amenities of receptors.						
Noise and Vibration	No Interrelationship	No Interrelationship	No Interrelationship	**Not Significant**	N/A	No Interrelationship	**Not Significant**
Road Drainage and the Water Environment	No Interrelationship	No Interrelationship	No Interrelationship	No Interrelationship	No Interrelationship	N/A	**Not Significant**
Overall significance of combined effects during operation (on balance): **Not Significant**							

Cumulative effects (Inter-project effects)

10.4.9 The potential cumulative effects are summarised in Table 10.6 and Table 10.7.

Table 10.98 - Assessment of cumulative effects during construction

Receptor	A1(M) J6-8 – Residual effects	Development ID		Cumulative effects
		CD1 - 22 The Avenue Welwyn AL6 0PP	CD2 – Land at Chadwell Road, Norton Green.	
Air Quality	**Not Significant**	**Not Significant** The effects of dust soiling and PM_{10} associated with the proposed development is considered to be negligible.	An air quality assessment was not undertaken as part of the planning application for CD2. Therefore, no information was available to undertake a cumulative assessment.	**Not Significant**
Biodiversity	**Not Significant**	**Not Significant** The development includes an ecological report which identifies no foreseen potential effects. It also found no bats, or evidence of bats or suitable roosting features in or on either building. Therefore, the property has negligible potential to support bat roosts.	**Not Significant** The development includes an ecological assessment, which identified potential minor effects on great crested newt habitats and if extant, reptiles, hedgehogs and other species of amphibians as a result of habitat loss. This has been mitigated for by the implementation of measures such as creating habitat around a pond and a 3m wide habitat strip against the site boundary (0.07ha of habitat is to be created).	**Not Significant**
Cultural Heritage	**Not Significant**	A cultural heritage assessment was not undertaken as part of the planning application for CD1. Therefore, no information was available to undertake a cumulative assessment.	**Not Significant** No common cultural heritage receptors detailed in the archaeological evaluation submitted as part of the planning application for CD2.	**Not Significant**
Landscape	**Slight Adverse**	A landscape assessment was not undertaken as part of the planning application for CD1. Therefore, no information was available to undertake a cumulative assessment.	A landscape assessment was not undertaken as part of the planning application for CD2. Therefore, no information was available to undertake a cumulative assessment.	**Not Significant**
Noise and Vibration	**Not Significant**	This was scoped out on the basis that cumulative developments are considered within the traffic model. Further, the cumulative effects with CD1 and CD2 which are not included within the traffic model are also reported within Chapter 8: Noise and Vibration. The assessment has not been repeated here.		
Road Drainage and the Water Environment	**Not Significant**	This was scoped out on the basis the Proposed Scheme does not introduce adverse changes to the quality and/or quantity of highway drainage outfalls. Further, there is no predicted significant effect on floodplains, with major infrastructure items such as gantries and emergency areas not located within floodplains.		
Overall significance of cumulative effects during construction (on balance): **Not Significant**				

Table 10.99 - Assessment of cumulative effects during operation

Receptor	A1(M) J6-8 – Residual effects	Development ID		Cumulative effects
		CD1 - 22 The Avenue Welwyn AL6 0PP	CD2 – Land at Chadwell Road, Norton Green.	
Air Quality	**Not Significant**	**Not Significant** Predicted concentrations of PM_{10} and NO_2 in all modelled years are below the relevant objectives.	An air quality assessment was not undertaken as part of the planning application for CD2. Therefore, no information was available to undertake a cumulative assessment.	**Not Significant**
Biodiversity	**Not Significant**	**Not Significant** The development includes an ecological report which identifies no foreseen potential effects. It also found no bats, evidence or suitable roosting features in or on either building. Therefore, the property has negligible potential to support bat roosts.	**Not Significant** The development includes an ecological assessment, which identified potential minor effects on great crested newt habitats and if extant, reptiles, hedgehogs and other species of amphibians as a result of habitat loss. This has been mitigated for by the implementation of measures such as creating habitat around a pond and creating a 3m wide habitat strip against the site boundary (0.07ha of habitat is to be created).	**Not Significant**
Cultural Heritage	**Not Significant**	A cultural heritage assessment was not undertaken as part of the planning application for CD1. Therefore, no information was available to undertake a cumulative assessment.	**Not Significant** No common cultural heritage receptors detailed in the archaeological evaluation submitted as part of the planning application for CD2.	**Not Significant**
Landscape	**Slight Adverse**	A landscape assessment was not undertaken as part of the planning application for CD1. Therefore, no information was available to undertake a cumulative assessment.	A landscape assessment was not undertaken as part of the planning application for CD2. Therefore, no information was available to undertake a cumulative assessment.	**Not Significant**
Noise and Vibration	**Not Significant**	This was scoped out on the basis that cumulative developments are considered within the traffic model. Further, the cumulative effects with CD1 and CD2 which are not included within the traffic model are also reported within Chapter 8: Noise and Vibration. The assessment has not been repeated here.		
Road Drainage and the Water Environment	**Not Significant**	This was scoped out on the basis the Proposed Scheme does not introduce adverse changes to the quality and/or quantity of highway drainage outfalls. Further, there is no predicted significant effect on floodplains, with major infrastructure items such as gantries and emergency areas not located within floodplains.		
Overall significance of cumulative effects during operation (on balance): **Not Significant**				

