Smart Motorways Programme

M40/M42 Interchange

Environmental Assessment Report
November 2019

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Executive Summary

Introduction

Highways England has commissioned Amey Arup to design and assess a proposed Smart Motorway - All Lane Running (SM-ALR) scheme on the M40/M42 between M42 Junction 3 –Portway with the A435, through Junction 3a with the M40 and Junction 4 at link with the A3400 to M40 Junction 16, referred to in this report as the 'Proposed Scheme' at Project Control Framework (PCF) Stage 3. The Proposed Scheme lies to the south of Birmingham, in Solihull (see Figure 1-1 for a location plan). Highways England expects to commence construction of the Proposed Scheme in 2022 and is expected to take approximately two years to construct, including commissioning.

The Proposed Scheme would provide four permanent running lanes, by converting the hard shoulder into a running lane (lane1), between M42 J3 and J3a. The 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 with a summary below:

48 overhead gantries (including 26 new gantries, 22 retained gantries) fitted with Advanced Motorway Indicators (AMIs), new Message Signs and/ or Advanced Directional Signs (ADS), strategic signs (MS3S/ MS4-L) and Variable Messaging Signs (MS4). These will display variable speed limits based on traffic conditions.

6 emergency refuge areas (ERAs) will be installed, 3 on the westbound carriageway and 3 on the eastbound carriageway. They will be constructed to provide a safe area for vehicles to stop in an emergency without interrupting the flow of traffic.

Hardening of the central reserve and installation of a reinforced concrete barrier at most of the mainline sections of the scheme. However, for the mainline link through J3A connecting M42 Eastbound to M40 Eastbound, it is proposed that the existing metal barrier be retained.

With regards to the M40/M42 SMP scheme, the only lighting that has not been converted to LED is on the M42 J3 and M40 J16 slip roads. The mainline M42 J3 to M42 J3A and M40 J16 and M42 J3A will remain unlit. Columns on north and south of M42 eastbound to north bound link are to be moved further back into the verge, and columns in the central reserve on approach to Junction 3A are to be re-sited on the concrete barrier in the same location.

This Environmental Assessment Report (EAR) 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 M40/M42 interchange is a key location on the London to Scotland corridor and it connects the South-East with Birmingham, Manchester, the North-West and the west of Scotland. The interchange also connects Yorkshire and East Midlands with the south-west of England. The interchange forms the south-east quadrant of the Birmingham Box motorway and as such is hugely significant for local commuter journeys. Significant new development is planned for Birmingham, Solihull and the Black Country, including several Enterprise Zones, which will further increase traffic demand on this key junction. The preferred solution announced by the Government was for a Smart Motorway with All Lane Running (ALR), utilising the existing hard shoulder as a running lane (enabling four through lanes) to be developed. This was also announced in the Highways England Road Investment Strategy and Delivery Plan and is consistent with the results of this high-level assessment.

Air Quality

A detailed air quality assessment has been undertaken to establish the potential effects of this scheme with the core scenario of Do-Something 2022. In addition to this core scenario the following additional scenarios were examined in order to ensure the avoidance of any adverse air quality effects:

- Base year scenario (2016)
- Projected base year (2022)
- Opening year Do-Minimum (2022)

Major schemes included within the assessment and associated traffic model include residential development at Blythe Valley Park.

The detailed assessment of local air quality 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 air quality assessment for the 'core' scenario indicates that there will be no significant adverse air quality effects at any of the modelled receptors.

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

The scheme will not result in significant effects on air quality receptors and no operational mitigation is deemed necessary.

Construction impacts for SMP Schemes were scoped out in the Scoping Report, May 2018 (Highways England – document reference MP0280-HEX-EGN-ZZ-AS-KK-0001) and so have not been considered in this assessment. The Outline Environmental Management Plan details the mitigation measures that will be implemented during the construction phase to reduce potential air quality impacts associated with construction activities.

The assessment has shown that there are exceedances of the annual mean nitrogen oxides UK AQO of 30□g/m3 for the protection of vegetation in the base year and opening year, both with and without the Proposed Scheme. These locations are: Coleshill and Bannerly Pools SSSI, and Windmill Naps Wood SSSI. The maximum change in annual mean NO2 concentrations at Coleshill and Bannerly Pools SSSI is 1.5□g/m3, this is less than 1% of the critical load of the site and so is not considered to be significant. For Windmill Naps Wood SSSI, the annual mean concentration from the scheme is 0.2□g/m3, this change is considered to be not significant. The potential for significant adverse effects on these sites is considered within Chapter 6: Ecology and Nature Conservation.

In terms of regional emissions, there is a predicted increase in all pollutant emissions of between 2.8% - 4.5% in the opening year and between 3.3% -5.3% in the design year. This is due to the increase in capacity created as a result of the Proposed Scheme. This is due to the predicted increase in traffic (20% on some links).

Overall the Scheme is not significant for air quality and it can progress without the need for mitigation.

Biodiversity

Ecological receptors in the study area include Windmill Naps Wood, Coleshill and Bannerly Pools and River Blythe Sites of Special Scientific Interest (SSSI), which lie within the zone of influence (Zol) of the Proposed Scheme (i.e. 200m from the Affected Road Network).

There are no internationally designated sites within the zone of influence of the scheme and no impact pathways that would necessitate the production of an assessment under the Habitats Regulations. Consequently the requirement for an HRA was scoped out for this Scheme.

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

The following legally protected species have been recorded or habitats are present within the Proposed scheme that may support roosting bats; great crested newts; dormouse; badger and breeding birds.

The badger survey identified two outlier setts within the soft estate along the scheme and within 30m of the proposed works.

Bat roost surveys have identified one structure with moderate potential to support bats within the scheme extents, this is the River Blythe subway. Seventeen trees have been identified as having high to moderate potential to support bat roosts, that may potentially be affected by the scheme from disturbance during construction.

Surveys for great crested newts indicate there are three ponds within the study area which support low populations of GCN.

Dormouse presence has been confirmed within verge habitat on the southbound carriageway between M42 J3a and J3.

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

Landscape and Cultural Heritage

The landscape is not covered by any national designation, but is located within the Arden Pastures, Arden Parklands and Ancient Arden Landscape Character Areas. The landscape around the M40 and M42 is gently undulating, with small to medium sized pastoral and arable fields divided by overgrown hedges. The agricultural land is interspersed with scattered farmsteads, hamlets and copses of ancient woodland. The motorways are a feature in the landscape and the verges are comprised of densely spaced broadleaved trees and shrubs that would have been planted during their construction.

Insofar as cultural heritage is concerned, the following assets are located within the zone of influence of the scheme: three listed buildings: Grade II listed Obelisk at Umberslade, Grade II listed Obelisk Farmhouse and Grade II listed East Lodge at Umberslade Park, all of which are associated with one another, and a further two listed buildings – Olive Cottage and Benson's Barn and Country Cottage.

The only public right of way to cross the motorway on a footbridge is to the east of Blythe Valley Park (south of M42 J4), while there are two underpasses where public footpaths cross the motorway at Spring Brook, between M42 J3 and J3a and between Umberslade and Obelisk Farm between M40 J16 and M42 J3a.

The removal of sections of existing mature vegetation, along with additional gantries, signs and acoustic 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 character areas with mitigation are considered to not be 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 twelve key visual locations, although this reduces to nine locations at year 1 of operation and none by the design year (15 years following opening). Due to the very localised and relatively temporary nature of each impact, overall it is concluded that the overall effect of the scheme would not be significant.

In terms of the heritage assets, the proposed scheme will not result in any significant adverse effects on the settings of any of the listed buildings during operation at Year 1. This is because the setting of the buildings will not be affected by the proposals. In relation to the Grade II East Lodge the intervening mature vegetation screens the receptor from the motorway corridor. At Year 15 the planting along the highway verges will have matured and will screen the gantries from the settings of the listed buildings.

While there would be short term visual effects upon key visual locations as a result of construction activities, these would not be significant. During the operational phase with the Proposed Scheme in place, there would also be no significant visual effects or effects on heritage assets such that overall, residual landscape, visual and heritage effects would not be significant.

Noise and Vibration

There are seven noise Important Areas located within the study area: Forshaw Heath Lane, Poolhead lane, Wood End Lane, Earlswood Common, Tinker's Lane, Pound House Lane and Stratford Road. Within 300m of the scheme there are 101 residential properties as well as community facilities and a hotel. There are two existing noise barriers on the scheme, ENBI is located on the east bound carriageway at Earlswood on the M42 between J3 and J3a. ENB2 is located on the M40 west bound carriageway near junction 16 at Kemp 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. This outcome is as a result of the Proposed Scheme providing no new noise barriers and low noise surfacing on lane 1 and lane 4 of both carriageways.

Where the provision of additional noise barriers within the soft estate has proved not to be at Portway, Poolhead Lane, Wood End Lane, Tinkers Lane or Hockley Heath, then consideration has been given to the provision of mitigation on third party land. No locations meet the criteria in Design Guide Annex E5.04. Given that the noise assessment indicates that noise barriers are not considered necessary to provide mitigation, they will not be considered at a later stage of the project.

Approximately 13% of residential properties are expected to experience a negligible increase in noise level, whilst 158 residential properties experience a minor increase of less than 3dB. These properties are located at Springbrook Lane, Malthouse Lane, Woodend Lane and Juggins Lane. The majority (198) of the remaining residential properties are expected to experience no change or a negligible decrease in noise levels. A total of 105 properties in Solihull would experience minor noise decreases of less than 3dB with a further 708 properties at Portway, Solihull and Wythall having a moderate or major noise reduction in noise.

In the long term (Do Minimum 2037 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 581 residential properties are expected to experience a negligible increase in noise levels. 149 residential properties experience no change or negligible decreases in noise levels for the daytime period, along with 806 properties which experience minor or moderate noise decreases.

For the opening year night-time period, 433 residential properties experience noise increases, 306 of which are negligible. 130 residential properties experience no change or negligible decreases in noise levels for the night-time period. A total of 201 properties are expected to experience a minor or moderate noise decrease in noise.

In terms of addressing the Noise Policy Statement for England, Aim 1 (to avoid) has been addressed by consideration of the candidate noise barriers, while for Aim 2 (to mitigate and minimise) consideration has been given to additional acoustic barriers. Modelling and the value for money assessment shows that the proposed barriers would provide poor value for money and poor acoustic performance, therefore they are not considered necessary as part of the scheme design. With regard to Aim 3 (contribute to the improvement of health and quality of life) there were no further measures which were not listed against the Aim 2.

During the construction period, 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 at Earlswood and Kemp Green; or where embankment widening necessitates piling, such as at Tinkers Lane and Poolhead Lane.

Of the available diversion routes a total of 4617 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. These are located in and around Alcester, Redditch, Warwick, and Henley-in-Arden.

The 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 motorway drainage system discharges into the River Blythe SSSI.

The Proposed Scheme will result in no residual effect on surface water flow. While the scheme includes the provision of six emergency areas, 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 do minimum situation. Attenuation, most likely by oversize pipes will include a 20% allowance for climate change for the additional impermeable area.

The scheme design has avoided or mitigated floodplain impingement at all but three locations along the scheme. Impingement in these three locations is assessed to have a minor adverse impact.

Although changes to traffic flow were conservatively estimated in excess of 20% on two of the road links with outfalls assessed, these changes have not been found to increase the risk of water quality deterioration on

receiving watercourses. As a result no significant effects have been recorded in relation to changes in traffic flow, the pollutant loading of road drainage and impacts to receiving watercourses.

Currently there are 3 Priority 'A' and 2 undetermined Priority Outfalls along the length of the Proposed Scheme. Of the undetermined outfalls, an assessment has been undertaken to reclassify these into Priority Status D and Priority Status C. The proposed scheme includes no measures to address any priority outfalls and no priority culverts within the scheme extents. The HAWRAT assessment concluded that no individual outfalls show a decline in Priority Outfall status in either the Do-Minimum or Do-Something scenarios. The proposed scheme does not require measures to address priority outfalls.

A Construction Environmental Management Plan (CEMP) 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 effects upon noise or air quality, 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 are 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 SMP 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. The Scheme Description records measures (if any) to be undertaken at junctions to improve safety and potentially reduce severance.

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

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

Climate Change

Effects on climate

An SMP scheme typically gives rise to an increase in traffic in order of 10-20%, however the change in greenhouse gas emissions is influenced by the extent to which existing traffic simply selects the SMP route in preference to others that may involve a longer distance or slower speed in addition to any induced traffic. The greenhouse gas emissions are thus a consequence of the overall change across the affected road network. For the Proposed Scheme the change in greenhouse gas emissions is expected to result in a present value of carbon dioxide equivalent emissions cost of -£62,172,689. This relates to a change in carbon dioxide equivalent emissions over a 60 year period of 1,375,681 tonnes between the with scheme and without scheme scenarios.

Vulnerability of the project to climate change

The historic climatic conditions insofar as awareness of flooding of carriageways are considered during the design of the drainage regime for the Proposed Scheme which also makes a 20% allowance for climate change for the additional impermeable area in the attenuation capacity of the drainage system.

Given the limited nature of the works associated with SMP schemes, the implications of increasing temperatures and rainfall intensity are matters for those responsible for maintenance of the motorway.

As the motorway soft estate is a stressful location for trees, species are selected that can withstand demanding conditions. As a consequence, it is considered that they are well able to accommodate climate change.

Greater wind speeds may increase the risk to high sided vehicles when passing through exposed parts of the motorway. Such risks are likely to be better managed on SMP schemes than other roads given the ability to provide advanced warning to drivers.

Material Assets and Waste

As the SMP scheme would not give rise to the import of more than 50% of primary resources from outwith the UK; sterilise a mineral safeguarding site and/or a peat resource; or does not employ re-used or recycled aggregate, significant effects can be discounted. In terms of waste, as the inert recovery/landfill capacities are typically of the order of several hundred thousand tonnes per annum and that a typical SMP scheme will generate approximately several hundred tonnes and thus no significant impact upon capacity is anticipated.

Major Accidents & Disasters

In terms of both man-made and natural major accidents the incremental environmental risk is associated with a SMP scheme could be associated with water quality. Given the low probability of a significant impact arising from a low probability major event, no measures are proposed to deal with major accidents or disasters and thus they are scoped out of the assessment.

Heat and Radiation

As the widening of the motorway and the introduction of signs and gantries etc do not involve the use of heat or radiation this aspect is scoped out of consideration in the assessment.

Cumulative Effects

The cumulative effects assessment considered 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 schemes.

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 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 therefore it as concluded that there is no potential for cumulative landscape and ecological effects.

There are no internationally designated sites located within the cumulative effects study area that would be affected by intra-project construction or operational 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, air quality, noise and road drainage and water environment assessments are inherently cumulative assessments.

Other relevant projects as of August 2013 to January 2019 were identified using a selection criteria methodology including scale, distance from the Proposed Scheme and development type. A total of four land use developments and no transport schemes were identified. Each identified development was examined to determine the potential for interactions 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 nature of proposed works.

Monitoring

The environmental assessment of SMP schemes that are delivered without recourse to the 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 'Outline Environment Management Plan' (OEMP) 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 OEMP has identified that there are no situations where monitoring of the mitigation measure and/or its effectiveness is required.

Assumptions

The assessment is based on the design details available at DF3. The extent of site clearance is based on a worst case scenario, which will be refined at detailed design stage. At time of writing, ecology surveys were on-going, and it is assumed that with the measures set out in the OEMP and utilising best practices from previous SMP schemes, that there will be no significant effects on any ecological receptors.

Conclusion

As described above, no significant adverse environmental effects have been identified. The Proposed Scheme includes design measures to avoid and 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 taken 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.

The environmental assessment has concluded that the following red risk areas exist where an adverse significant impact requires the delivery of effective environmental management measures to ensure that such impacts would not arise:

Tinkers Lane – risk of noise disturbance to residential properties during construction of emergency areas and gantry removal/installation.

Juggins Lane – risk of noise disturbance to residential properties during gantry removal and installation.

An overview of the environmental management measures provided in each topic chapter with details being provided in the OEMP.

In addition, the following amber risk areas have been identified where there is a potential for a significant impact that is dependent upon the working methods adopted by the Delivery Partner during construction:

Juggins Lane – risk of noise disturbance to residential properties due to resurfacing and night time works.

Pound House Lane – risk of noise disturbance to residential properties due to site clearance and night works.

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) and use closed-circuit television (CCTV), allowing Highways England traffic officers to be deployed 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 Controlled Motorway Indicators (CMIs) 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 on Enhanced Message Signs; 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 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 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.
- 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 Plan1, directly contributing to the following outcomes:

- Supporting economic growth;
- 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.

1.2 The scheme

1.2.1 Highways England is proposing to upgrade the M40/42 Motorway Interchange between Junction 3 Portway with the A435, through Junction 3a with the M40 to Junction 4 at link with the A3400 to M40 Junction 16 to a Smart Motorway referred to in this report as the 'Proposed Scheme'. The Proposed Scheme lies to the south of Birmingham, in Solihull (see Figure 1-1 for a location plan).

Highways England expects to commence construction of the Proposed Scheme in 2022 and is expected to take approximately two years to construct, including commissioning.

1.2.2 The Proposed Scheme would provide four permanent running lanes, by converting the hard shoulder into a running lane (lane1), between M42 J3 and J3a and between M42 J3a and M40 J16. Although no Through Junction Running (TJR) will be introduced as part of the scheme in order to maintain clarity of operation and due to absence of demand at Junction 3, the scheme has been designed to facilitate (future-proof) TJR should a future All Lane Running (ALR) scheme west of J3 be introduced. Lane gain/drop is provided at each of the three terminal junctions. The 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.

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 (ALR) along this 13km (8.1 miles) from M42 J3 to J3a and between M42 J3a and M40 J16, with the exception of the M40W-M42N and M42S-M40E link roads which will be 2-lane Controlled Motorway (hard shoulder retained) 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.

1.3 Purpose of this Environmental Assessment Report

1.3.1 Highways England has commissioned Amey Arup 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 EIA Screening (Determination) document and then published in a formal public Notice of Determination (NoD).

1.3.4 The purpose of this non-statutory Environmental Assessment Report (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 Scoping Report (Ref MP0280-HEX-EGN-ZZ-AS-KK-0001, SMP M40/42 Interchange Environmental Scoping Report, May 2018);
- Assess likely cumulative effects on environmental receptors;
- Describe mitigation, rectification and enhancement measures to minimise potentially significant impacts; 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 which following further engineering design results in the DF3 design reported upon in this document.

1.3.6 Following preparation of a desk based Scoping Report, various topics were scoped out of consideration in the EAR, but may require measures to be identified within the Environmental Management Plan (EMP). Section 4.2 of this EAR provides details of the topics that have been scoped out that require consideration in the EMP.

1.3.7 This EAR is supported by other related documents produced at DF3 stage, including:

- The Outline Environmental Management Plan (OEMP) (HE551530-AMAR-EGN-SWI-RP-YE-000002); and

- A Protected Species Report (at time of writing the ecology surveys were on-going therefore once these are complete, the final Protected Species Report will be submitted. Dormouse surveys are due to be completed in October 2019)

1.3.8 At present, no adverse significant environmental effects are predicted, the conclusions of this environmental assessment process will be summarised in a Environmental Impact Assessment Screening (Determination) and published in a Notice of Determination (NoD) by Highways England as required by Interim Advice Note (IAN) 126/15 .

1.3.9 The relationship between the EAR and the OEMP is set out in Chapter 11 of this report. 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).

1.3.10 Subsequent design change through to DF4 (detailed design) and beyond will not 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 Environmental Management Plan (EMP). Any such changes would be assessed in the Evaluation of Change Register.

Reporting

1.3.11 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	**Scheme Description**	Provides a detailed description of the Proposed Scheme.
3	**Alternatives**	Discusses the alternatives considered for the Proposed Scheme.
4	**Methodology**	Outlines the scoping report outcomes and environmental impact assessment 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	**Cumulative Impacts**	Details the assessment of cumulative impacts undertaken for the Proposed Scheme.
11	**Outline Environmental Management Plan (OEMP)**	Provides the key actions to be addressed in the outline EMP for the Proposed Scheme.
12	**Recommendations**	Provides the recommendation on determination (i.e. whether a statutory EIA is required or not), regarding the conclusions of the environmental assessment.
13	**Glossary and Abbreviations**	Presents the glossary and abbreviations.
	Figures	Drawings to support individual topic chapters
Appendices		
A.	**Committed Developments**	A.1 Committed Development Review
B.	**Air Quality**	B.1 Air Quality Strategy and Methodology Report B.2 Air Quality Technical Note B.3 Legislation

Chapter	Title	Description
		B.4 Baseline B.5 Operational Methodology B.6 Verification B.7 Operation Results
C.	**Biodiversity**	C.1 Ecological Survey Report
D.	**Landscape/Heritage**	D.1 Landscape and Heritage BIM table
E.	**Noise and Vibration**	E.1 Regulatory and Policy Framework E.2 Baseline, constraints and opportunities E.3 Noise assessment inputs E.4 Assessment of Impact E.5 Management of construction works
F.	**Water**	F.1 Priority Outfall assessment
G.	**Environmental Expertise**	G.1 Environmental Expertise

1.3.12. The EAR has been prepared based on this Scoping Report and will be made available to the statutory environmental organisations (Local Authorities, Natural England, Historic England and Environment Agency) in October 2019.