11. Abbreviations

Term	Definition
AADT	Annual Average Daily Traffic
AAWT	Annual Average Weekday Traffic
ADS	Advanced Directional Signs
ALR	All Lane Running
AMIs	Advanced Motorway Indicators
AOD	Above Ordnance Datum
AQMA	Air Quality Management Area
ARN	Affected Road Network
ARM	Active Traffic Management
BOCC	Birds of Conservation Concern
CCD	Cross Carriageway Duct
CCTV	Closed Circuit Television
CEMP	Construction Environmental Management Plan
CRTN	Calculation of Road Traffic Noise
DCO	Development Consent Order
DF	Design Fix
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
DNO	Distribution Network Operator
EAR	Environmental Assessment Report
EAV	External Aspect Verification
ECP	Emergency Crossing Point
eDNA	Environmental DNA
EI	Electrical Interface
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ENB	Existing Noise Barrier
EnvIS	Highways England Environmental Information System
EqIA	Equality Impact Assessment
EQS	Environmental Quality Standards
ERT	Emergency Roadside Telephone
EU	European Union
EZoI	Ecological Zone of Influence
GCN	Great Crested Newts
GIS	Geographical Information Systems
GIR	Ground Investigation Report
GLVIA	Guidelines for Landscape and Visual Impact Assessment
HADDMS	Highways Agency Drainage Data Management System
HADECS	Highways Agency Digital Enforcement Camera System
HAPMS	Highways England Pavement Database
HAWRAT	Highways England Water Risk Assessment Tool
HDV	Heavy Duty Vehicle
HE	Highways England
HERC	Hertfordshire Environmental Records Centre
HRA	Habitats Regulations Screening Assessment
HGVs	Heavy Goods Vehicles
HSI	Habitat Suitability Index
IAN	Interim Advice Note
LAQM.TG	Local Air Quality Management Technical Guidance
LCA	Landscape Character Area

Term	Definition
LNRs	Local Nature Reserves
LNS	Low Noise Surface
LOAEL	Lowest Observed Adverse Effect level
LWS	Local Wildlife Site
NB	Northbound
NCA	National Character Area
NPPF	National Planning Policy Framework
NPSE	Noise Policy Statement for England
mAOD	Meters Above Ordnance Datum
MIDAS	Motorway Incident Detection and Automated Signs
MS4	New Message Sign Mark 4
nIAs	Noise Important Areas
N	Nitrogen
NNR	National Nature Reserves
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
NoD	Notice of Determination
NSSH	New Short Section of Hardshoulder
OEMP	Outline Environmental Management Plan
PBRA	Potential Bat Roost Assessment
PCD	Pollution Control Devices
PCF	Project Control Framework
PCM	Pollution Climate Mapping
PMW	Precautionary Method of Working
PPV	Peak Particle Velocity
PRoW	Public Right of Way
PSCRG	Project Safety Control Group
PSSR	Preliminary Sources Study Report
PTZ	Pan, Tilt and Zoom
RCB	Rigid Concrete Barrier
RCC	Regional Control Centres
REAC	Register of Environmental Actions and Commitments
RIS	Roads Investment Strategy
ROTTMS	Remotely Operated Temporary Traffic Management Signs
SAC	Special Area of Conservation
SB	Southbound
SBI	Sites of Biological Interest
SETRM	South East Regional Transport Model
SGAR	Stage Gate Assurance Review
SMIS	Structures Management Information System
SOAEL	Significant Observed Adverse Effect Level
SPA	Special Protection Area
SRN	Strategic Road Network
SSSI	Site of Special Scientific Interest
SuDs	Sustainable Drainage Systems
SVD	Stopped Vehicle Detection
TJR	Through Junction Running
TRA	Traffic Reliability Area
UNECE	United Nations Economic Commission for Europe
VfM	Value for Money
VMS	Variable Message Signs
VMSLs	Variable Manadtory Speed Limits

Term	Definition
VRS	Vehicle Restraint System
WCH	Walking Cycling and Horse riding
WCHAR	Walkers, Cyclists & Horse-Riding Assessment
WFD	Water Framework Directive
WPZ	Water Protection Zone
ZVI	Zone of Visual Influence