1.4 Regulation and Guidance

Environmental Impact Assessment Directive

1.4.1 The Environmental Impact Assessment Directive 2011/92/EU was amended by EIA Directive 2014/52/EU which was transposed into English legislation in June 2017 (Ref 1.2). Highways England issued a Major Projects' Instructions in May 2017 and revised 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 – Scheme Description, Section 2.3. 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 with each topic providing details of how that aspect would evolve without the scheme.
Biodiversity.	Now re-titled as Biodiversity.
Population & human health.	Health effects are generally scoped out of the SMP 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 – Cumulative effects.
Land	SMP schemes (delivered outwith the DCO process) do not involve the use of land not in public ownership. As a result, it is not intended to report land further.
Climate	The approach to the assessment of climate, which is scoped out is described in Chapter 4, 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, Section – 4.2.

EIA Directive Requirement	
Expertise for EIA	The expertise used in the assessment of each topic is presented in Appendix G.

1.4.2 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.

1.4.3 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 Environmental Impact Assessment (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 Environmental Assessment Report (EAR) informing that process.

1.4.4 Where significant effects are anticipated then 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 (NoD).

1.4.5 No abnormal load bays (ALBs) form part of the Proposed Scheme.

Guidance Documents

1.4.6 The EAR has been undertaken in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 11: Environmental Assessment (Ref 1.3 and associated Interim Advice Notes (IAN's):

- IAN 161/15 – Smart Motorways (Ref 1.4);
- IAN 183/14 – Environmental Management Plans (Ref 1.5);
- IAN 125/15 – Supplementary guidance for users of DMRB Volume 11 'Environmental Assessment Update (Ref 1.6); and
- 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);
- IAN 126/15 – Environmental Assessment, Screening and Determination (Ref 1.7).

1.4.7 The following Major Project Instructions (MPIs) have been taken into account during the assessment:

- MPI 28 – Determining the correct base year traffic model to support air quality assessments;
- MPI 29 – One-Team' delivery approach for Traffic and Environmental Teams;
- MPI 34 – Smart Motorways: Environment Assessment and Drainage Design Philosophies
- MPI 57 – Environmental Impact Assessment: Implementing the Requirements of 2011/92/EU as amended by 2014/52/EU (EIA Directive) – 2018 Revision;
- MPI 71 – National Noise Policy and EIA Significance of Noise Effects.

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

- E5.01 – Site Clearance
- E5.02 – Soft Estate;
- E5.03 – Assessment of existing noise barriers;
- E5.04 – Noise assessment methodology;

- E5.05 – Cost Benefit Ratio analysis of noise barriers;
- E5.06 – Construction noise and vibration assessment;
- E5.07 – Noise Surveys;
- E5.08 – Candidate Construction Compound Site Tool;
- E5.09 – Ecological Survey Report Template;
- E5.10 – Environmental Data (Specification and Reporting) to SMP GIS;
- E5.11 – Dynamic Reporting of Environmental Risk;
- E5.12 – Implementation of Limits of Deviation to Environmental Assessment.

1.4.9 Additional guidance is listed for each topic specific assessment in the Chapters 5 to 9.

1.4.10 The scope and content of this EAR have been informed by the M40/M42 Interchange Smart Motorway Scoping Report (Ref 1.8) (hereafter referred to as the Scoping Report).

Highways England License Requirements

1.4.11 It is the responsibility of Highways England to comply with (or have due regard to) the conditions set out in the Highways England License (April 2015) , 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 .

1.4.12 The relevant License requirements that this EAR must consider, on behalf of the License 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.

Road Investment Strategy (RIS)

1.4.13 The RIS was published in December 2014 , setting out a long-term strategic plan for investment in the Strategic Road Network (SRN) between 2015 and 2020. Smart Motorway schemes consider the RIS Objectives and seeks to:

- Reduce noise levels within noise Important Areas (see Section 8);
- Deliver no net loss in biodiversity (see Section 6);
- Enhance landscape setting (see Section 7); and
- Improve the quality of runoff at priority outfalls (Section 9).

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

1.5 Expertise Used to Undertake the Assessment

1.5.1 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, as well as those responsible for assuring the quality of the report. This expectation is to fulfil requirements of EU Directive 2014/52/EU.

1.5.2 The Environment Coordinator and Quality Assurance Leads for this EAR are detailed in **Table 1-3** below. The expertise of the specialist topic leads can be found in Appendix G.

Table 1-3: Professional Competence

Name	Grade and Company	Expertise and Professional Qualification
Helen Craig	Environmental Co-ordinator, Amey	Chartered Environmentalist and full member of Chartered Institute of Ecology and Environmental Management (CIEEM) BSc (Hons) Environmental Biology MSc Applied Environmental Sciences Helen has 10 years experience of working in environmental assessment on road schemes. She was environmental co-ordinator on the A47 Blofield to North Burlingham Dualling Stage 2 CDF scheme. In addition she has worked on a number of environmental impact assessments for road schemes for Department for Infrastructure in Northern Ireland including an environmental statement for a new road scheme on the A32 Cornamuck.
Mike Potts	Noise Lead, Amey	Chartered Environmentalist and Full Member of the Institute of Acoustics BSc (Hons) Geology MSc Pollution & Environmental Control Post-graduate Diploma in Acoustics & Noise Control Mike has 19 year's experience in acoustics and has been involved Acoustic Lead for the A47 Dualling scheme and the M25 SMP in addition to providing expert post-construction advice on the M1 SMP schemes. He is also Environmental Co-ordinator for the Area 13 EDF schemes programme and is providing expert advice into the Area 10 network upgrade works. Additionally, Mike provides ad-hoc expert advice in respect of strategic highway schemes across the UK including Scotland and N Ireland.
Christine McHugh	Air Quality Lead, Arup	MIEnvSc, MIAQM and AMIOA MA (Hons) Engineering Choate Fellow Harvard University PhD Engineering Christine has previously been involved in other SMP and highways schemes including M1 J13-16 and A30.
Jenny Singh	Biodiversity Lead, Arup	Chartered Environmentalist and Full Member of CIEEM BSc (Hons) Geography MSc Environmental Management Jenny has worked on other SMP schemes such as M1 J13-16.
John Ravening	Water Quality Lead, Arup	Chartered Environmental Water Manager (CWEM) and full member of Chartered Institution of Water and Environmental Management (CIWEM) BSc (Hons) Joint Geology and Physical Geography MSc Environmental Water Management John has been involved in other SMP schemes

Name	Grade and Company	Expertise and Professional Qualification
		such as M1 J13-16.
Declan Hurl	Cultural Heritage, Amey	Member of Certified Institute of Archaeologists (MCIfA) Member of Institute of Archaeologists of Ireland (MIAI) Post Grad Certificate of Field Archaeology Declan has over thirty years of archaeological experience in public and private sectors throughout the UK and RoI, involving road schemes (e.g. A75 Dunragit Bypass, A66 Kirkby Thore, A47 Norfolk/ Cambridgeshire), pipeline projects, renewable energy projects, quarries, residential units and waste facilities, as a project manager and a cultural heritage consultant. He is also a qualified and experienced Bridge Examiner, mainly for Network Rail.
Mary O'Connor	Landscape Lead, WYG	Diploma in Landscape Architecture – DipLA MSc Computer Science and Applications Practitioner Member IEMA – PIEMA Fellow of the Landscape Institute – FLI WYG lead for landscape and visual assessment, member of the Landscape Institute Advisory Panel for GLVIA3 Mary has worked on a variety of schemes, including a number of road schemes.

1.6 Stakeholder Engagement

1.6.1 No formal consultation has been undertaken in the production of the EAR, however contact has been made with the following stakeholders to gather baseline information to inform this assessment:

- Bromsgrove District Council – Stephen Williams, Environmental Health Officer to obtain the latest air quality monitoring data and Annual Status Report for Bromsgrove (February 2019).
- Solihull Metropolitan Borough Council – Beverley Hill, Environmental Health Officer to obtain the latest air quality monitoring data and Annual Status Report for Solihull (February 2019).
- Warwickshire Wildlife Trust (September 2018)
- Warwickshire Biological Records Centre – to obtain biological records (September 2018)
- Worcestershire Biological Records Centre – to obtain biological records (September 2018)
- Area 9 Environment Team at Kier (August 2018) to obtain biological records held by them.

2. The Proposed Scheme

2.1 Need for the Proposed Scheme

2.1.1 The M40 and M42 in this area is a strategic route that carries high volumes of heavy goods (15.5%) and other vehicles. The M40/42 interchange is a key location in the London to Scotland corridor, connecting the south east with Birmingham, Manchester, the north west and west of Scotland. The interchange also connects Yorkshire and the East Midlands with the south west of England. The interchange forms the south east quadrant of the Birmingham Box motorway and is also significant for local commuter journeys. The majority of the motorway is set within a rural environment. Congestion and unreliable journey times are experienced at busy periods and traffic is predicted to continue to grow.

- AM peak average speeds – the M42 J3 to M42 J4 (eastbound to northbound) and the M42 J4 to M42 J3 (southbound to westbound) carriageway features slow moving traffic during morning peak, with M42 J3-4 especially affected.
- PM peak average speeds – the M42 J3A to M42 J4 (northbound) and the M42 J4 to M42 J3A (southbound) carriageway especially features slow moving traffic. Consequently, the M40 approach to J3A is also impacted by the resulting congestion.

2.1.2 The baseline traffic assessment reported the following:

- The 2015 Annual Average Daily Traffic (AADT) west bound flows on the M40 J16 to M42 J3A is just over 48,500 vehicles and east bound flows are approximately 42,500 AADT.
- The west bound AADT flows on M42 J3A to M42 J3 are just over 56,600 vehicles and east bound flows are approximately 50,500 AADT.
- The west bound AADT flows on M42 J3A to M42 J4 are just over 61,700 vehicles and east bound are just over 61,800 AADT.
- The percentage of HGVs on the M40 J16 and M42 J3a in 2015 was on average 16% in the west bound direction and 15% in the east bound direction;
- The percentage of HGVs on the M42 J3A to M42 J3 in 2015 was on average 16% in the westbound direction and 14% in the eastbound direction;
- The percentage of HGVs on the M42 J3A to M42 J4 in 2015 was on average 16% in the westbound direction and 16% in the eastbound direction;
- At an average speed of 113km/hr (70mph), the journey time should take 6.1 minutes for weekdays;
- The average journey time in a typical morning period (7am to 10am) was 7.85 minutes, which is an average delay of 1.75 minutes for every light vehicle;
- In the inter-peak period (10am to 4pm) this journey time improves to 6.63 minutes, although this still represents an average delay of 0.53 minutes for every car; and
- PM peak period (4pm to 7pm), the average journey time is 9.35 minutes, equivalent to a delay of 3.25 minutes for each light vehicle.

2.1.3 These delays are the result of intensive traffic flows, with network stress particularly high between J3 and J4 on M42. This leads to slow journey speeds and frequent incidents of flow-breakdown, resulting in physical queues and delays. This poses a threat to road safety, because delays can lead to sudden braking and last-minute lane-changing behaviours. Congestion occurs east/north bound during the morning (AM) peak on the M42 between J3 and J4 sometimes extending back towards J2 (outside the scheme extent). Congestion occurs north bound on the M42 trough J4 to J3A towards J3 and also southbound on the M42 between J3A and J4 towards J5 (outside the scheme extent) during the afternoon (PM) peak. This congestion consequently affects the merging traffic from the M40 to J3A with subsequent congestion on the M40 back to, and beyond J16.

2.1.4 The Proposed Scheme, 13km in length, 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 M40 and M42 are three-lane motorways with hard shoulders built in the early 1960s with additions in the late 1980s and key features include:

- The M42 J3A – this is a major free-flow motorway interchange connecting the M40 with the M42 and forms part of the south-east quadrant of the Birmingham box. The M42 J4 is a major interchange between the north-south alignment of the M42 and the A34 and A3400 Stratford Road. The M40 J16 is a dumb-bell junction between the M40 and the A3400 Stratford Road;
- bridges over minor watercourses;
- bridge over railway line at Spring Brook.

Climbing lanes

2.2.2 There are no climbing lanes on the M40 or M42 between J3 and 4.

Pavement

2.2.3 The motorway is predominantly Thin Surface Course (TSC), a low noise surface, on the M42 between J3 and J3a. Hot rolled asphalt is predominant on the M40 J16 to M42 J3a.

Structures and other infrastructure

2.2.4 The number of existing structures, retaining walls and Closed Circuit Television (CCTV) masts are given in **Table 2-1** below.

Table 2-1: Existing Structures

Structure	Number
Overbridge	17
Underbridge	7
Footbridge	0
Culverts	8
Gantries	24
Retaining Walls	68
CCTV Masts	52

2.2.5 No structures are considered to merit engineering attention as part of the scheme.

2.2.6 Significant repairs or replacement of components are needed at none of the structures.

2.2.7 A total of 4 structures have been identified as having failed a pier impact assessment:

- Spring Lane SK19253
- Poolhead Lane SK17840
- Nuthurst Road SK19255 and
- Earlswood Common SK17841.

2.2.8 However, the pier impact assessments concluded that all piers are able to withstand residual impact loading, in accordance with BD48/93 and IAN 91/07. All piers will be adequately protected from impact by the installation of Rigid Concrete Barrier in the central reserve. Piers in the verge will be protected by adequate VRS system in front with appropriate working width.

2.2.9 All mass concrete abutments are assumed to be adequate against vehicle impact due to the large volume of the reinforced concrete full height abutments and the supporting earth fill and hence no further protection will be proposed.

Lighting

2.2.10 The M42 is lit through J3a on both the main carriageway and link roads with sodium lighting. The main carriageway on the M42 between J3a and J4 and the whole of J4 is lit. The slip roads at the junction roundabouts at the M40 J16 and M42 J3 are also lit. The lighting columns are located in the

central reserve/either side of the carriageways. Current lighting consists of high pressure sodium lanterns on 12m poles. The section between the M40 J16 and the start of the M42 J3a is unlit.

Abnormal load bays

2.2.11 No abnormal load bay facilities are located along scheme length.

Police observation platforms

2.2.12 One police observation platform is located on the M42 westbound carriageway approximately 1.5km in advance of J3.

Turnaround points

2.2.13 There is one turnaround point located along this section of motorway, within J3a connecting M40 westbound with the M42 northbound.

Transmitter stations

2.2.14 There is one Transmission Station (TS) located near the scheme:

- on the M42 eastbound to M42 northbound slip at MP19/1.

Motorway drainage and pollution control

2.2.15 The current drainage system is composed of the following:

- The drainage systems used to collect surface water run-off from the existing M40/M42 carriageway vary across the length of the scheme. The predominant system used is over the edge drainage collected by a filter drain with stone up to the surface in areas of cutting and kerb and gullies out falling into sub surface carrier drains in areas of elevation. Gravel filter drains with stone up to the surface are utilised in the central reserve in some areas. Combined kerb drains and linear drainage features are not predominately used, however slot drains and ACO drains are utilised in the nose of merge and diverges. The whole section of the M40/M42 central reserve is post and rail Vehicle Restraint System.
- No drainage ponds/SUDs;
- 3 Priority Outfalls and 2 non-determined outfalls.

Geotechnics

2.2.16 The British Geological Survey geological maps show that the study area is underlain by alluvium, river terrace deposits, glacial till, glaciofluvial deposits and glacial lake deposits. Bedrock geology is composed of Mercia mudstone and Arden sandstone.

2.2.17 The majority of the M42 and M40 in the study area is underlain by glacial till, with some areas of aluvium, glacial lake and head deposits. These typically coincide with localised valleys in the toography or the presence of rock near surface. Mercia mudstone is present close to the surface between J3A and J16 and at J4. Glacial sands and gravels are typically present beneath the glacial till overlying the mudstone. There is made ground present due to a number of historical landfills and due to the construction of the motorways.

2.3 Description of the Proposed Scheme

2.3.1 The Proposed Scheme provides All Lane Running (ALR) between M42 J3 Portway with the A435, through Junction 3a with the M40 to the M40 J16 with the A3400, and including the section of the M42 as it continues northwards from J3a to J4 where it connects with A34 and the A3400 comprising:

- 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 reinforced concrete barrier (RCB) component requiring the hardening of the central reserve and installation of RCB between the majority of the mainline sections of the scheme. However, the for the mainline link through J3A connecting M42 eastbound to M40 eastbound, it is proposed that the existing metal barrier be retained;
- Emergency Areas (EAs) to provide safe stopping areas in case of emergency;

- Overhead gantries fitted with Advanced Motorway Indicators (AMIs), new Variable Message Signs (MS4) and/ or Advanced Directional Signs (ADS), strategic signs (MS3S/ MS4-L); and
- Incident detection systems, speed enforcement cameras and comprehensive CCTV coverage.

2.3.2 Controlled motorway is being retained on the M40W – M42N and M42S – M40E link roads. These will be subject to VMSL with no restricted speed limits. In addition, a controlled motorway would be introduced using the existing lanes with variable mandatory speed limits at M42 J3a eastbound and westbound interchange.

2.3.3 Smart motorways also have the following key features:

- 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. There is no TJR on this scheme (see Table 2-2);
- Variable Mandatory Speed Limits (VMSL) enabled using a combination of verge and portal and cantilever gantry-mounted variable message signs and lane-specific signalling, with variable speed limits displayed on AMIs 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;
- Emergency roadside telephones (ERTs) provided in Emergency Areas and possibly adjacent to hard shoulders on slip roads;
- Earthwork modifications at some gantry, cabinet/ chamber and Emergency Area locations;
- No additional noise barriers will be provided for this scheme.
- Speed enforcement using Highways Agency Digital Enforcement Camera System 3 (HADECS3);
- 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.

2.3.4 An indicative layout required by an ALR scheme is presented in Figure 2-1.

Carriageway

2.3.5 Where the existing dual three-lane carriageway (motorway) with hard shoulder (D3M) is to be upgraded to four-lane ALR (D4ALR), the proposed layout will be accommodated within the existing paved area (current carriageway and hard shoulder). In general, no pavement widening within the verge will be required.

2.3.6 Where a lane drop/ lane gain is to be provided at a given junction, the existing three lanes and hard shoulder configuration will be retained through the junction. TJR involves taking the four running lanes through the junction with junction layouts realigned to accommodate the fourth lane generally by re-configuration of slip roads and amending road markings and vehicle restraint systems (VRS) appropriately. Lane-drop and lane-gain or TJR arrangements will be provided as detailed in **Table 2-2**.

2.3.7 The physical design elements of scheme include:

- Conversion of the hard shoulder to a permanent traffic lane making four lanes of 13.75m overall width. The operational width of the road would be 3.5m wider than existing;
- Provide a hard strip of approximately 1m width with enhanced edge drainage;
- Re-configure junction layouts to accommodate the fourth lane.

2.3.8 The General Arrangement of the Proposed Scheme, including the location of new and existing gantries, other signs and Emergency Areas is presented in Drawings HE551530-AMAR-HGN-ZZ-DR-CH-000001 to HE551530-AMAR-HGN-ZZ-DR-CH-000010.

2.3.9 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.

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

Table 2-2: Proposed Carriageway Configurations

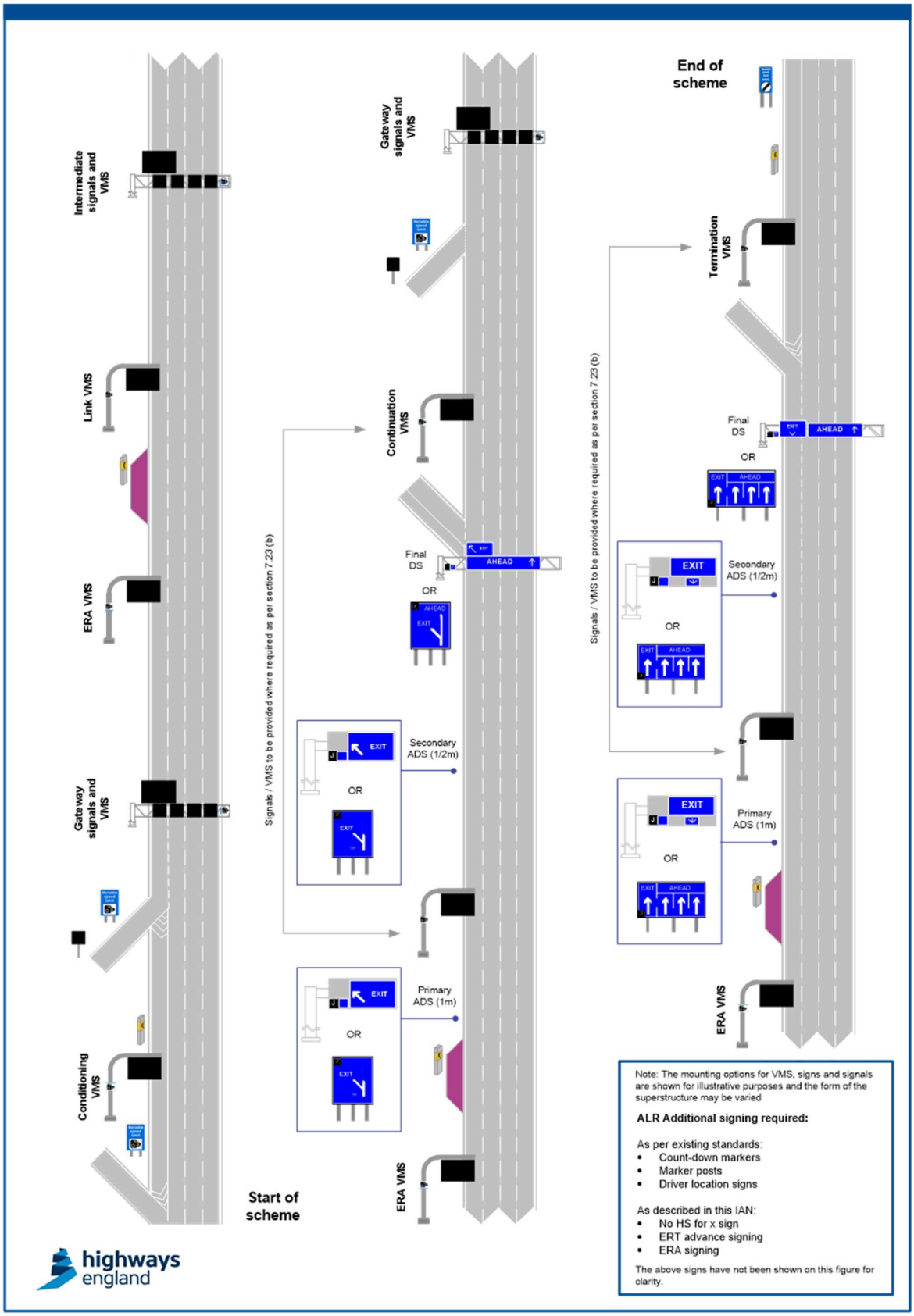
	north/east bound	south/west bound
Through J3	D3M	D3M
J3 to J3A	4 lane ALR	4 lane ALR
J3a EB to NB connector	3 lane ALR	-
J3A SB to WB connector	-	3 lane ALR
J3A to J4	4 lane ALR	4 lane ALR
Through J4	D3M CM	D3M CM
J3A SB to EB (M42 to M40) connector	-	D3M CM
J3A WB to NB (M40 to M42) connector	D2M CM	-
J3A EB M42 to M40 connector	D2M CM	-
J3A WB M40 to M42 connector	-	D2M CM
J3A to M40 J16	4 lane ALR	4 lane ALR
Through J16	D3M	D3M

Pavement

2.3.11 The carriageway within the Proposed Scheme limits will be resurfaced within lane 1 and sections of lane 4, with low noise surfacing in the opening. Other lanes would be resurfaced where necessary as a maintenance measure.

2.3.12 The Junction layouts will be realigned to accommodate the fourth lane by re-configuration of slip road merge and diverges.

Figure 2-1: Illustrative drawing of an All Lane Running Layout


Intermediate signals and VMS
Link VMS
ERA VMS
Gateway signals and VMS
Conditioning VMS
Start of scheme
Gateway signals and VMS
Continuation VMS
Final DS
AHEAD
EXIT
OR
Secondary ADS (1/2m)
Primary ADS (1m)
ERA VMS
Signals / VMS to be provided where required as per section 7.23 (b)
End of scheme
Termination VMS
Final DS
AHEAD
EXIT
OR
Secondary ADS (1/2m)
Primary ADS (1m)
ERA VMS
Signals / VMS to be provided where required as per section 7.23 (b)
Note: The mounting options for VMS, signs and signals are shown for illustrative purposes and the form of the superstructure may be varied
ALR Additional signing required:
As per existing standards:
Count-down markers
Marker posts
Driver location signs
As described in this IAN:
No HS for x sign
ERT advance signing
ERA signing
The above signs have not been shown on this figure for clarity.
highways england

Central reserve works

2.3.13 All mainline central reserve is currently steel barrier VRS to separate the carriageways. The Proposed Scheme will replace the steel barriers with RCB, which will allow the central reserve to be narrowed. A hard surface will be introduced for the full length of the central reserve to minimise the need for future maintenance work.

2.3.14 The central reserve works comprises the following components:

- Replacement of steel barrier VRS with a Rigid Concrete Barrier (RCB), installed between the following chainages:
  - Marker post P13/9A to P170/8B;
  - Marker post P19/9A to P170/8B
  - Marker post P169/9B to P22/9A.
- Central reserve pavement throughout, with narrowing to 3.25m minimum but typically 4m to 4.5m (none of the central reserve is currently paved);
- Localised widening and concrete collars at overbridge locations to provide impact protection to overbridges; and
- Central reserve drainage works to replace existing drains and provide attenuation as required.

Verge works

2.3.15 The Controlled Motorway component of the proposed scheme provides enhanced signalling to the existing carriageway cross section, as well as changes to lane widths where this is beneficial for operational reasons or for compliance with standards.

2.3.16 The scheme comprises the following components:

2.3.17 The scheme comprises the following components:

- On ALR 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.
- 26 new gantries (need for piling to be confirmed following GI), existing gantry foundations to be re-used where feasible and retention of 22 existing gantries;
- Removal of eight existing gantries;
- Provision of six new Emergency Areas;
- New longitudinal communication ducting along the Proposed Scheme length;
- 23 new CCTV cameras;
- 4 HADECS3 live enforcement sites, no non-live sites;
- 24 new MIDAS radar sites;
- 6 sets of ROTTM signs, each set consists of five signs (notionally 1 mile MAW, 800, 600, 400 and 200 yards);
- 6 Entry Stop Signals (post mounted AMIs) in pairs on every entry slip roads;
- 2 new Electrical Interface (EI) cabinet sites, with 19 existing EIs sites to be retained;
- New VRS at specific locations new infrastructure such as gantries;
- New retaining structures to accommodate Emergency Areas, communication cabinet sites, gantries and other verge infrastructure;
- Replacement lighting;
- New signing; and
- Remedial works are anticipated at 4 underbridges.

Geotechnics

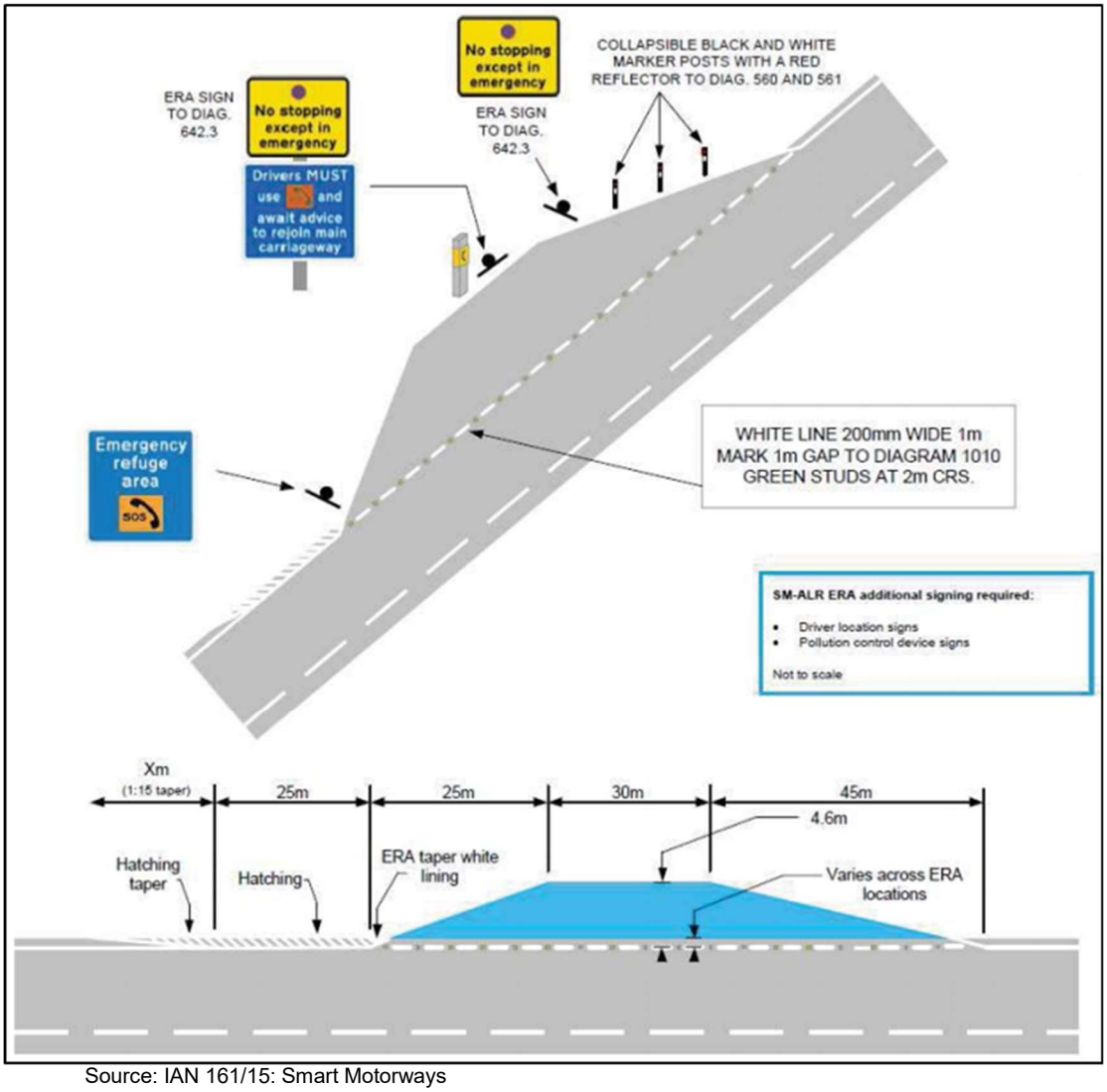
2.3.18 To accommodate the scheme the existing earthworks along the motorway verges will be regraded, where space permits. However, it is likely that new retaining walls will be required to support verge widening and construction of infrastructure such as gantries. At detailed design these geotechnical solutions will be investigated further and the assumptions confirmed using confirmatory ground investigation prior to construction. At DF3 stage a total of 45 retaining walls are proposed in cut with 23 retaining walls in fill. The height of the walls will be between 0.5m and 3m high. The length of the walls vary from a minimum of 10m to a maximum of 1370m. Full details of the proposed retaining

walls are available in the Form 303. The highest walls are proposed at ch 860, Ch 1785, Ch 5025, Ch 7220, Ch 7250, Ch 7640, Ch 1327.5 and Ch 1880.

Emergency areas

2.3.19 Emergency Areas are provided along ALR 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 30m from the start of the Emergency Area to 1.6m at the end of the area (see **Figure 2-2**).

Figure 2-2: Illustrative drawing of an ERA



Source: IAN 161/15: Smart Motorways

2.3.20 It is proposed to provide four Emergency Areas for the M42 from J3 to 3a (two eastbound and two westbound) and two for M42 J3a to M40 J16 (one each direction). The east bound EA on (EB 1) already exists but is partially closed off from the existing hard shoulder by an 'Armco' barrier. **Table 2.3**. lists the locations.

2.3.21 Emergency roadside telephones (ERT) will be provided in all dedicated refuge areas. Existing ERT elsewhere along the extent of the Proposed Scheme will be removed, apart from those within a junction where the existing hard shoulder is retained.

2.3.22 To enhance the conspicuousness of an Emergency Area to motorway users these areas are to be provided with an orange coloured surface (see **Figure 2-3**).

Table 2.3: Proposed Emergency Area Locations

Eastbound Carriageway		Westbound Carriageway	
Emergency Area Id	Approx. Location2 (MP)	Emergency Area Id	**Approx. Location[3] (MP)**
M42 ERA-EB1	J3-J3a Ch.2205m	M42 ERA-WB2	J3a-J3 Ch. 2580m
M42 ERA-EB2	J3-J3a Ch.4000m	M42 ERA-WB1	J3a-J3 Ch. 4110m
M42 ERA-EB3	Ch.4738m	M40 ERA-WB1	J16-J3a Ch.7699m
M40 ERA-EB1 Layout already exists	J16-3a Ch.7000m		

Figure 2-3: Indicative Emergency Area

2.3.23 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.

Signs, gantries and roadside devices

2.3.24 Operation of the Smart Motorway 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 gantries is provided in **Table 2-4**.

2.3.25 There are four main types of LED signals, which are described below:

- AMI are used to display variable VMSL for each lane using programmable high resolution LEDs;
- MS4 (Message Sign Mark 4) are a type of variable message sign used to provide driver information in the form of text and pictograms;
- MS3/ MS4-L (Message Sign Mark 3 / Message Sign Mark 4 - Long) are deployed in advance of strategic junctions and provide information to the travelling public in the form of text messages; and

[2] Defined as the centre of the Emergency Area.
[3] Defined as the centre of the Emergency Area.

- 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 (Ch)	Carriage-way	Gantry history (New/ retained/ existing foundations re-used)	Type	Proposed gantry equipment
M42 J3 to 4 (EB to NB) & J4-3 (SB to WB)	G-M42-01	264	J3-4 Eastbound to Northbound	New	MS4 Cantilever	1 MS4
	G-M42-02	1480	J3-4 Eastbound to Northbound	New	Supersp an Portal	1 MS4, 4 AMIs
			J4-3 Southboun d to Westbound			1 ADS
	G-M42-03	2133	J3-4 Eastbound to Northbound	New	Supersp an Portal	1 MS4
			J4-3 Southboun d to Westbound			1 ADS
	G-M42-04A	2714	J3-4 Eastbound to Northbound	Existing	MS3 Cantilever (Re-located)	1 MS3
	G-M42-04	2989	J3-4 Eastbound to Northbound	New	Supersp an Portal	1 MS4
	G-M42-05	3246	J3-4 Eastbound to Northbound	Existing	Supersp an Portal	1 ADS
			J4-3 Southboun d to Westbound			1MS4
	G-M42-06A	3547	J3-4 Eastbound to Northbound	Existing	MS3 Cantilever (Re-located)	1 MS3
	G-M42-06	3774	J3-4 Eastbound to Northbound	New	MS4 Cantilever	1 MS4

Link	Gantry Id	Indicative Location (Ch)	Carriage-way	Gantry history (New/ retained/ existing foundations re-used)	Type	Proposed gantry equipment
	G-M42-07	4272	J3-4 Eastbound to Northbound	New	Supersp an Portal	1 MS4, 1 ADS
			J4-3 Southboun d to Westbound			1 MS4, 4 AMIs
	G-M42-08	4813	J3-4 Eastbound to Northbound	New	Supersp an Portal	4 AMIs, 1 ADS
			J4-3 Southboun d to Westbound			
	G-M42-09	5345	J3-4 Eastbound to Northbound	New	Supersp an Portal	2 MS4, 5 AMIs, 2 ADS
			J4-3 Southboun d to Westbound			
	G-M42-10	601	J3-4 Eastbound to Northbound	New	MS4 Cantilev er	1 MS4
	G-M42-11	313	J3-4 Eastbound to Northbound	Existing	Supersp an Portal	1 MS4, 4 AMIs
			J4-3 Southboun d to Westbound			1 ADS
	G-M42-12	705	J3-4 Eastbound to Northbound	Existing	Supersp an portal	1 MS4
			J4-3 Southboun d to Westbound			1 MS4, 1 ADS
	G-M42-13	1013	J3-4 Eastbound to Northbound	Existing	ADS Cantilev er	1 ADS

Link	Gantry Id	Indicative Location (Ch)	Carriage-way	Gantry history (New/ retained/ existing foundations re-used)	Type	Proposed gantry equipment
	G-M42-14	1310	J3-4 Eastbound to Northbound	Existing	Supersp an Portal	1 MS4
			J4-3 Southboun d to Westbound			1 MS4, 1 ADS
	G-M42-15	1585	J3-4 Eastbound to Northbound	Existing	ADS Cantilev er	1 ADS
	G-M42-16	2024	J3-4 Eastbound to Northbound	Existing	Supersp an Portal	1 MS4
			J4-3 Southboun d to Westbound			1 MS4, 4 AMIs
	G-M42-17	2604	J3-4 Eastbound to Northbound	Existing	Supersp an Portal	2 ADS
			J4-3 Southboun d to Westbound			-
	G-M42-18	2801	J3-4 Eastbound to Northbound	Existing	ADS Cantilev er	1 ADS
	G-M42-19	3020	J3-4 Eastbound to Northbound	Existing	Supersp an Portal	1 MS4
			J4-3 Southboun d to Westbound			-
	G-M42-20	3336	J3-4 Eastbound to Northbound	Existing	Supersp an Portal	1 MS4, 4 AMIs
			J4-3 Southboun d to Westbound			-

Link	Gantry Id	Indicative Location (Ch)	Carriage-way	Gantry history (New/ retained/ existing foundations re-used)	Type	Proposed gantry equipment
	G-M42-23	141	J3-4 Eastbound to Northbound	Existing	Supersp an Portal	-
			J4-3 Southboun d to Westbound			4 AMIs
	G-M42-24	70	J4-3 Southboun d to Westbound	New	Supersp an Portal	2 MS4, 5 AMIs, 2 ADS
	G-M42-25	865	J4-3 Southboun d to Westbound	New	MS4 Cantilev er	1 MS4
	G-M42-26	236	J4-3 Southboun d to Westbound	New	MS4 Cantilev er	1 MS4
	G-M42-27	2689	J4-3 Southboun d to Westbound	New	MS4 Cantilev er	1 MS4
	G-M42-28	1760	J4-3 Southboun d to Westbound	New	MS4 Cantilev er	1 MS4
	G-M42-29	1160	J4-3 Southboun d to Westbound	New	MS4 Cantilev er	1 MS4
	G-M42-30	595	J4-3 Southboun d to Westbound	New	MS4 Cantilev er	1 MS4
	G-M42-31	3672	J3-4 Eastbound to Northbound	Existing	Supersp an Portal	1 MS4, 4 AMIs
			J4-3 Southboun d to Westbound			2 ADS
	G-M42-32	3522	J4-3 Southboun d to Westbound	Existing	ADS Cantilev er	1 ADS

Link	Gantry Id	Indicative Location (Ch)	Carriage-way	Gantry history (New/ retained/ existing foundations re-used)	Type	Proposed gantry equipment
	G-M42-33	960	J4-3 Southbound to Westbound	New	ADS Cantilever	1 ADS
	G-M42-34	2291	J3-4 Eastbound to Northbound	Existing	Supersp an Portal	-
			J4-3 Southbound to Westbound			1 ADS
M40 J3A-J16 & J10-3A	G-M40-01	568	J3A-J16 Eastbound	New	MS4 Cantilever	1 MS4
	G-M40-02	5851	M42 J4-3 (SB to WB)	New	MS4 Cantilever	1 MS4
	G-M40-03	6448	J3A-J16 Eastbound	Existing	Supersp an Portal	2 ADS
			J16-J3A Westbound			2 MS4, 4 AMIs, 2 ADS
	G-M40-04	6743	J3A-J16 Eastbound	New	Supersp an Portal	1 MS4, 4 AMIs, 1 ADS
			J16-J3A Westbound			-
	G-M40-05	7108	J3A-J16 Eastbound	Existing	Supersp an Portal	2 ADS
			J16-J3A Westbound			1 MS4
	G-M40-06	7625	J3A-J16 Eastbound	New	Supersp an Portal	1 MS4, 1 ADS
			J16-J3A Westbound			-
	G-M40-07	7937	J3A-J16 Eastbound	Existing	Supersp an Portal	2 ADS
			J16-J3A Westbound			1 MS3, 4 AMIs
	G-M40-08	8417	J16-J3A Westbound	New	MS4 Cantilever	1 MS4
	G-M40-09	8804	J3A-J16 Eastbound	Existing	Supersp an Portal	1 ADS
			J16-J3A Westbound			1 MS4, 3 AMIs

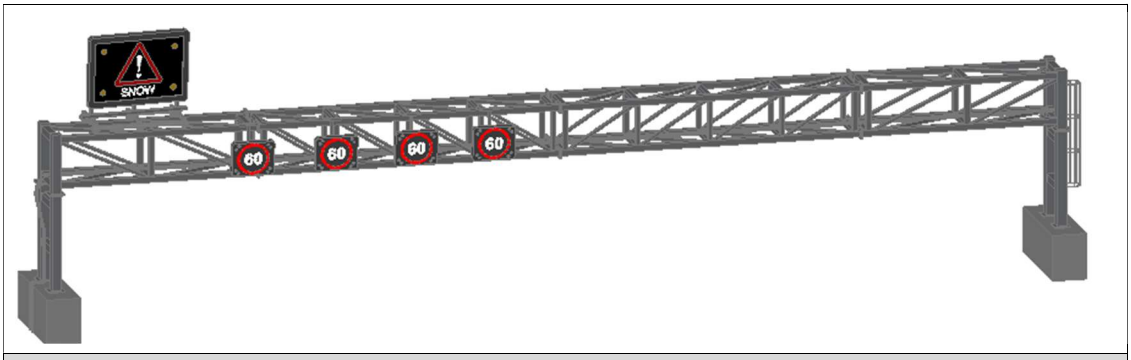
Link	Gantry Id	Indicative Location (Ch)	Carriage-way	Gantry history (New/ retained/ existing foundations re-used)	Type	Proposed gantry equipment
	G-M40-10	648	J16-J3A Westbound	Existing	Superspan Portal	1 MS4
	G-M40-11	984	J16-J3A Westbound	New	MS4 Cantilever	1 MS4
	G-M40-12	5793	J16-J3A Westbound	New	MS4 Cantilever	1 MS4
	G-M40-13	5156	J16-J3A Westbound	New	MS4 Cantilever	1 MS4
	G-M40-14	8950	J16-J3A Westbound	New	MS3 Cantilever	1 MS3

2.3.26 The roadside devices to be included as part of the Proposed Scheme are detailed in **Table 2-5** below. **Figure 2-4** illustrates typical views of a Superspan Gantry, MS3/ MS4 Cantilevers, Directional Signs and AMI signage. Verge located nine ADS and no other large driver information signs (see Table 2-6).

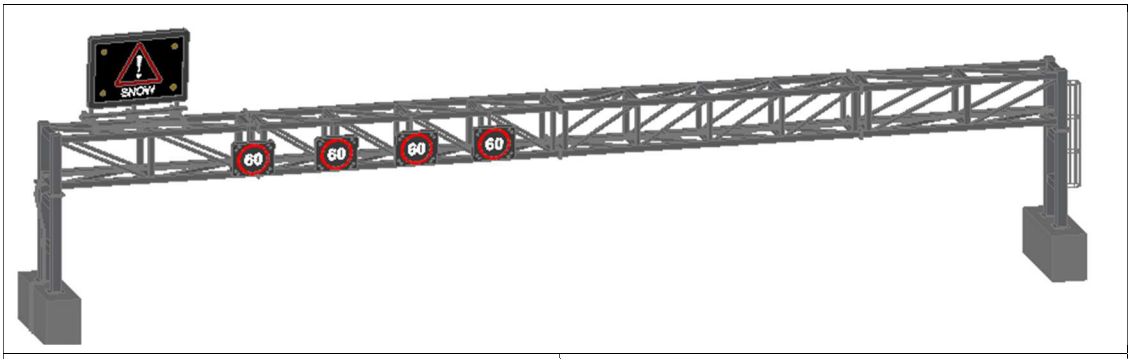
2.3.27 The base height to the underside of the gantries is approximately 6m, but with the addition of an MS4 sign (3.2m high), the most prominent proposal visual infrastructure would be approximately 9m. AMIs are mounted onto the face of the gantry and would not protrude above the gantry top, as shown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

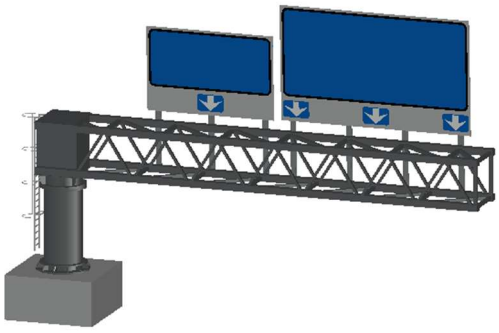
2.3.28 As recorded in Table 2-4, the link between M40 and M42 would require the installation of superspan gantries, potentially leading to motorway closures. At time of writing it was expected that approximately 30 carriageway closures will be required for gantry works.

Figure 2-4: Typical views of a Superspan Gantry, MS3/ MS4 Cantilevers, Directional Signs and AMI signage



Superspan Gantry with AMI and MS4





Superspan Cantilever Gantry with Advanced Directional Sign (ADS)

MS4 Cantilever

MS3 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)	66	0
AMI (post mounted)	0	0
MS4	45	0
MS3 / MS4-L	4	1
ERT	10	12
HADECS enforcement cameras (ENF) (live sites)	3	1
HADECS enforcement cameras (ENF) (non-live sites)	0	0
MIDAS outstation	24	15
MIDAS Radar sites	24	15
Pan, tilt and zoom (PTZ) CCTV camera	23	7
Remotely operated temporary traffic management (ROTTM) signs	33	0
Entry Stop Signals	0	6
Speed Equalisation Signals	0	0

Roadside device	New	Existing
Electrical Interface (EI) cabinets	2	19

Table 2-6: Proposed Signs and Signals

Proposed Assets	Type	Estimated Asset Quantities4	
		New	Remove
Cantilevered Signs/Signals	MS4	TBC	TBC
	AMI	0	0
Superspan Signs/Signals	AMI/ADS	66	36

Lighting

2.3.29 No new lighting is being proposed for the Proposed Scheme.

2.3.30 Where replacement lighting is required, this would 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.

Demolition and new structures

2.3.31 Nine new structures (super-span gantries across both carriageways) are currently indicated within the Proposed Scheme. Eight existing structures (super-gantries) are planned for demolition and removal.

Overbridges and underbridges

2.3.32 The proposed works to the overbridges are outlined in **Table 2-7** below.

Table 2-7: Proposed Works to Overbridges

Structure Name	Structure Number	Location (MP)	Works to Structure	Located in Flood Zone (2/3)	Located within the River Channel
Nuthurst Road	19255	7750	Bifurcation at pier.	No	No
Spring Lane	19253	6810	Bifurcation at pier.	No	No
Umberslade East	19252	5935	No change in alignment proposed.	No	No
Poolhead Lane	17840	2330	Bifurcation at pier. A rigid concrete barrier is needed in the eastbound and westbound verge.	No	No

4 Quantities may vary.

Earlswood Common O/B	17841	3800	Bifurcation at pier. A rigid concrete barrier is needed in the westbound verge.	No	No
Tithe Barn Lane O/B	17838	4560	Bifurcation at pier. A rigid concrete barrier is needed in the westbound verge	No	No
Umberslade I/C West	17834	5525	No change in alignment proposed.	No	No
Umberslade I/C North	17833	800	None. No pier.	No	No
Cut Throat Lane O/B	17836	550	Bifurcation at pier. A rigid concrete barrier is needed in the northbound and southbound verge.	No	No
Kineton Lane O/B	17837	2122	Bifurcation at pier.	No	No
Sidenhales O/B	17842	2827	None. No pier. A rigid concrete barrier is needed in the southbound verge.	No	No
Blythe Valley	25059	3304	None. No pier.	No	No

2.3.33 The proposed works to the underbridges are outlined in Table 2-8

Table 2-8: Proposed Works to Underbridges

Structure Name	Structure Key	Chainage	Works to Structure
Obelisk Farm Accommodation	19254	7766	Central reserve Rigid Concrete Barrier.
Forshaw Heath Lane	17844	843	Central reserve Rigid Concrete Barrier.
Springbrook Railway Bridge	17845	3358	Central reserve Rigid Concrete Barrier. Upgrade to parapet transition.
Stratford Canal U/B	17843	839	Central reserve Rigid Concrete Barrier.
School Road U/B	17835	906	Central reserve Rigid Concrete Barrier.

Communication cabling and ducting

2.3.34 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 1.5m from the edge of the existing carriageway.

2.3.35 Ducts and cabling will be situated where required along the length of the scheme, this will be confirmed at detailed design.

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

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

2.3.38 New CCDs are likely to be provided, some terminating in the central reserve others spanning bth carriageways. Once surveys have been concluded and ducts proved there may be opportunities to re-use existing CCDs, thereby minimising any impacts. The detailed design will be developed in PCF Stage 5 to confirm vegetation clearance and retention.

Proposed Power Supply

2.3.39 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. At this stage, two new supply requirements have been identified and eight new EIs will be required at existing supply locations. Neither of the two new locations are located near Windmill Naps Wood SSSI. The power design will be progressed at DF 4 Detailed design.

Table 2-9: Potential Locations for New or Upgrade Power Supply

Existing		New	
ID	**Location (MP)**	**ID**	**Location (MP)**
6246A	408708E, 272881N	6237M	Ch280
6258A	409791E, 272655N	9700M	413374E, 272214N
6265A	410531E, 272600N		
6274A	411369E, 272314N		
9692B-1	414111E, 271888N		
9692B-2	414125E, 271904N		
9689A-1	414311E, 271660N		
9689A-2	412977E, 271642N		
9673B	415630E, 270786N		
6292A-1	412958E, 272415N		
6292A-2	412977E, 272407N		
6296A	412069E, 272810N		
A_3653	412152E, 273173N		
6302B	413238E, 273382N		
6306B	413377E, 273655N		
6312A	413735E, 274290N		
CwickGreen	414106E, 274645N		
6319B	414179E, 274674N		
6322B2	414359E, 274993N		
6329M	414657E, 275654N		

Turnarounds

2.3.40 No new turnarounds points for use by authorised vehicles including emergency services and highways maintenance are proposed for this scheme.

Police observation platforms

2.3.41 Should observation platforms be included then they will be co-located within the closest appropriate EA location

2.3.42 There is one existing Police Observation Post (POP) within the scheme extents, on the M42 west bound, approximately 1.5km prior to M42 J3. This POP will no longer be safely accessible as this link will be upgraded to ALR, consequently this facility will be removed. An at-grade maintenance hardstanding will be provided at the rear end of a nearby Emergency Area on this link that can be utilised by both Core Responders and Maintenance Providers.

Drainage strategy

2.3.43 Treatments for drainage will be determined during the detailed design stage. 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.

2.3.44 If drainage 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. Where a concrete barrier already exists the existing surface drainage will be retained, subject to condition.

2.3.45 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.

2.3.46 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 attnuation requirements in accordance with IAN 196/17.

Land take

2.3.47 It is assumed that there is no requirement for permanent additional landtake. There is a potential requirement to provide alternative access to the transmission station currently located in the northbound verge, to the north of the interchange. Two options are being considered and will be explored further at detailed design:

- option 1 – provide off network access via Umberslade Road. This is the preferred option as it retains the location of the transmission station. It would include the construction of a paved access track, but is dependent on land owner agreement. The total area of the access track is estimated to be approximately 416m2. Highways England are determining whether an extension to an existing easement at this location may be viable (currently there is a hardened non-paved access from Umberslade Road within the private land). It should be noted that the type and use of this access would need to be agreed with NRTS who maintain and use the transmission station.
- option 2 – close the existing transmission station and provide a new one within the triangle of land within J3A. This is a more expensive option due to relocating the transmission station as well as providing alternative access. At this time, the exact area of land required for this option has not been determined but based on the existing footprint of the station and assuming the access track will have a similar area to that of option 1, the area of land required is estimated to be approximately 600m2.

2.3.48 The Proposed Scheme would require temporary land-take for compound areas, material storage and temporary breakdown vehicles. Candidate construction compound sites have been identified and subject to protected species surveys during 2018-19. Selection of compound sites remain matters for the Delivery Partner and thus the actual temporary land taken will be reported within the Construction Environmental Management Plan following environmental surveys and assessments.

2.3.49 The size of the compound is estimated to be approximately 60,000m^2. 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.

2.3.50 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

2.3.51 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 and will involve the construction of new footways to these assets. This will involve the provision of a 1m wide pedestrian access route along the highway boundary fence, to allow for temporary running of cabling.

2.3.52 The viability of maintenance vehicle parking, including the construction of new maintenance laybys on the local road network will require consideration. 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

2.3.53 The design of retaining walls and embankments will be finalised during detailed design, following ground investigations. The design will take into account environmental constraints, such as areas at risk of flooding, in order to prevent any significant environmental impacts.

2.3.54 A limits of deviation assessment is provided as part of the OEMP that summarises environmental constraints information relating to noise, landscape and biodiversity to inform the Delivery Partner and Design Agent at detailed design. This provides a risk based approach based on whether a change in design resulting in the relocation of infrastructure will result in significant environmental effects.

2.4 Rectification, Mitigation and Enhancement

Scheme evolution from operational concept

2.4.1 The location of EAs and retaining walls has been reviewed and located to ensure minimal encroachment into areas of floodplain.

2.4.2 Other design elements that have not been confirmed such as power supplies and cable ducting will not result in any significant environmental effects.

Rectification of outfalls and culverts

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

- New carrier drains and attenuation for verge drainage as required;
- No upgraded runoff outfalls with enhanced pollution control measures; and
- Enhancements to no priority outfalls and culverts were considered necessary following the priority outfalls assessments, as the outfalls passed the HAWRAT assessment. (Table 2-10). Locations of outfalls are shown on Figure 9.4.

Table 2-10: Priority Outfalls and Culvert Locations

Outfall				
Reference	**Location (MP)**		**Priority Status**	**Enhanced Pollution Control Measures**
NOT REFERENCED A	P16/7B	(ND) C	No enhancements considered	
NOT REFERENCED B	P16/7A	(ND) D	No enhancements considered	
NOT REFERENCED C	P169/6M	(ND) C	No enhancements considered	
NOT REFERENCED D	P168/7A	(ND) D	No enhancements considered	
NOT REFERENCED E	P23/3A	(ND) D	No enhancements considered	
NOT REFERENCED F	P21/6B	(ND) D	No enhancements considered	
NOT REFERENCED G	P170/2M	(ND) D	No enhancements considered	
NOT REFERENCED H	P14/0A	(ND) C	No enhancements considered	
NOT REFERENCED I	P14/1B	(ND) C	No enhancements considered	
SP0972_2269a	P15/1A	(C) C	No enhancements considered	
SP1172_6823b	P17/7A	(B) C	No enhancements considered	
SP1372_0422a	P170/4B	(X) C	No enhancements considered	
SP1373_2435a	P20/2B	(D) C	No enhancements considered	
SP1471_7921a	P168/3B	(X) D	No enhancements considered	
SP1474_2588e	P22/1A	(C) C	No enhancements considered	
SP1476_8412a	P23/5B	(C) D	No enhancements considered	
SP1570_0098a	P167/9A	(X) D	No enhancements considered	
SP1670_2159b	P166/7A		(X) D	No enhancements considered

Outfall			
Reference	**Location (MP)**	**Priority Status**	**Enhanced Pollution Control Measures**
Culvert			
Reference	**Location (MP.)**	**Priority Status**	**Enhanced Pollution Control Measures**
Not applicable to this scheme			

2.4.4 Although there are 57 recorded flood events, there are no high impact events, however there were 10 events with a flood severity indices ranging from 7 to 1. The proposed drainage design provides across the board enhanced performance and capacity within the system to alleviate existing flood risk problems and makes allowance for climate change. There are no specific drainage improvements (**Table 2-11**) incorporated into the Proposed Scheme Design as a result of a review of the Category A flooding hotspots.

Table 2-11: Drainage Improvements at Flooding Hotspots

Reference	Location (approx.)	Proposed Mitigation Measure
1354	M42 (NB) at and around J3	No specific action proposed under this scheme HAGDMS note: West bound entry slip road covered in VM00575
2062	M40 (NB),M42 (SB) between J3 and J3a	No specific action proposed under this scheme HAGDMS note: VM00727 taken through VM workshop - awaiting funding
954	M40 (NB),M40 (SB),M42 (NB),M42 (SB) at and around J3a	No specific action proposed under this scheme HAGDMS note: M40 / M42 Interchange-EFP Prelim Design Report
1371	M42 (NB),M42 (SB)	No specific action proposed under this scheme HAGDMS note: VM00596 M42 J4 Drainage scheme on 18/19 programme

2.4.5 Following a review of the 2 outfalls classified as of 'Not Determined' status in Highways Agency Drainage Data Management System (HADDMS), no outfalls which discharge into watercourses are targeted for water quality improvement, are connected to SSSI or discharge into Flood Zone 2 or 3 have been confirmed for improvement and are listed in **Table 2-12.**

Table 2-12: Non-Determined Outfall Locations

Reference	Location (MP)	Proposed Mitigation Measure
SP1475_5086a (NOT REFERENCED E)	P23/3A	Discharges to River Blythe SSSI. No mitigation measures considered. Priority Status assessed as 'D'
SP1373_2435a	P20/2B	No mitigation measures considered. Priority Status assessed as 'D'

Environmental barriers (new/renewal and temporary removals)

2.4.6 To address the Highways England Licence and Roads Investment Programme objectives, sites six candidate new noise barriers were identified in the Scoping Report. Following the review of their suitability and value for money assessment, the scheme is to provide no new barriers. The existing

noise barriers (ENB1 and ENB2) are likely to be reinstated following their temporary removal to facilitate the works. The locations of the existing noise barriers are detailed in **Table 2-13.**

2.4.7 Approximately 0.31km of existing noise barriers is likely to be removed temporarily during cnstruction 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 the minimum amount of time to reduce disturbance. Based on previous SMP schemes this is likely to be around 3-4 months, however it is expected that the Delivery Partner will liaise with the noise assessment team to ensure the length of time the barrier is temporarily removed is such that a significant effect will not occur. The table below records those noise barriers that are to be removed on a temporary basis.

Table 2-13: Works to Existing Noise Barriers

Noise Barrier ID	Location	Length (m)	Height (m)	New/ Renewal/ Temporary Removal
ENB1	Earlswood on M42 between J3-J3a along dwellings on Juggins Lane	220	2	Temporary removal (anticipated to be 3-4 months)
ENB2	Kemp Green on M40 between J16-3 along dwelling within NIA7599	90	2	Temporary removal (anticipated to be 3-4 months)

Non-motorised user movements at junctions

2.4.8 There are no measures proposed to be delivered as part of the Proposed Scheme to reduce severance to walkers, cyclists or horse-riders. However, there is potential for the application of designated funds to discuss improving the access from a public bridleway at the northern side of the A3400 overbridge at J16 of the M40.

Ecological and landscape measures

2.4.9 Four proposed areas for landscape and ecological enhancement beyond the soft estate has 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 Design Fix 3. The proposed enhancement areas have been identified at:

- M40 motorway verges – creation of wildflower rich grassland to support the National Pollinator Strategy;
- Spring Brook – enhancement measures for otter and water vole could be provided at the bridge such as otter ledge or bank habitat improvement works;
- Windmill Naps Wood SSSI – provision of dormouse nest boxes in suitable vegetation within or near the highway boundary to link suitable habitats;
- River Blythe SSSI – bank and channel habitat enhancement measures for otter.

2.4.10 Opportunities have been identified within the scheme where the scheme design will endeavour to create 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 following measures have been identified and would be further developed as part of the detailed design process:

- 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 motorways pass, particularly adjacent woodlands, scrub, field boundary hedgerows and flight lines.
- 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.

- Solid barrier fencing or earth mounding may be considered at further design stages to improve or constrain views of the motorway.
- The following sections of environmental barriers have been identified to merit visual design/ planting to reduce visual impact:
  - Beggars Roost, Forshaw Heath Lane, M42 west-bound side, chainage 0+700 to 0+800;
  - Parkhomes and PRoW, M42 east-bound, chainage 1+050 to 1+125;
  - East Lodge, M40 west-bound, chainage 7+000 to 7+100; and
  - Lilac Cottage, Tinkers Lane, M42 south-bound, 0+450 to 0+550.

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 VRS in the central reservation with RCB with associated hardening of the reserve and any drainage, modifications.
- In lit areas replacement central reserve lighting columns will be installed on top of the RCB;
- Harden central reserve (where not already hardened) and install RCB in the central reserve;
- Resurface and/or strengthen the hard shoulder of both carriageways to provide a running lane with TWC/ low noise surfacing being used;
- Resurface lane 4 of both carriageways with TWC where RCB 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 ALR infrastructure with any associated earthworks or retaining systems including, PTZ CCTV mast, Radar MIDAS masts, EAV masts, chamber cluster and cabinets;
- Improve slip road arrangements;
- Install ROTTM 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 Area's footprint;
- Install 'remote', buried surface water attenuation and Pollution Control Devices (PCDs);
- Installation of environmental barriers within the verge;
- Install VRS in the verge to protect gantries and other apparatus;
- Install power supplies at the highway boundary; and
- Construction of no ALBs and associated signage, VRS, drainage and road markings.

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 site(s) 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 some months. This may be concurrent with a period of site clearance operations, prior to commencement of construction.

2.5.6 The location of the construction compound 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 Construction Environmental Management Plan 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 (c.6 ha) and several smaller section compounds (c.1 ha 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 While environmental surveys have been undertaken for candidate construction compounds, the location and results are commercially confidential prior to the Delivery Partner reaching agreement with landowners as to their selected compounds. These may or may not be the same as the candidate compounds. Consequently, the location and survey information is not reported in this EAR or within the Ecological Survey Report.

2.5.9 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.

2.5.10 Details of the approximate number of heavy goods vehicle (HGV's) 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

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

- A 1.5m 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 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.
- Working space requirements where new infrastructure is proposed, including gantries, Emergency Areas, retaining walls and electricity cabinet a clearance area would extend around each infrastructure site.
- Site clearance is also required associated with the construction of drainage features and the improvement of existing drainage.

2.5.12 An approximate total area of 70ha is to be cleared based on the site clearance boundary drawings, however it should be noted that these include the existing motorway footprint. An indicative plan of these areas is provided on Drawings HE551530-AMAR-HGN-SWI-DR-CH-000072 to 000081 with indicative temporary and permanent works footprints presented in

2.5.13 **Table 2-15**. At preliminary design, the works footprint is not known, and will be confirmed at detailed design and following appointment of a Delivery Partner. Based upon these assumptions, **Table 2-14** details the estimated vegetation clearance that would be required to construct and operate the proposed Scheme.

Table 2-14: Estimated vegetation clearance requirements

Land Use	Estimated Area of Vegetation Clearance (ha)
Ancient woodland	0.44
Deciduous woodland, plantation	7.11
Scrub	8.00
Waterbody	N/A
Grassland	1.02
Bare ground	N/A

2.5.14 Clearance works are not unlike the maintenance activity when managing landscaped area, with most of the greenery and branches being chipped on site and left on the verge slopes. Larger branches or trunks of trees are removed from site and taken to a timber yard of the Delivery Partners choice.

2.5.15 Detailed requirements for site clearance will be developed through PCF Stage 5 (Construction Peparation), 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.

Table 2-15: 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:2.5h to 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:2.0h. 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 20m long and 4m wide.	TBC at detailed design but assumed to be at most 5m from base dependent on location and distance to highway boundary	4m wide 20m long	TBC at detailed design but assumed to be at most 5m from base dependent on location and distance to highway boundary	4m wide, 20m long plus area of retaining wall/cut if required (tbc at detailed design)	TBC at detailed design but assumed to be at most 5m from base dependent on location and distance to highway boundary	4m long, 20m long plus area of regraded embankment, tbc at detailed design

Component	Assumption	At grade		Cutting		Embankment	
EA site	The permanent works footprint, excluding earthworks, of a typical EA site will be 100m long and 4.6m wide.	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	4.6m wide, 100m long.	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	4.6m wide, 100m long.	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	4.6m wide, 100m long.
CCTV sites	The permanent works footprint, excluding earthworks, of a typical CCTV site with associated cabinets will be 11.4m long and 2.4m wide.	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	2.4m wide, 11.4m long	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	2.4m wide, 11.4m long	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	2.4m wide, 11.4m 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 will be confirmed at detailed design. For planning purposes, it is assumed that the	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	61m wide, 5m long	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	61m wide, 5m long	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	61m wide, 5m long

Component	Assumption	At grade		Cutting		Embankment	
	launch pit and reception pit dimensions are identical.						
Longitudinal cables and ROTTM signs	A 4m wide 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 and ROTTM signs. The cables will be buried and so would have no permanent footprint. The permanent footprint, excluding earthworks, of each ROTTM signs is expected to be 8.1m long by 1.8m wide	4m wide across verge over entire scheme length.	1.8m wide, 8.1m long at ROTTMS only	4m wide across verge over entire scheme length.	1.8m wide, 8.1m long at ROTTMS only	4m wide across verge over entire scheme length.	1.8m wide, 8.1m long at ROTTMS only
MIDAS Side Fire Radar	The permanent works footprint, excluding earthworks, of a typical MIDAS Side Fire Radar site with associated cabinets will be 11.4m long and 2.4m wide.	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to	2.4m wide, 11.4m long	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to	2.4m wide, 11.4m long	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to	2.4m wide, 11.4m long

Component	Assumption	At grade		Cutting		Embankment	
		highway boundary.		highway boundary.		highway boundary.	
Electrical interface cabinet	The permanent works footprint, excluding earthworks, of a typical electrical interface cabinet site will be 0.9m long and 1.55m wide	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	1.55m wide, 0.9m long	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	1.55m wide, 0.9m long	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	1.55m wide, 0.9m long
A chamber	The permanent works footprint, excluding earthworks, of a standard A chamber will be 2.7m long and 2.3m wide	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	2.3m wide, 2.7m long	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	2.3m wide, 2.7m long	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to highway boundary.	2.3m wide, 2.7m 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 4.35m long and 2.3m wide	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to	2.3m wide, 4.35m long	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to	2.3m wide, 4.35m long	TBC at detailed design but assumed to be at most 5m in the verge dependent on distance to	2.3m wide, 4.35m long

Component	Assumption	At grade		Cutting		Embankment	
		highway boundary.		highway boundary.		highway boundary.	
Abnormal load bays	No abnormal load bays to be provided as part of the Scheme	n/a	n/a	n/a	n/a	n/a	n/a

Demolition and removals

2.5.16 The EIA Directive requires consideration of the demolition phase, where relevant. There is no requirement to demolish any bridges.

2.5.17 Those bridges unaffected by the proposals would typically have a residual design life of over 60 yars 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 project may cause 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.

2.5.18 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.

2.5.19 As part of the Proposed Scheme, lanes 1 and 4 would be resurfaced with the other lanes potentially being resurfaced where the residual life is less than 5 years. Within a 5 to 12-year period the current road surface would be replaced using conventional techniques.

2.5.20 Lighting columns have a 25-30-year design life with 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.

2.5.21 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 environmental barriers

2.5.22 It is anticipated that there is a requirement to temporarily remove existing noise barriers at 2 locations (see **Table 2-13**) 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 with the proposed environmental management requirements being documented in the Outline Environmental Management Plan. 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 had been minimised after consideration of alternative construction techniques;
- When and where temporary barriers would be used;
- The elevated level of stakeholder engagement that would be afforded to the affected residents.

2.5.23 The acoustic assessment detailed in chapter 8 are made on the basis that existing noise barriers are not in place during construction.

Retaining walls

2.5.24 The locations of proposed retaining walls are represented on Drawing HE551530-AMAR-HGN-ZZ-DR-CH-000001 to HE551530-AMAR-HGN-ZZ-DR-CH-000010. 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

2.5.25 It is currently not confirmed if any overbridges will require piling works to be undertaken. Where piling is required, a piling platform will be created and specialist rigs used to install the piles.

Gantry construction

2.5.26 Concrete foundations will be constructed using traditional methods for reinforced concrete: shuttering, scaffolding, reinforcement fixing and casting of concrete however, this will be confirmed at detailed design.

2.5.27 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

2.5.28 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.

2.5.29 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 stepped concrete barrier. This can achieve 200m to 300m per day. On this basis, whilst this is a large and potentially noisy operation, it is transient and should only affect any adjacent receptors for no more than a day.

Paving

2.5.30 The existing pavement will be planed out using large rotary planers, HGV's 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.

2.5.31 For those sections of concrete road surface, equipment is used to roughen the road surface (scabbling) generating high noise levels in the region of 100dBA while doing so (Ref 2.1). There are no areas of concrete surfacing along the scheme.

2.5.32 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. A single team of planer, lorries and pavers can complete 1 lane-km per shift. Road finishes and white lining will be undertaken in the same night shift as the paving operation.

Replacement planting

2.5.33 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.

2.5.34 As the soft estate is a stressful location, the species selected are therefore capable of surviving and so are also envisaged to be capable of surviving changing conditions induced by climate change.

Construction materials, recycling and waste

2.5.35 The re-use of existing materials will be explored further at detailed design stage. Minimisation of waste production will be the responsibility of the Delivery Partner and waste disposal will be undertaken in line with best practice and legal requirements. The waste hierarchy will be applied with reuse and recycling a priority with disposal of waste as a last option. The scheme will apply the relevant guidance such as Highways England Sustainable Development Strategy.

Construction traffic management

2.5.36 It is currently anticipated that the Proposed Scheme would be constructed mainly under a 50 mph enforceable variable speed limit with traffic management between M42 J3 and M40 J16, extending beyond the junctions to the scheme extent. A detailed TM strategy will be developed during DF4 to DF5.

2.5.37 Subject to safety and road alignment considerations, the 50mph limit may be locally increased to 60 mph. The existing 3 lane motorway capacity would be maintained during the daytime; reducing outside of peak periods.

2.5.38 It is envisaged that the works would be undertaken in phases under traffic management, with the first works being central reserve. This will be followed by verge works with vegetation clearance followed by off side verge works.

2.5.39 Some 30 estimated total carriageway closures could be required for the removal of existing gantries and the erection of the new superspan or cantilever gantries. Any night time closures will be determined by the delivery partner.

2.5.40 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.

2.5.41 During periods of overnight or weekend carriageway closures would involve the diversion of traffic which tends to be dominated by HGVs onto alternative routes. Each motorway has a defined series of Emergency Diversion Routes, which would be evaluated for their suitability for the planned diversion of motorway traffic during the scheme 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.

2.5.42 The location of sensitive receptors along the Emergency Diversion Routes are shown on Figure 8.4 as part of the noise chapter. In total 4617 residential receptors are located within 50m of the emergency routes. Details of carriageway and any motorway closures will be confirmed as part of the activities to prepare the Construction Environmental Management Plan at DF5.

2.5.43 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

2.5.44 At the time of writing, advanced construction of the Proposed Scheme is scheduled to commence in March 2020, with main works commencing in October 2022 and is expected to take approximately two years to construct, including commissioning.

2.5.45 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 area. 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.

2.5.46 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

2.5.47 All works on site and within the Contractor's construction compound(s) would be undertaken in compliance with a Construction Environmental Management Plan (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 Outline Environmental Management Plan (OEMP).

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

2.5.49 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.

Forecast Traffic Characteristics

Other transport schemes

2.5.50 Apart from the Proposed Scheme the following other Highways England schemes are anticipated to be delivered in accordance with the relevant Road Investment Strategy:

- Oldbury viaduct (planned completion Spring 2019)
- M42 J6 – capacity improvement works (Start 2020)
- M6 J2-J4 SMP Scheme (planned completion spring 2020)
- M42 J3 improvement works (due to comment April 2019 and be complete in October 2019)

2.5.51 The following non-Highways England schemes are expected to be delivered:

- High Speed 2 (HS2) works to commence in the Midlands/Birmingham area from 2019.

2.5.52 Traffic modelling for the Proposed Scheme has taken account of housing and employment developments at Langley, Browns Lane, Friargate, HS2 triangle, Sandhills Green, Land at Crabmill Lane Hollywood, Jaguar Land Rover Site, Fore Business Park, Blythe Valley Park, Land at Hampton Lane Solihull, The Green Business park, Box Tree farm, Kidpile Farm, Land at Ravenshaw Way, Land around Earlswood Station and housing at The Memorial Clubhouse and Grounds as part of the baseline forecasting for the SMP scheme.

Land use development proposals

2.5.53 Major development sites within 10km of the scheme have been captured through a review of the Local Planning Authority's Planning Register and other sources over the period August 2013 to January 2019 using the following criteria:

- Employment land (B1, B2 and B8 only): 3ha + within 1km of the scheme;
- Residential: 200 + dwellings within 1km of the scheme;
- Residential: 10+ number of dwellings within 300m of the scheme
- Major Minerals and Waste applications within 1km of the scheme;
- NSIPs within 1km; and
- Transport infrastructure projects within 1km (trunk roads or motorways only).

2.5.54 There are no proposals for residential development within 200m of the proposed scheme. The closest proposed site is at Blythe Valley Park and would be approximately 500m from the motorway carriageway. No proposals for industrial/commercial development were identified within 200m of the Proposed Scheme. These are discussed further in Ch 10 of the EAR and included in Appendix A.

2.5.55 A summary of these developments including those which have been included in the traffic model are included in **Table 2-16.** A consistent approach to traffic modelling is taken across all schemes such that those transport schemes and land use planning developments that are approved to proceed are given more weight that those that are at the proposals or at the plan/strategy stage.

Table 2-16: Summary of Developments

Development	Description	Included in the Traffic Model (Y/N)
Blythe Valley Development, Blythe Valley Park Planning application: PL/2016/00863/MAOOT	Hybrid planning application for a mixed use development of land at Blythe Valley Park to comprise: in outline with all matters reserved (save for the new access, internal spine road and elements of landscaping - as described below), up to 750 residential dwellings, up to 98,850sqm of Use Class B1, B2 and B8 floor space, up to 250 unit housing with care facility (Use Class C2/C3) up to 2,500sqm of ancillary town centre uses (Use Class A1-A5), up to 1000sqm of ancillary leisure and community uses (Use Class D2), up to 200 bed hotel (Use Class C1) associated car parking (including shared car parking which could be decked) public open space, public realm and highways works; in full, new vehicular access, internal spine road, soft and hard landscaping (in part) SUDS and balancing ponds.	Yes – Residential uses only
Land Adjacent to J4 M42, Box Tree Farm, Stratford Road, Hockley Heath, Solihull Planning application: PL/2016/02754/MAJFOT	Development of new motorway service area, associated highway improvement works and other associated infrastructure. Land Adjacent J4 M42 Box Tree Farm Stratford Road Hockley Heath Solihull	Y
Land at Fore Business Park, Huskisson Way, Shirley, Solihull Planning application: PL/2017/01594/MAJFOT	Hybrid planning application for employment development at Fore Business Park to comprise a) in full: Erection of two office buildings (Use Class B1) with ancillary automotive training and testing facility, security gatehouse, access road, car parking, landscaping and associated work; and b) in outline, with all matters reserved: up to 10,930 square metres (GIA) of office floor space.	Y
Land at Fore Business Park, Huskisson Way, Shirley, Solihull	Reserved matters application pursuant to outline planning permission	Y

Development	Description	Included in the Traffic Model (Y/N)
Planning application: PL/2018/01988/PPRM	PL/2018/01336/VAR for the erection of an office building incorporating research and development labs (Use Class B1) with associated internal access road, service yard, car parking (including a decked car park), landscaping and all other details required by condition 35 relating to the reserved matters of access, appearance, landscaping, layout and scale.	

Traffic modelling

2.5.56 The traffic modelling has been relied upon a base year of 2015 and has employed the Midlands Regional Traffic Model (MRTM) to derive forecasts for the opening year (2022) and design year (2037) for situations with and without the Proposed Scheme.

Reliability of Traffic Model

2.5.57 The Traffic Reliability Area has been defined according to the expected area of influence of the scheme and incorporating where possible environmental considerations such as Air Quality Monitoring Areas or Noise Important Areas; however, the area is restricted by the calibration and validation links in the model. Consequently, the TRA has been defined predominantly on the SRN, and excludes the majority of the more urban areas where available count data was sparse. The AQMAs in the Birmingham, Dudley, Sandwell and Coventry districts, as well as the PCM links in towns such as Redditch and Warwick, are therefore not covered in the Traffic Reliability Area.

Affected Road Network

2.5.58 The Affected Road Networks (ARNs) for the opening and design year for the scheme are presented in Figures 2-5 and 2-6. These reveal a predicted increase in flows and/or speeds in 2022 in the area around M42 J3a, stretching north to M42 J7, east to M40 J16, and west to the M5 and to M5 J7. In 2037, changes affect a wider area, including the M6 between J2 and J4, and the length of the M42/A42 as far north as its intersection with the M1. Some decreases in flow are forecast on the north and west sides of the Birmingham Box, as some traffic re-routes to take advantage of the increased capacity at M42 J3a.

2.5.59 The Proposed Scheme is envisaged to generate an increase in traffic of up to 15% through M42 J3a (particularly approaching from J3 to the west), while there will be corresponding reductions on local parallel routes such as the A34 leading to the B4102 through Earlswood and Rumbush Lane through Dickens Heath compared to the 'do minimum' scenario. The increase in AADT is expected due to the increased capacity at the junction relieving the anticipated congestion in future years, thus allowing an increased flow through the junction and attracting additional traffic from parallel routes.

2.5.60 The scheme is forecast to have a small impact on traffic routing throughout the urban area, however the percentage of HGVs is not envisaged to change significantly from at present, with reductions in the surrounding urban network adjacent to the scheme of around 1%. The net impact is that through the junction HGV traffic is expected to increase approximately in line with other vehicle classes, for the reasons outlined above.

2.5.61 There are 17 links along the motorway are forecast to experience an increase in traffic volume in the region of 20% in either 2022 or 2037 (or both).These links are at the following locations:

- On the M42 northbound:

- Through J3a (3 links);
- The J4 diverge;
- Through J4;
- The J4 merge (2 links);
- Between J4 and J5;
- The J5 diverge; and
- The J6 diverge.

- Other motorway links:
  - M5 J4a NB merge; and
  - M40 SB merge from M42 SB at M42 J3a

2.5.62 In terms of a change in movements at junctions, the following junctions involve an increase in excess of 10% in the ADDT flows:

- This information will be provided once updated traffic data is available as part of on-going BCR commission

Figure 2-5: Opening Year (2022) Affected Road Network

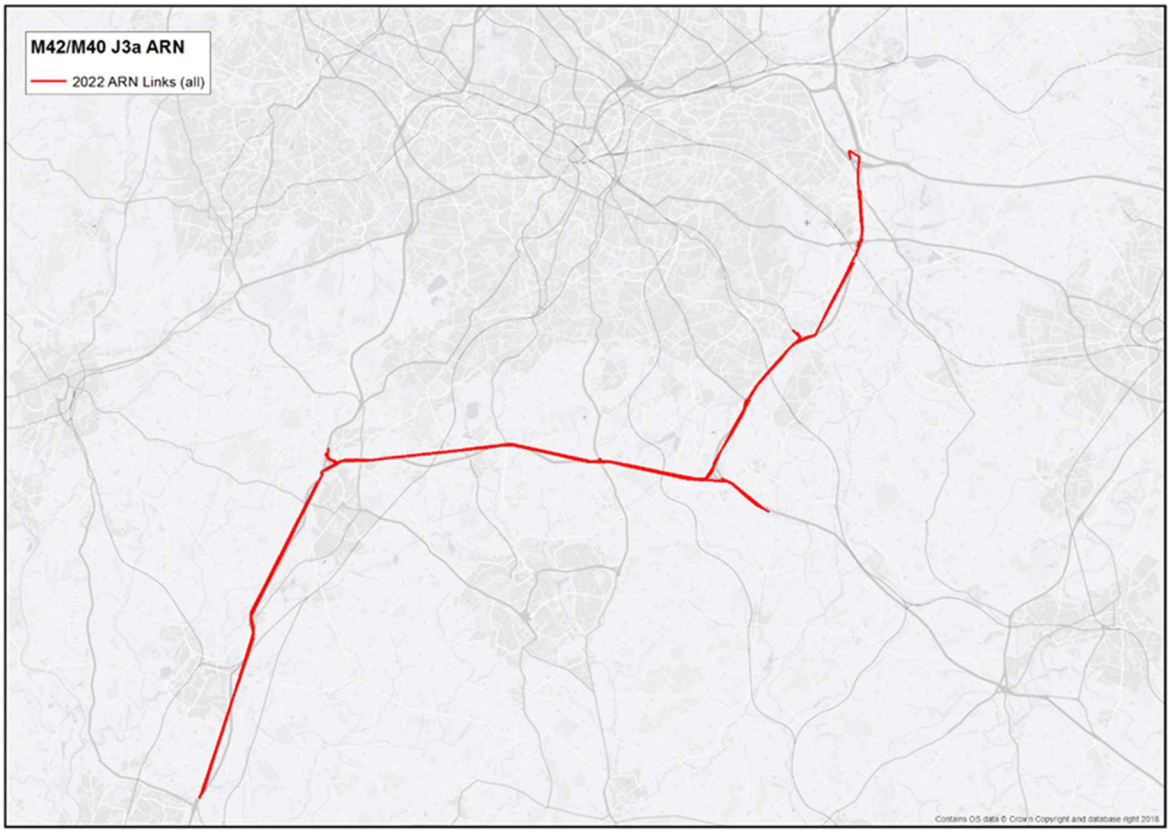
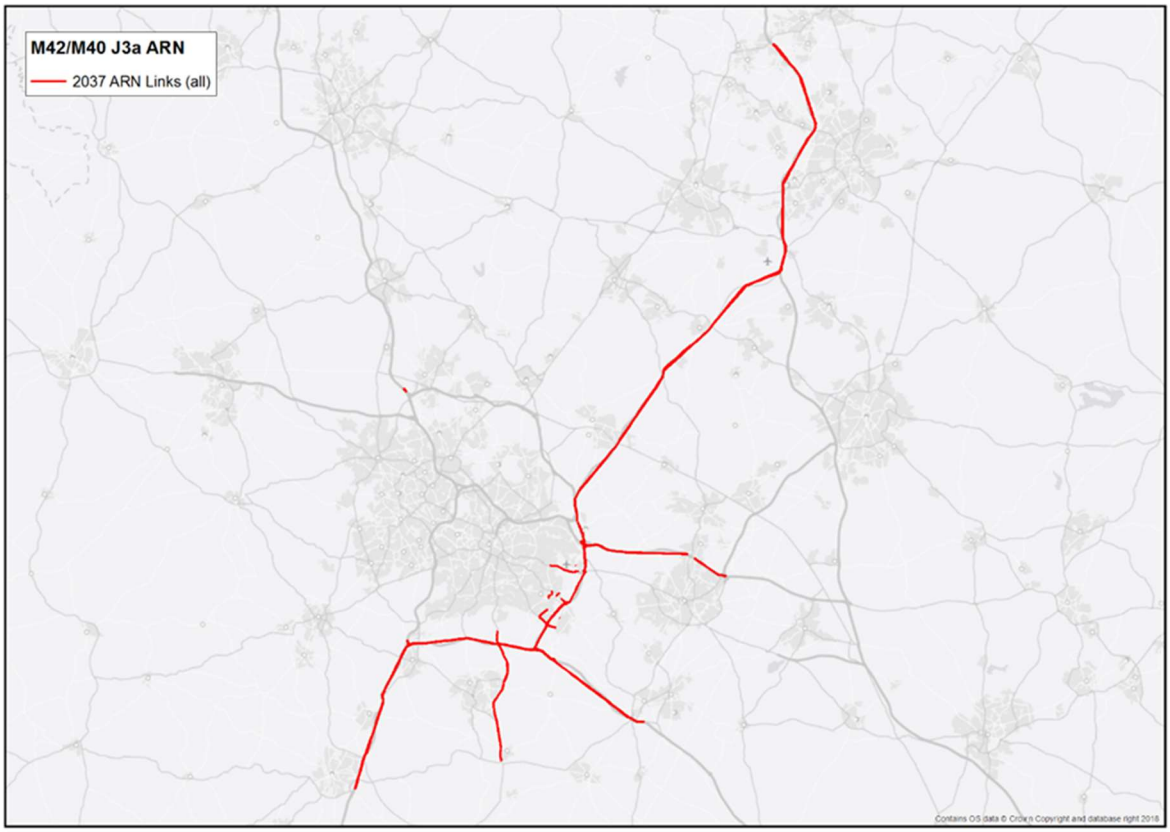


Figure 2-6: Design Year (2037) Affected Road Network



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 Dynamic Hard Shoulder (DHS) design guidance developed by the Highways Agency, 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 IAN 161/15.

3.2 Scheme Specific Alternatives

3.2.1 As the 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 One EA (M42 EA EB3) and two gantries (G-M42-04A and G-M42-06A) locations proposed in the DF1 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 A summary of significant changes to the Proposed Scheme between DF1 and DF3 are summarised below**.**

Table 3-1: Principal Design Changes between DF1 to DF3

Marker Post (approx.)	Scheme Link	Details	Reason
	M42 J3 to M42 J3a	EA on M42 eastbound relocated closer to Tithe Barn Lane overbridge	Safety and visibility approaching interchange
	M42 J3A – M40 J16	Gantry relocated G-M42-04A	Design standards compliance
	M42 J3A – M40 J16	Gantry relocated G-M42-06A	Design standards compliance

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 impacts and the project characteristics.

4.2.2 A screening checklist adapted from IAN 125/15 - Environmental Assessment Update (Annex B) reorded that it was considered unlikely that significant environmental impacts would result from the Proposed Scheme (Ref 4.1). However, there was some uncertainty because of level of information available at that time and further scoping and desk study was required, to ensure impacts could be avoided or managed to below significant levels.

4.2.3 A Scoping exercise for the Proposed Scheme was undertaken in line with established guidance (Ref 4.2). This report concluded that there were unlikely to be significant environmental effects (Ref 4.3). 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 are detailed in **Table 4-1** .

Table 4-1: Scoping conclusions

Topic	Scoped in / out of EAR		Environmental Management Plan
	Construction	Operation	
Air quality	Out	In	In
Noise and vibration	In	In	In
Biodiversity	In	In	In
Cultural heritage	Out	In	In
Landscape character	Out	Out	Out
Landscape and visual effects	In	In	In
Road drainage and the water environment	In	In	In
Geology and soils	Out	Out	Out
Materials & waste	Out	Out	Out
Population and health	Out	Out	Out
Cumulative environmental effects	In	In	Out
Climate change	Out	Out	Out
Major accidents & disasters	Out	Out	Out

Topic	Scoped in / out of EAR		Environmental Management Plan
	Construction	Operation	
Heat and radiation	Out	Out	Out.
Demolition	Out	Out	Out
Land take	Out	Out	Out.

4.2.4 For the purpose of this EAR, the assessment of the proposed scheme has been undertaken on DF3. Topics scoped into the EAR have been subject to further assessment, the result of which is described in Chapters 5 to 9 of this report. The cultural heritage assessment of operational effects will be assessed and reported within Chapter 7: Landscape, visual and cultural heritage effects since the potential for change 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 although this is not the case for this Proposed Scheme.

4.2.5 Topics scoped out are excluded from further environmental assessment, although they have been considered to determine whether the Environmental Management Plan needs to include measures to ensure the absence of significant impacts. The reasoning behind the decision to scope topics out is outlined below by topic and described in the Scoping Report.

4.2.6 Due to progression of the scheme design and field based surveys, the scoping decisions have been re-confirmed within this EAR with some resulting changes to the scope of this EAR. The following text provides justification.

Air quality – construction impacts

4.2.7 In principle there is the potential for effects on receptors within 200m of construction sites and haulage routes associated with the Proposed Scheme. In practice construction impacts have been scoped out of the EAR, as any effects would be temporary, and under appropriate standard EMP mitigation measures it is considered likely that there would be no significant effects on air quality during the construction phase. On that basis, assessment of construction was scoped out of further assessment.

4.2.8 Diversion routes used during construction are only used infrequently and certainly less than a period of a continuous six months, thus traffic management measures (diversion) and the effect of the additional construction vehicles do not require assessment (Ref 4.1).

Cultural heritage

4.2.9 In terms of construction impacts, the Proposed Scheme is limited to the physical extent of existing highways boundaries. This area would have been topsoil stripped during the construction phase and, as a result, any archaeological remains would have been removed or truncated. Hence there are not expected to be any impacts on buried archaeological remains within the existing road corridor.

4.2.10 Construction activity would be localised and limited to the existing road corridor. As a result, no significant impact on the setting of any heritage assets is predicted as a result of the Proposed Scheme.

4.2.11 There is the potential for impacts from compounds set up on buried archaeological remains, however, mitigation through archaeological recording or use of non-invasive construction methods could reduce any potential impact. Hence measures are included within the OEMP to cover the unlikely event of discovery of unknown archaeological remains during the construction phase

4.2.12 In terms of operation, the current motorway section features existing overbridge structures and signage. The introduction of new gantries and signage is unlikely to have a significant effect on

the setting of listed buildings which are set back from the road and are screened by existing mature vegetation beyond the highway boundary.

4.2.13 Experience from SMP schemes is that they do not give rise to a perceptible increase in operational noise and so it is unlikely that the acoustic setting of historic assets would be adversely affected. Nevertheless, during construction there may be short periods while noise levels are elevated. Should such potential instances be identified then appropriate management responses would be specified in the OEMP such that no significant effects would arise.

4.2.14 An assessment of the operational effects upon the setting of designated cultural heritage assets is provided in Chapter 7 Landscape and Visual Effects.

Landscape Character

4.2.15 An assessment of construction and operational effects on landscape character was scoped in although construction activities would be localised and limited to the existing motorway corridor.

Road Drainage and the Aquatic Environment

4.2.16 In considering the implications of the Proposed Scheme upon water quality, the ecological status of local watercourses, groundwater conditions, surface and groundwater abstractions have been scoped out. Impacts on water quality from motorway drainage outfalls and culverts and flood risk have been scoped in. The following justifications are provided:

- Given the type of construction works, standard pollution prevention measures and best practice will be employed during construction, as detailed in the OEMP and the Construction Environmental Management Plan (CEMP) result in a low likelihood of a significant effect.

4.2.17 to traffic flow were conservatively estimated in excess of 20% on two of the road links with outfalls (J3a to J4 and M40 SB merge from M42 SB at M42 J3a) in the Do-Something scenario. A simple DMRB assessment was carried out to assess the impact on outfalls. The assessment concluded that the scheme would not result in an increased risk of water quality deterioration on receiving watercourses.

4.2.18 Temporary construction works within the floodplain of local watercourses is anticipated, as items of key infrastructure are proposed within the flood zones of local watercourses. As a result, relevant management measures are included in the OEMP to ensure no adverse effect on flood risk.

4.2.19 Retaining structures will need to be built-out within flood zones to accommodate additional infrastructure but encroachment will be minimised by over steeping the embankments within the soft estate to minimise flood risk.

4.2.20 In the event current drainage capacity is lost it will be replaced.

4.2.21 Drainage improvements are provided in accordance with Interim Advice Note 161/15 such that discharges will be at existing established rates (up to the 1:100-year rainfall event). Hence additional drainage capacity will be provided within the piped network to account for the small increase in impermeable area.

4.2.22 There are no surface water abstraction located within the scheme, therefore abstraction issues are scoped out of the assessment.

4.2.23 Records indicate groundwater Source Protection Zones are not located within study area. Where records indicate that groundwater is located beneath the motorway then these areas (none in the study area) would be interrogated to confirm whether they either require protection or are susceptible to groundwater flooding. This will inform the potential for either infiltration or sealed drainage systems. The Proposed Scheme is designed, and will be managed through the OEMP, to ensure water volumes or pollutants do not increase at any existing outfalls.

4.2.24 Works, which are to be confirmed during detailed design, would be undertaken to improve 3 priority A outfall to contribute to the objectives of the Water Framework Directive. A further 2

outfalls are classified as of Not Determined status. Both are on a watercourse targeted for water quality improvement. Opportunities to provide water quality betterment and enhancement will be investigated at detailed design. It is anticipated that these will be located immediately downstream of outfalls when space and situation allow. Implementation of such measures will be considered alongside drainage design.

Geology and Soils

4.2.25 Regarding soils, geology and contamination, ground disturbance within the highway boundary will have already occurred during construction of the motorway. Furthermore, the Proposed Scheme lies within the existing highway boundary, as such, there are not expected to be any significant effects on surrounding land use, land value or soil.

4.2.26 The motorway is constructed on predominantly made ground associated with current and former road surfaces and supporting layers of imported and man-made materials. While there is potential for contaminated materials from use and maintenance of the motorway, such quantities will be small in relation to capacity of appropriate disposal sites such that no significant impact is expected. There is however the possibility that geotechnical investigations might identify substantive areas of existing contamination where measures would be required to ensure that no pathways for contamination were created. It is nevertheless unlikely that a significant impact would result given the controls available via the design and the OEMP.

4.2.27 The location of construction site compounds is unknown at the time of writing. Should construction site compounds, or construction activities, be located outside of the highways boundary mitigation of adverse impacts of such siting should be considered through good construction practices as recorded in the OEMP.

4.2.28 The topic of soils and geology has been scoped out of further assessment as no significant effects upon mineral extraction, productive soils, land contamination or waste disposal are envisaged.

Materials and Waste

Construction materials

4.2.29 The Proposed Scheme may require land beyond the highway boundary but will not sterilise mineral resources. Further, the scheme does not involve the removal of peat from within its soft estate.

4.2.30 A decision on whether to scope in material resources to the assessment has been based on the following:

- **Slight significance:**
  - Less than 50% of primary materials are sourced from outside the region;
  - Aggregates imported to site comprise re-used/recycled content above the relevant regional percentage target;
- **Moderate significance:**
  - More than 50% of primary materials are sourced from outside the region;
  - Aggregates imported to site comprise re-used/recycled content below the relevant regional percentage target;
- **Large significance:**
  - More than 50% of primary materials are sourced from outside the country;
  - Aggregates imported to site do not comprise re-used/recycled content;
  - Project sterilises ≥1 mineral safeguarding site and/or peat resource.

4.2.31 The regional recycled aggregate content target for the Midlands region is 25% for the period up to 2020. In the absence of targets for construction in later years, no change in the target has been assumed.

4.2.32 At this stage the quantities required to construct the scheme are unconfirmed, however it is antcipated that this would be no more than is necessary to provide for 6 EAs, resurfacing of lanes

1 and 4, 26 new gantries, two new power supply points, 68 retaining walls and associated earthworks, line painting and vehicle restraint barriers.

4.2.33 Materials would be sourced from existing quarries, batching plants or factories for which separate planning consent would be in place.

4.2.34 There is a reasonable likelihood that it would deploy re-used or recycled aggregate and thus no sigificant effect on materials is considered to arise.

4.2.35 The movement of materials from their origin to the Proposed Scheme would be mainly via the motorway network and the strategic road network. Some materials may be sourced from local rail served depots. The volume of movements associated with the Proposed Scheme construction would be a small proportion of HGV movements on the motorway network.

Waste

4.2.36 The amount of waste generated by the proposed SMP scheme is currently unknown, however it may be several hundred tonnes. Given that there is approximately 88 million tonnes waste disposal storage within the neighbouring waste authority areas (West Midlands Regional Waste Planning Strategy), the significance of the Proposed Scheme on waste storage infrastructure would be slight.

People and Communities

4.2.37 A review of non-motorised user routes has identified no existing routes through junctions that could be potentially affected by severance at the motorway junctions and hence this aspect is scoped out.

4.2.38 As non-motorised users potentially pass through M40 Junction 16, there may be merits in enhancing safety by improving sightlines, but no adverse significant effects are anticipated.

Population and Health

4.2.39 As the Proposed Scheme does not give rise to significant adverse operational effects upon noise or air quality, 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 are 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.

4.2.40 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. Designs are to ensure vegetation clearance is to be mindful of the local community.

4.2.41 The SMP 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. The Scheme Description records measures (if any) to be undertaken at junctions to improve safety and potentially reduce severance.

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

4.2.43 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 baseline health profile of wards neighbouring the scheme whose population is in of itself dynamic, is subject to many uncertainties and prevents a meaningful assessment at the opening year or at the design year.

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

Climate Change

4.2.45 Assessment and reporting of GHG emissions associated with a project is considered in the following stages:

- Construction (of the scheme): i.e. material supply, transport, manufacturing and construction process.
- Operation:
  Road user carbon - use of the asset or vehicle emissions; and
  Maintenance - emissions associated with maintenance/refurbishment
- Opportunities to minimise production/use of GHG emissions i.e. the potential for GHG reduction of emissions through reuse and recycling during the construction of the scheme.

Effects on climate

4.2.46 An SMP scheme typically gives rise to an increase in traffic in order of 10-20%, however the change in greenhouse gas emissions is influenced by the extent to which existing traffic adopts the SMP route in preference to others that may involve a longer distance or slower speed in addition to any induced traffic. The greenhouse gas emissions are thus a consequence of the overall change across the affected road network. Further details can be found in the Scoping Report.

4.2.47 Carbon emissions associated with a SMP scheme are dominated by the vehicles using the motorway rather than the embodied carbon associated with scheme construction and maintenance (see **Table 4.2**).

Table 4.2 Carbon emissions

Project Stage	Estimated total Carbon (Carbon Budget (tCO_2e) With Scheme	Net CO_2 Scheme Emissions (tCO_2e) Without Scheme	Relevant Carbon Budget period		
			2018 - 2022	2023 - 2027	2028 -2032
Construction	TBC at detailed design*	TBC at detailed design*	-	-	-
Operation	800805.5	781966.6	26560.3	138113.5	-
Total			Limit value: 55,000,000 carbon units	Limit value: 1,950Mt CO2e	Limit value: 1,725MtCO2e

* at this stage, without a detailed design or delivery partner on board, there is limited information on construction methods or the plant likely to be used. It is therefore not possible to provide an estimate of construction carbon emissions at this stage.

Weather conditions

4.2.48 The Proposed Scheme and the nearest Met Office Weather Station (Birmingham Airport) are located within the UK Climate Projections' UK region (UK climate projections, UKCP 2018). Predictions from the UKCP18 for a 2oC warming include:

- a gradual warming, with a move towards warmer, wetter winters and hotter, drier summers;
- The largest warming in the UK will be in the South East where summer temperatures may increase another 3-4oC relative to present day;
- Median warming will be at least 1-2oC throughout the year across the whole of the UK;
- winter cool days will warm by 1-1.5oC across the country, while in summer, both hot and cool days will warm by 1-1.5oC across Scotland and 1.5-2oC in England;
- rainfall changes are uncertain, but suggest slightly wetter winters and drier changes, with dry days in summer having 30% less precipitation in parts of the south west.

4.2.49 Vulnerability of the project to climate change

4.2.50 It is predicted that climate change will increase the frequency and severity of some types of extreme weather events in England. The Scoping Report documents UK Climate Projections (2009) generally show that warmer, drier summers are more likely along with warmer, wetter winters (Ref 4.4).

4.2.51 The historic climatic conditions insofar as awareness of flooding of carriageways are considered during the design of the drainage regime for the Proposed Scheme which also makes a 20% allowance for climate change for the additional impermeable area in the attenuation capacity of the drainage system.

4.2.52 Given the limited nature of the works associated with SMP schemes, the implications of increasing temperatures and rainfall intensity are matters for those responsible for maintenance of the motorway.

4.2.53 Vegetation stress due to drought conditions is anticipated to be a risk to SMP schemes given the reduced width of soft estate, steepened slopes and potential damage to root systems. Adding in the effect of increased wind velocities due to climate change, it is feasible that increasing

loss/damage to trees could occur. As the motorway soft estate is a stressful location for trees, species are selected that can withstand such conditions. As a consequence, it is considered that they are well able to accommodate climate change.

4.2.54 Greater wind speeds may increase the risk to high sided vehicles when passing through exposed parts of the motorway. Along with vegetation clearance and climate change, there are no locations along the scheme that would increase the risk from existing conditions.

4.2.55 The likelihood of the event is considered to be low risk and would typically cause less than 1 day's disruption to an individual section of the strategic road network and is thus of negligible significance.

4.2.56 Awareness of these areas of risk enable better management on SMP schemes given the ability to provide advanced warning to drivers.

4.2.57 Existing construction management practices, such as avoidance of storing construction materials in floodplains and dampening of soils and stockpiles are included in the OEMP. For the above reasons climate change has been scoped out.

Major Accidents and Disasters

4.2.58 SMP schemes like any major transport corridor are considered to be potentially vulnerable to the major man-made events such as road, aviation, industrial accidents, and terrorist incidents. In terms of natural hazards – those of relevance to a motorway relate to extreme adverse weather leading to unsafe driving conditions. Such events may lead to the spillage of fuel or other hazardous materials.

4.2.59 For both man-made and natural major accidents, the incremental environmental risk is associated with a SMP scheme could be associated with water quality.

4.2.60 Given the low probability of a significant impact arising from a low probability major event, no measures are proposed to deal with major accidents or disasters and thus they are scoped out of the assessment. Indeed, the very nature of an SMP scheme with the elevated level of motorway surveillance would mean that the response time to any such incidence would be enhanced.

4.2.61 The Proposed Scheme has been designed to address safety considerations and will deliver an elevated level of motorway surveillance and signals capable of managing flow, speed and access which would mean that the response time to any such incidence would be enhanced. Additionally, it also makes provision for pollution control devices to contain and manage accidental spillages. Major accident events are therefore scoped out of the assessment.

Demolition

4.2.62 Section 2.5 sets out the type of demolition and removal operations for the Proposed Scheme. Based on the works, it is not envisaged that demolition/removal operations would give rise to significant impacts that would be not controlled via the Construction Environmental Management Plan as part of the OEMP and hence demolition impacts have been scoped out of the assessment.

Heat and Radiation

4.2.63 The Proposed Scheme is a major highways improvement project as described in Section 2 and due to its scale and nature, there will be not be any significant sources of heat or radiation either during construction or operation of the road. The consideration of heat and radiation emissions has therefore been scoped out of the assessment.

Land Take Effects

4.2.64 All works are to be undertaken within the soft estate under permitted development rights. The provision of construction compounds would be delivered under permitted development rights with candidate sites being subject to a high level assessment. During the process of selecting

construction compound sites the Delivery Partner would establish whether adverse effects are likely and detail management measures within the CEMP.

Monitoring

4.2.65 The environmental assessment of SMP schemes that are delivered without recourse to the 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 'Outline Environment Management Plan' (OEMP) are intended to avoid significant adverse effects.

4.2.66 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 will identify any locations where monitoring of the mitigation measure and/or its effectiveness is required, following the completion of the ecology surveys.

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 (Ref 4.5)

Study areas

4.3.2 The individual study areas for each environmental topic are defined in chapters 5 to 9. 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 chapter.

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 as set out in sections of this report prior to the opening of the scheme.

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 Section 2.6 identifies land use and development proposals that are proposed, but not necessarily consented. Major development sites within 1km of the scheme have been captured through a review of the Local Planning Authority's Planning Register and other sources over the period August 2013 to January 2019 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).

4.3.6 Details of other infrastructure projects have been identified and captured in the Transport Modelling Uncertainty Log.

4.3.7 Where such development has the potential to generate additional traffic requiring consideration within the traffic model for the scheme then it has been captured within an uncertainty log that reflects the likelihood of the development proceeding.

4.3.8 In addition to development proposals within consenting processes, 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 and updated up to January 2019. Major development sites such as sustainable urban extensions are then captured in the transport modelling uncertainty log.

4.3.9 Development proposals with consent and located within 300m of the scheme have been considered to determine whether they would either introduce new receptors for visual, air quality or noise. 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 Chapter 10 and Figure 1 in Appendix A.

4.3.10 Beyond the potential for change in land use, other 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 or assessment year.

4.3.11 The 'future baseline' i.e. changes that would occur in the absence of the Scheme have been identified in Chapter 5-9 providing consideration of trends as appropriate.

Impact Avoidance and Mitigation

4.3.12 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 scheme design along with those aspects where design rule prevents a preferred environmental location from being selected are presented in section 2.4.

4.3.13 An Outline EMP (OEMP) has been produced as part of the Environmental Assessment. The OEMP sets mitigation and enhancement measures to be delivered during the construction and/or operation of the Proposed Scheme. The structure of the Outline EMP follows IAN 183/14.

Assessment of Effects

4.3.14 Policy and guidance relevant to each specific environmental topic are identified within the following topic Chapters of this EAR.

4.3.15 In accordance with the DMRB, the assessment focusses 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.

Traffic Forecasting

4.3.16 The Appraisal Summary 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 ARN only (worst case of Opening or Design Year) and within 200m of ARN. In addition, those links outside the Traffic Model Reliability area (TRA) are not assessed.

4.3.17 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 on the basis of average speed links inclusive of junction delay.

4.3.18 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.

4.3.19 A base year of 2015 traffic model has been used for the environmental assessments.

4.3.20 Calculation of 18 hr 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

4.3.21 The significance of the identified environmental impacts score is determined by considering the changes with and without construction and operation of the Proposed Scheme. Volume 11 Section 2, Part 5 of the DMRB (specifically Tables 2.1 and 2.2) provides advice on typical descriptors of environmental value, magnitude of change 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.

4.3.22 Within the EAR certain impacts would be avoided as a result of management actions undertaken prior and during construction. Such commitments and actions are documented in the Outline Environmental Management Plan (OEMP) (Document ref HE551530-AMAR-EGN-SWI-RP-YE-000002) with sufficient spatial precision to be delivered by the organisation constructing the Proposed Scheme. The OEMP would also clearly identify the structures and processes that would be used to manage and control these aspects. Such actions also form part of the Works Instructions as necessary.

4.3.23 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 effect, 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 Scheme Design (Chapter 4) and OEMP.

4.3.24 Further details of the topic specific significance criteria used in this EAR are discussed in chapters 5-9.

Cumulative and Human Health Effects

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

- Type 1 – 'Interrelated' effects from interactions of a single project, upon individual receptors (e.g. changes in noise levels together with visual effects at a single receptor); and
- Type 2 - Cumulative effects from different projects, described in Section 2.6 and discussed in Chapter 10, in combination with the project being assessed.

Assumptions and Risks

4.3.26 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, but such changes will be assessed to ensure that no significant effects result.

4.3.27 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 was 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.

4.3.28 Topic specific assumptions and limitations are identified in Chapters 5-9.

5. Quality

- The impact of the Proposed Scheme on air quality was predicted to be imperceptible and would not result in a delay to compliance.
- There are two Air Quality Management Areas (AQMAs) within 200m of the Affected Road Network (ARN). The highest predicted annual mean nitrogen dioxide (NO2) concentration in the 2022 DS scenario in the Lickey End AQMA was 36.2µg/m3, with a change of 0.3µg/m3 compared with the DM scenario. The highest predicted annual mean NO2 concentration in the 2022 DS scenario in the Worcester Road, Wychbold AQMA was 30.1µg/m3, with a change of 0.2µg/m3 compared with the DM scenario.
- Nine receptors were predicted to experience a deterioration in air quality, however, these are not at locations which are already above the Air Quality Objective in the 2022 do-minimum scenario and were not predicted to result in the creation of a new exceedance.
- Three receptors were predicted to experience an improvement in air quality. These are not at locations which are already above the Air Quality Objective in the 2022 do-minimum scenario and the improvement would result in concentrations further below the Air Quality Objective.
- Receptors at Coleshill and Bannerly Pools Site of Special Scientific Interest (SSSI) and Windmill Naps Wood SSSI were not predicted to breach acceptable nitrogen deposition rates.
- The maximum annual mean nitrogen dioxide (NO2) concentration in the opening year (2022) was predicted to be 39.0µg/m3, at receptor H49, located on Warwick Road near the M42.
- No adverse effects on any of the PCM links which intersect the ARN was predicted as a result of the Proposed Scheme.

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 and does include impacts from other consented Highways England schemes, Appendix B.1 (Section 2.1.4) provides details of other schemes included in the traffic data provided.

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 (NO2) 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 (NOx), carbon dioxide (CO2) and particulate matter.

5.1.5 The scope of the assessment is in line with that set out in the Environmental Scoping Report, consequently construction impacts were scoped out as they are highly localised and temporary.

5.1.6 This chapter is supported by:

- Appendix B.1 – Air quality assessment strategy and methodology paper
- Appendix B.2 – Air quality technical note on progressing without updated traffic data;
- Appendix B.3 – Legislation, Policy and Guidance;
- Appendix B.4 – Baseline;
- Appendix B.5 – Operational Methodology;
- Appendix B.6 – Model Verification; and
- Appendix B.7 – Assessment of Impact.

5.1.7 The following figures also support this chapter.

- Figure 5.1 - Affected Road Network;
- Figure 5.2 -Constraints Maps;
- Figure 5.3 - Air Quality Monitoring Sites;
- Figure 5.4 - Ecological Receptors;
- Figure 5.5 - Verification;
- Figure 5.6 - Air Quality Management Areas
- Figure 5.7 - Compliance Risk Road Network;
- Figure 5.8 - Do Something Results; and
- Figure 5.9 - Discussion Regions.

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

Professional Competency Air Quality

Name	Grade and Company	Expertise and Professional Qualification
Christine McHugh	Associate Director, Arup	The Air Quality Lead expert is an Associate Director and is Arup's UK lead on air quality, has an MA and PhD in Engineering from the University of Cambridge and is a Member of the Institution of Environmental Sciences, a Member of the Institute of Air Quality Management, and an Associate Member of the Institute of Acoustics. She has previously been involved in other SMP and highways schemes including M1 J13-16, M25 and A30 and on road schemes following the DMRB methodology including the New Tees Crossing and A66 schemes. In these jobs she has been technical lead involved in technical reviews and providing guidance

5.2 Scoping

5.2.1. This assessment has been undertaken in accordance with the conclusions of the Environmental Scoping Report (ESR) (Ref 5.1) , however, the following additional considerations have been brought into the assessment:

- A series of assumptions have been made to calculate the worst case emission factors based on two sets of traffic data that were provided. Details can be found in Appendix B.1, B.2 and B.4;
- The regional affected road network (ARN) has been calculated using the local ARN. This was because the size of the regional ARN was smaller than the local ARN; and
- Background has been calculated by removing “in square” and “out square” motorway road contributions only as most of the A and B roads have not been modelled.

5.2.2. The basis for scoping out an assessment of air quality effects associated with the occasional diversion of motorway traffic and construction activities has been confirmed particularly as management clauses are provided in the Outline Environmental Management Plan (OEMP) (Ref 5.2) .

5.3 Methodology

5.3.1. This section summarises the following:

- Study area;
- Legislation, policy and guidance;
- Operational air quality scenarios;
- Baseline information and data sources;
- Constraints mapping;
- Traffic data;
- Local air quality assessment;
- Verification;
- Regional air quality assessment;
- Receptors;
- Magnitude of impacts;
- Significance of effects;
- Stakeholder engagement; and
- Assumptions and limitations

5.3.2. A detailed review of the air quality assessment strategy and methodology is available in **Appendix B.1**. The assumptions made to proceed with the assessment without updated traffic data are detailed in Appendix B.2.

Study Area

5.3.3. The air quality assessment presented for the Proposed Scheme was a study area of the roads affected, the Affected Road Network (ARN), and is illustrated in **Figure 5.1**. The extent of the ARN was defined using traffic data provided by the traffic consultants, and is shown on Figure 5.1. It covers the following areas:

- M40 Junction 16 to M40/M42 Junction 3a;
- M42 Junction 1 to 7a; and
- M5 Junction 4 to 6.

5.3.4. The air quality study area has been determined in accordance with traffic change criteria set out in the DMRB Volume 11, Section 3, Part 1 (HA207/07) which defines the ARN for local (paragraph 3.12) air quality assessments (Ref 5.3). Having confirmed with the TMT there were no valid roads within the traffic model but outside of the TRA that exceeded the DMRB traffic change criteria.

5.3.5. The ARN 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 following traffic change criteria (based on the two-way flow on all roads):

- Road alignment will change by 5 metres (m) or more;
- 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;
- Daily average speed will change by 10 kilometres per hour (km/hr) or more; and/or
- Peak hour speed will change by 20 km/hr or more.

5.3.6. The air quality study area has been defined, based on the local ARN screening criteria, and those links which have relevant receptors within 200m of either side of road carriageways (Ref 5.4). The assessment is undertaken by identifying where relevant receptors are located adjacent to the screened in roads and all road sources within 200m of that receptor. It was confirmed with the TMT that there were no valid roads within the traffic model but outside of the TRA that exceeded the DMRB traffic criteria.

5.3.7. For the regional air quality assessment, the ARN is defined as those links in the TRA which meet any of the criteria below in the scheme opening year or design year (+15 years):

- Daily traffic flows will change by 10% AADT or more;
- HDV flows will change by 10% AADT or more; and/or
- Daily average speed will change by 20km/hr or more.

5.3.8. For the regional air quality assessment, the study area has been defined as all road links in the local ARN because the calculated regional ARN was smaller than the local ARN.

5.3.9. To ensure all potentially significant air quality impacts have been assessed, the study area has considered impacts from other consented schemes. Appendix B.1 (Section 2.1.4) provides details of other schemes included in the traffic data provided.

Legislation, Policy and Guidance

5.3.10. Relevant air quality legislation, policy and guidance, including relevant Air Quality Objectives (AQO), are detailed in Appendix B.3.

5.3.11. Potential effects on air quality have been assessed following principles in relevant guidance outlined in DMRB HA207/07, associated Interim Advice Notes (IANs) and the Department for the Environment, Food and Rural Affairs' (Defra) Local Air Quality Management Technical Guidance (LAQM.TG(16)) . Relevant guidance documents used for the air quality assessment are listed below:

- HA207/07 DMRB Volume 11, Section 3, Part 1, May 2007**Error! Bookmark not defined.**;
- IAN 170/12 v3 Updated air quality advice on the assessment of future NOx and NO2 projections for users for the DMRB Volume 11, Section 3, Part 1 Air Quality, November 2013 (Ref 5.6),
- 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 (Ref 5.7),
- 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 (Ref 5.8);
- IAN 185/15 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 Volume 11, January 2015 (Ref 5.9),
- Note on Highways England's Interim Alternative Long Term Annual Projection Factors (LTTE6) for Annual Mean NO2 and NOx Concentrations between 2008 and 2030, draft, October 2013 (Ref 5.10),
- MPI-28-082014: Highways England Major Projects' Instructions – Determining the correct base year traffic model to support air quality assessments (August 2014); and
- Defra's Local Air Quality Management Technical Guidance (LAQM.TG(16)) (Ref 5.11), where appropriate.

Operational Air Quality Scenarios

5.3.12. A detailed assessment has been carried out for local air quality, which takes into account diurnal changes in traffic flows using the dispersion modelling software ADMS-Roads version 4.1 to determine potential impacts on NO2 concentrations at human health receptors, and NOx 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.

5.3.13. The following scenarios have been considered in the local air quality assessment:

- Base year (2016);
- Projected base year (2022);
- Opening year Do-Minimum (DM) (2022); and
- Opening year Do-Something (DS) (2022).

5.3.14. In addition to the scenarios above, the regional air quality assessment also considered the following scenarios:

- Future year DM (2037); and
- Future year DS (2037).

5.3.15. Evidence from monitoring across the UK has indicated concentrations of pollutants are not reducing as quickly as predicted by Defra despite improvements to engine technology. To account for this, the future baseline projections scenarios were also calculated for 2022 following the methodology in IAN 170/12/v36.

Baseline Information and Data Sources

5.3.16. Information on existing baseline air quality conditions in the study area was obtained from the following sources:

- Local Air Quality Management (LAQM) review and assessment reports5;
- Diffusion tube surveys and continuous air quality monitoring stations (CMS) operated by the above listed local authorities, in addition to diffusion tube surveys managed by or for Highways England;
- Air pollutant background concentrations (Ref 5.12);
- Pollution Climate Mapping (PCM) modelling (Ref 5.13) and
- Designated ecological site information (Ref 5.14) and critical load data for identified designated ecological habitats and background nitrogen deposition rates (Ref 5.15).

5.3.17. A summary of existing air quality conditions in the study area has been based on recent air quality monitoring data, where available, and data from the wider study area from the ARN. Baseline air quality is discussed further in Section 5.4 and in Appendix B.4.

Constraints Mapping

5.3.18. A constraints map for the Proposed Scheme air quality study area is shown in **Figure 5.2**. The figure shows boundaries of Air Quality Management Areas (AQMAs), the Compliance Risk Road Network (CRRN) and the locations of designated sites containing features sensitive to air pollution.

Traffic Data

5.3.19. The cumulative worst case traffic impacts for the Proposed Scheme, uses traffic data provided by Systra. The Midlands Regional Transport Model (MRTM) model, is a strategic wide area "regional traffic model" (RTM) and is based on the SATURN software (version 11.3.12U multicore), and was used to provide the traffic data for the air quality assessment.

5.3.20. Details of the traffic modelling are provided in Appendix B.1 and a list of other Road Investment Strategy (RIS1) schemes and non-RIS schemes included in the traffic model is provided in Appendix B.1 Section 2.1.4.

5.3.21. Extensive engagement has been undertaken between the air quality team (AQT) and traffic modelling team (TMT). Following receipt of traffic data the AQT reviewed the information and provided comments back to the TMT, resulting in a list of questions being raised, as summarised in Appendix B.2 and B.5. A number of telephone conferences were arranged to discuss and resolve the matters collaboratively and included the SMP Environmental Lead and Environmental Co-ordinators. On one occasion consultation with the Transport Planning Group at Highways England was also carried out to seek clarification and confirmation.

Local Air Quality Assessment

5.3.22. A summary of the inputs required for dispersion modelling is provided below, with further details presented in Appendix B.5.

5.3.23. A local air quality assessment for relevant illustrative sensitive receptors was undertaken using ADMS-Roads (v4.1) to determine the operational effects of the Proposed Scheme on human health receptors and sensitive ecological receptors (where relevant). The model used information on road link emission rates, road alignment and width, and local meteorological data (Birmingham Airport 2016) to estimate local air pollutant concentrations.

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

- Road sources were modelled using the ADMS-Roads (v4.1) software;
- 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 in GIS software ArcMap.

5.3.25. Traffic conditions vary throughout the course of a day, hence 24-hour emission profiles or morning peak period (AM) (7am to 10am), an inter-peak period (IP) (10 am to 4pm), an evening peak period

Full list of LAQM reports reviewed is included in Appendix B4.

(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.

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

5.3.27. The modelled road NOx and background NO_2, based on Defra background maps with a 2015 base year, were converted to total annual mean NO2 for comparison with the UK AQO using the Defra NOx to NO2 tool (Ref 5.16).

5.3.28. In order to avoid double counting the contribution from modelled emission sources, the in-square contributions in Defra background maps from motorways was removed from the total background NO2 concentration, using the NO2 Adjustment for NOx Sector Removal Tool (Ref 5.17).

5.3.29. The potential for exceedances of the 1-hour NO2 UK AQO to occur was assessed based on whether annual mean NO2 concentrations were greater than 60µg/m3, in accordance with Defra's Technical Guidance LAQM.TG(16)**Error! Bookmark not defined.** .

5.3.30. Base year (2016) modelled annual mean NO2 concentrations were verified, by comparison against available ratified monitoring data in the study area, with reference to LAQM.TG(16). Where systematic bias, in either direction, was clearly evident in the base year, adjustment was applied to bring modelled concentrations in-line with measured concentrations.

5.3.31. Defra's advice on long term NO2 trends creates a gap between projected vehicle emission reductions and the estimated annual rate of improvement in annual mean NO2 in Defra's published technical guidance, and observed trends. Air quality assessments following LAQM.TG(16) guidance are therefore considered likely to be overly optimistic in some cases. IAN 170/12v3 requires that steps are taken to adjust the estimated total NO2 concentrations from modelling, termed "gap analysis", in order to better reflect future trends.

5.3.32. An additional scenario (projected base year) is required to enable the gap analysis to be completed. The projected base year scenario has been modelled using the base year traffic data with the opening year vehicle emission factors and opening year background concentrations. Total NO2 concentrations for the projected base year have been calculated as described above. The results for the opening year were then adjusted using gap analysis to represent the observed long term trend profile.

5.3.33. Modelled annual mean NO2 concentrations and impacts have been evaluated with regard to compliance with the EU Directive on ambient air quality in accordance with IAN 175/13**Error! Bookmark not defined.**.

5.3.34. Commentary on compliance with the EU Air Quality Directive in accordance with IAN 175/13, has been provided where Defra PCM model links intersect with ARN links to aid the assessment of significance of effect.

5.3.35. A total of 72 discrete illustrative human health receptors and 22 monitoring locations were included in the air quality model. The location of human receptors can be seen on Figure 5.8 and are outlined in Appendix B.6. The location of monitoring sites can be seen on Figure 5.3 and in Appendix B.4.

5.3.36. Two internationally or nationally designated ecological sites were identified in the study area, containing features potentially sensitive to airborne nitrogen. Further details of the designated ecological sites, habitat types and applicable critical loads, are provided in the Appendix B.5 and their location can be seen on Figure 5.4. The designated sites assessed are:

- Coleshill and Bannerly Pools Site of Special Scientific Interest (SSSI); and
- Windmill Naps Wood SSSI.

Verification

5.3.37. 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 (2016). Verification was undertaken in accordance with Defra's Technical Guidance LAQM.TG(16)**Error! Bookmark not defined.**. Details of the verification process are provided in Appendix B.6. The key findings of the verification process is summarised below.

5.3.38. The location of monitoring sites used for model verification and the model domain boundaries defined are shown in Figure 5.5. In summary:

- 22 monitoring sites were used to compare the modelled results with 2016 annual mean NO2 concentrations;
- Unadjusted modelled NO2 concentrations were compared with the monitoring data;
- The air quality model was found to compare well with monitoring data at the majority of locations, with no evidence of systematic bias;
- The adjusted total NO2 concentrations were considered to have acceptable model performance in accordance with Defra LAQM.TG(16), with all of the verification sites modelled, except two (one overprediction and one under prediction), being within 25% of measured values, and 60% being within 10% of measured values. The model performance statistics are presented in Appendix B.6 and post-adjustment are all acceptable; and
- The model results for human health and designated ecological sites for the base year scenario and the opening year with and without the Proposed Scheme were adjusted using the model adjustment factor.

Regional Air Quality Assessment

5.3.39. Pollutant emissions have been calculated for the regional assessment study area based on the regional assessment screening criteria outlined in Section 5.3.7. Emissions have been calculated using the traffic characteristics (AADT flows, average vehicle speeds and percentage HDVs) and road length for each affected road in the study area. The emission factors given in IAN 185/15**Error! Bookmark not defined.** have been used. Total annual emissions for both the base year (2016), DM and DS scenarios for the Opening year (2022) and Design year (2037) have been calculated for the purposes of the regional assessment. As emission factors are not available for 2037, the traffic data for 2037 have been processed using emission factors for the latest year for which factors are available, 2030.

Receptors

5.3.40. 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 ARN. The assessment considers impacts at residential properties, schools and hospitals, and ecological receptors including SSSIs. Receptors assessed are those located within 200m of the ARN. The location of human and ecological receptors can be seen on Figure 5.8 and Figure 5.4 respectively.

5.3.41. Not all receptors within 200m of the ARN were modelled. A selection of illustrative discrete receptors have been included at worst case locations within 200m of to the ARN. Where potential exceedances of the annual mean NO2 AQO were forecast, additional receptors have been included in the surrounding area to identify the total number of receptors affected. In addition, relevant monitoring locations have been included in the air quality model for use during air quality model verification.

Magnitude of Impacts

5.3.42. 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**Error! Bookmark not defined.**. These criteria have been used in the assessment of annual mean concentrations of NO2.

5.3.43. The changes in magnitude, which are based on an assumed measure of uncertainty (MoU) of 10%, may be described as small, medium, large or imperceptible, 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'.

5.3.44. **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.

5.3.45. There is no guidance on classification of magnitude of impact or significance of effect for the regional air quality assessment.

Table 5-1 Magnitude of change criteria for local air quality

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 AQO (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 AQO.
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 AQO (4µg/m^3).
Imperceptible (≤0.4µg/m^3)	Less than or equal to 1% of the AQO (0.4µg/m^3).

Significance of Effects

5.3.46. 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 then 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** (an imperceptible magnitude of change need not be considered further with regards to significance of effects). Where the difference in concentrations are less than 1% of the AQO (for example, less than 0.4µg/m3 for annual mean NO2) then the change at these receptors is considered to be 'imperceptible' and can be scoped out of the judgement on significance.

5.3.47. IAN 174/13**Error! Bookmark not defined.** outlines the criteria for the determination of significance for NOx effects on designated ecological sites. Where the difference in concentration is less than 0.4µg/m3 for annual average NOx, then the change at these receptors is considered to be 'imperceptible' and can be scoped out of the judgement on significance. Where a change is greater than 0.4µg/m3 advice has been sought from the ecology team.

Table 5-2 Guideline to number of receptors constituting a significant effect for air quality[7]

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

5.3.48. Discussions have been undertaken with the following stakeholders:

- Stephen Williams, Environmental Health Officer at Bromsgrove District Council, to obtain the latest air quality monitoring data and Annual Status Report for Bromsgrove; and
- Beverley Hill, Environmental Health Officer at Solihull Metropolitan Borough Council, to obtain the latest air quality monitoring data and Annual Status Report for Solihull.

Assumptions and Limitations

5.3.49. Any air quality dispersion 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.

5.3.50. The key assumptions and limitations are presented below:

- **Traffic data:** Use of validated traffic models (see Appendix B.5), with active engagement between TMT and AQT addressing uncertainty in traffic model output and post-processed traffic. This included road links with a low level of traffic model assurance that were key to the air quality assessment (such as the use of 2015 traffic data for 2016 prediction). A jointly agreed approach was developed, tested and applied with the agreement of Transport Planning Group (TPG) consistent with Major Project Instructions (MPI29);
- **Excluded schemes:** Construction traffic from HS2 has not been included in either the transport modelling or the air quality modelling. It is not expected that such traffic would materially affect the conclusion of this study;
- **Emission rates:** To reduce uncertainty, sensitivity testing of emissions data has been carried out using the most recent guidance from Highways England (IAN 170/12v3). The methodology used in this assessment is designed to provide a robust assessment, reducing uncertainty caused by the above limitations; and
- **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. Meteorological data from Birmingham Airport for 2016 was used for this assessment, which is considered to be the most representative for the study area. Further details can be found in Appendix B.5.
- **PCM data**: The base year for the Proposed Scheme is 2016, but the latest PCM model does not contain data for this particular year. It is possible to estimate whether the 2016 value exceeds the annual mean NO2 EU LV by comparing the base year data (2015) and the predicted 2017 data following the methodology outlined in IAN 174/13**Error! Bookmark not defined.**.

5.4 Baseline Conditions

5.4.1. The sources of baseline conditions are outlined in paragraph 5.3.16 and summarised below. Further information on baseline conditions is provided in Appendix B.4.

5.4.2. In order to provide an assessment of the significance of any new development proposal (in terms of air quality), it is necessary to identify and understand the baseline air quality conditions in and around the study area. This provides a reference level against which any potential changes in air quality can be assessed. Since the baseline air quality is predicted to change in the future (mainly because vehicle emissions will change), the baseline situation has also been predicted in the opening year. The DM scenario is the predicted baseline for the opening year, and includes any other proposed schemes with a high level of certainty of being built. The DS scenario is the same as the DM, but also includes the Proposed Scheme. The baseline year used for the Proposed Scheme is 2016.

5.4.3. 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 2013, 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

5.4.4. There are six Local Authorities located in the Proposed Scheme's study area, comprising:

- Bromsgrove District Council;

- North Warwickshire County Council;
- Solihull Metropolitan Borough Council;
- Stratford on Avon District Council;
- Warwick District Council; and
- Wychavon District Council.

5.4.5. These local authorities have carried out regular reviews and assessments of local air quality and have shown that the UK AQO most likely to be exceeded is for annual average NO2 due to road traffic emissions.

5.4.6. Some of the local authorities in the study area have designated AQMAs due to measured or modelled exceedances of the annual mean NO_2 AQO. There are two AQMAs located in the study area the location of which is shown in **Figure 5.6** and described in **Table 5-3**. Both of them are less than 200m from the affected road networks (ARNs) and therefore have the potential to be affected by the Proposed Scheme.

Table 5-3 AQMA in the Proposed Scheme's study area

	Air quality criteria exceeded	Description	Distance from scheme	Distance from local ARN
Bromsgrove District Council				
Lickey End AQMA	NO2 annual mean	A number of residential properties surrounding the M42/A38 junction	10.8 km	0.0 km
Wychavon District Council				
Worcester Road, Wychbold AQMA	NO2 annual mean	Section of A38 from Junction 5 of M5 at Worcester Road, Wychbold to Upton Warren, also incorporating a section of the M5 at Junction 5.	17.0 km	0.0 km
Note: AQMA information taken from Department for Environment, Food and Rural Affairs (Defra) AQMA website and local authority review and assessment reports.				

Pollution Climate Mapping (PCM)

5.4.7. Information on where the annual mean NO_2 EU limit value (LV) is exceeded is available from Defra's PCM model. This model provides projected roadside concentrations of pollutants, including annual mean NO2 and NO_x in the years 2017-2030 inclusive, based on a 2015 base year.

5.4.8. The locations of Defra PCM model links in the Proposed Scheme's study area are shown in Figure 5.7.

5.4.9. Defra PCM mapping shows that roadside exceedances of the annual mean NO2 EU LV occur within the Proposed Scheme's study area in the base year (2016). The location of the exceedance is as follow:

- Link to the west of the M6/M42 junction (ID UK0035)

5.4.10. As the annual mean NO2 EU limit value is not projected to be exceeded in the Proposed Scheme opening year (2022) along any link which intercepts the ARN for the Proposed Scheme, there is no potential risk of affecting compliance with the EU Air Quality Directive.

5.4.11. Where roads are not included in the PCM model no assessment of compliance risk can be 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".

Air Quality Monitoring

Local Authority Monitoring

5.4.12. Air quality monitoring data from passive diffusion tubes in the Proposed Scheme's study area are presented in Appendix B.4, shown on Figure 5.3. The data is colour coded by the 2016 annual mean NO2 concentration. There is no continuous monitoring sites (CMS) within 200m of the ARN in the study area.

5.4.13. In 2016, none of the local authority diffusion tube sites in the Proposed Scheme's study area, measured concentrations above the annual mean NO2 UK AQO.

Highways England Monitoring

5.4.14. Highways England carried out an NO2 diffusion tube survey in the Proposed Scheme's study area between 2013 and 2016.

5.4.15. The measured period means for the most recent six months of data obtained in 2016 have been calculated and then annualised in accordance with the methodology in LAQM.TG(16)**Error! Bookmark not defined.** to provide 2016 annual mean NO2 concentrations for use in verification.

5.4.16. The results show that of the 22 Highways England diffusion tubes, three exceedances of the annual mean AQO were recorded at monitoring sites. Full details of these monitoring sites and the annualised bias-adjusted 2016 results are provided in Table 2 in Appendix B.4. Exceedances were recorded at three diffusion tube sites near Junction 1 and Junction 4 of the M42. The maximum recorded concentration of 41.8µg/m3 was at site BBP4_018_0116 located on Stourbridge Road between J0 and J1 on the M42. However exceedance was unlikely when distance correction is applied to nearest receptor locations.

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

Ecological Designations

5.4.18. There are two designated sites of national importance, Coleshill and Bannerly Pools and Windmill Naps Wood SSSI, within 200m of the Proposed Scheme ARN, containing habitats sensitive to airborne NOx and nitrogen deposition. Critical loads for nitrogen deposition are available from the APIS website. The recommended UNECE critical loads for the main habitat type have been selected (where available) and these are set out in Appendix B.5 and the location of these sites can be seen in Figure 5.4.

5.4.19. Background annual average NOx concentrations recorded at the sites were:

5.4.20. 41.8µg/m3 at the Coleshill and Bannerly Pools SSSI, which exceeded the vegetation objective of 30µg/m3; and

5.4.21. 29.0µg/m3 at the Windmill Naps Wood SSSI, which did not exceed the vegetation objective of 30µg/m3.

Future Baseline

5.4.22. Future baseline projections have been carried out to assess the implications of vehicle emissions not improving as quickly as predicted by Defra. Evidence from monitoring across the UK has indicated concentrations of pollutants are not reducing as quickly as predicted. To account for this, the future baseline projections scenarios were also calculated for 2022 following the methodology in IAN 170/12/v3**Error! Bookmark not defined.**.

5.4.23. The average change in annual mean NO2 and PM10 concentrations at the sensitive receptors modelled from baseline to opening year do minimum is predicted to decrease by 16% and 4% respectively.

5.5 Assessment of Effects

Operational Effects

Local Air Quality Assessment

5.4.24. The air quality assessment results are presented in detail in Appendix B.7, Section 6.2, and shown on Figure 5.8. Appendix B.7 describes the results of selected receptors in four discussion

regions across the Proposed Scheme in detail (Figure 5.9). The results tables in the appendices indicate which figure each modelled receptor can be found.

5.5.1. The modelling results show that estimated concentrations exceed the NO_2 annual mean AQO of 40µg/m3 at:

- Five modelled receptors in the base year (2016);
- Zero receptors in the opening year (2022) without the Proposed Scheme. The maximum concentration was predicted to be 37.7µg/m3, located at receptor H49 in Solihull near the M42; and
- Zero receptors in the opening year (2022) with the Proposed Scheme. The maximum concentration was predicted to be 39.0µg/m3, also located at receptor H49.

5.5.2. There are no receptors where an exceedance of the annual mean AQO is predicted to occur in the opening year (2022) and therefore the change at all receptors can be described as 'imperceptible' according to the criteria in Table 5-4.

Compliance Risk Assessment

5.5.3. According to the Defra PCM model, exceedances of the annual mean NO_2 EU limit value are not predicted to occur in the modelled opening year (2022) adjacent to any road links in the study area.

5.5.4. The potential risk of the Proposed Scheme affecting compliance with EU limit values has been assessed by considering the changes in annual mean NO2 concentration at the closest modelled receptors to those links which intersect the ARN. These are H14, H15, H50, H53, H64, H65 and H66. The change in annual mean NO2 concentration at one of these receptors (H50) is over 1% of the annual mean NO2 EU limit value (0.9µg/m3), however, the DS concentration at this location with this increase remains well below the AQO.

5.5.5. At the remaining six modelled receptors, where concentrations are estimated to be below the NO2 annual mean AQO, changes in concentrations are estimated to be 'imperceptible' (i.e. less than or equal to 0.4µg/m3). The overall risk rating associated with the Proposed Scheme is therefore concluded to be "Neutral".

5.5.6. Details of the Proposed Scheme's Compliance Risk Assessment are reported in Appendix B.7 and the location of the CRRN Links can be see in Figure 5.7.

Designated Ecological Sites

5.5.7. The assessment has shown that there are exceedances of the annual mean NOx UK AQO of 30µg/m3 for the protection of vegetation in the base year (2016) and opening year (2022), either with or without the Proposed Scheme, these locations include:

- Coleshill and Bannerly Pools SSSI; and
- Windmill Naps Wood SSSI.

5.5.8. The maximum change in annual mean NOx concentrations in Coleshill and Bannerly Pools SSSI is 1.5µg/m3. 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 Coleshill and Bannerly Pools to the M42 as a result of the Proposed Scheme is estimated to be less than 1% of the most relevant critical load, and is therefore considered unlikely to be significant.

5.5.9. The maximum change in annual mean NOx concentrations in Windmill Naps Wood SSSI is 0.2µg/m3. In accordance with IAN 174/13, as this change is lower than 0.4µg/m³, the effect on nutrient nitrogen deposition at this location did not need to be estimated.

5.5.10. The annual mean NOx and nitrogen deposition results for all modelled ecological receptors are presented in detail in Appendix B.7.

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

Regional Air Quality Assessment

5.5.12. Total emissions from roads in the Traffic Reliability Area (TRA) have been estimated for NOx, PM10 and CO2 in the base year (2016) and with and without the core cumulative worst case scenarios in the opening year (2022) and design year (2037). Emissions are shown for the base year (2016) and with and without the Proposed Scheme in the opening year (2022) and design year (2037).

5.5.13. In the opening year (2022) there is a predicted increase in all pollutant emissions of between 2.8-4.5%. This is due to the increase in capacity created as a result of the Proposed Scheme which will result in increased traffic volumes.

5.5.14. In the design year (2037) there is a predicted increase in all pollutant emissions of between 3.3-5.3%. This is due to the increase in capacity created as a result of the Proposed Scheme which will result in increased traffic volumes.

Health Assessment

5.5.15. As the Proposed Scheme would not be open to traffic without mitigation measures to ensure that there is no significant worsening or new exceedances of AQO, there would be no deterioration in the health status of human receptors along the ARN.

5.6. Design, Mitigation and Enhancement Measures

Construction

5.6.1. This EAR is supported by an Outline Environmental Management Plan (OEMP), that details mitigation measures that will be implemented during the construction phase to reduce potential air quality impacts associated with construction activities. The OEMP will form the basis for the Delivery Partner's CEMP and standard appropriate mitigation measures - including those described in IAQM Guidance on the assessment of dust from demolition and construction, will be detailed in Method Statements. With the adoption of best practice measures for control of dust the impact of construction activities was considered to be imperceptible.

5.7. Residual Effects

Construction Impacts

5.7.1. No significant adverse residual effects are expected to occur as a consequence of the Proposed Schemes construction.

Operational Impacts

5.7.2. No significant adverse residual effects are expected to occur as a consequence of the Proposed Scheme after opening, as described in Section 5.5.

5.8 Summary

5.8.1. 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 AQO

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
Will there be a large change in environmental conditions?	No
Will the effect continue for a long time?	No
Will many people be affected?	No
Is there a risk that designated sites, areas, or features will be affected?	No
Will it be difficult to avoid or reduce or repair or compensate for the effect?	No
On balance is the overall effect significant?	No

The findings of the air quality assessment show that the Proposed Scheme are not significant for air quality and can progress without any additional mitigation.
Potential cumulative effects are discussed further in Chapter 10.

5.9. Summary

Summary of Potential Construction Effects

Table 6-6 Summary of construction effects

Aspect	Post mitigation predicted effect
Air Quality - Construction	• None expected
Health - Construction	• None expected

Summary of Potential Operational Effects

Table 6-7 Summary of operational effects

Aspect	Post mitigation predicted effect
Air Quality - Operation	• None expected
Health - Operation	• None expected

6. Biodiversity

- No significant residual effects upon Biodiversity are anticipated following implementation of mitigation.
- There are no impact pathways or hydrological connections to European Sites within 2km or Special Areas of Conservation designated for bats within 30km, therefore a Habitat Regulations Assessment (HRA) is not required.
- There are no direct or indirect effects upon SSSIs and it is considered that no areas of ancient woodland or other priority habitats will be significantly affected with the implementation of standard good practice measures.
- Approximately 99% of the soft estate has been subject to a habitat survey to date. Surveys remain to be undertaken for roosting bats, otter and water vole. Surveys are now complete for hazel dormouse.
- Mitigation proposed includes advanced planting to enhance adjacent hedgerows and woodland for hazel dormouse (under licence) prior to construction works, obtaining Natural England licences for hazel dormouse, bats, great crested newt, and badgers (if required) as well as post construction landscaping to replace habitat impacted during construction.
- Highways England biodiversity targets are proposed to be met by the creation of invertebrate-friendly habitats including wildflower-rich grassland and the installation of additional dormouse boxes and planting adjacent to Windmill Naps Wood to enhance connectivity for the local dormouse population.

6.1. Introduction

6.1.1. This section 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 Scoping Report and field surveys, outlines recommended mitigation measures to reduce or minimise potential significant effects and assess the residual effects during construction after these are implemented.

6.1.2. Highways England is committed to achieving biodiversity gains, as set out in the Biodiversity Action Plan , which may be achieved through careful consideration of impacts and opportunities during the environmental assessment process for schemes of this type. Opportunities for delivering biodiversity gains are therefore considered as part of this assessment.

6.1.3. 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;
- Opportunities for the enhancement of biodiversity.

6.1.4. The supporting appendices are:

- Appendix C.1 – Ecological Survey Report;

6.1.5. The following figures support this chapter:

- Figure 6.1 – Phase 1 Habitat Map
- Figure 6.2 – GCN Ponds
- Figure 6.3 – Ecological Constraints Map

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

Professional Competency Biodiversity

Name	Grade and Company	Expertise and Professional Qualification
Jenny Singh	Senior Ecologist - Arup	Jenny has over 12 years' experience in ecological consultancy, specialising in highway developments. She has an MSc in Environmental Management from the University of Nottingham. She is a Chartered Ecologist (CEcol) and Chartered Environmentalist (CEnv) a full member of CIEEM and an associate member of IEMA. Jenny is the lead ecologist on several SMP schemes and specialises in environmental assessment and protected species licensing, mitigation and monitoring.

6.2. Scoping

6.2.1. This assessment has been undertaken in accordance with the conclusions of the Scoping Report and the only change to the ecological receptors to be assessed or the methodology by which the assessment has been undertaken is that the Scoping Report recommended riparian mammal surveys but these were not undertaken as at present there are no proposed works impacting priority outfalls or culverts.

6.2.2. As works are constrained to the motorway soft estate, the impacts upon ecological features 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 discharges are expected. Temporary construction effects risks include:

- Works to no priority outfalls and culverts potentially affecting riparian species;
- Vegetation removal;
- Water pollution or changes to local hydrology;
- Construction lighting;
- Dust deposition;
- Direct mortality/disturbance.
- A change to local hydrology, water pollution.

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;
- Limits of deviation; and
- Assumptions and limitations.

Study Area

6.3.2. The Study Area reflects the location of ecological features and their potential Ecological Zone of Influence (EZoI) for the Proposed Scheme. The potential EZoI of each important feature differs according to the attributes of the feature (see **Table 6-1**).

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 and 200m of Affected Road Network • Within 30km for sites designated for bats	• Nitrogen deposition within 200m of the Affected Road Network. • Designated sites hydrologically connected to the Proposed Scheme. • European designated sites designated for bats within 30km (Ref 6.1)
Sites of Special Scientific Interest	• Within 2km and sites sensitive to nitrogen deposition within 200m of Affected Road Network	• Within 200m of the Proposed Scheme • Nitrogen deposition within 200m of the Affected Road Network for SSSIs only • Designated sites hydrologically connected to the Proposed Scheme within 200m
Non-statutory designated sites for nature conservation and notable habitats	• Local designated sites within 1km • Ancient Woodlands within 200m • Priority habitats within and immediately adjacent to the Proposed Scheme	• Local designated sites within 50m of the Proposed Scheme, and beyond if hydrologically linked • Ancient Woodland within 15m of the boundary fence • Priority habitats within the Proposed Scheme
Notable and legally protected species	• Within 2km	• Waterbodies suitable to support great crested newts within 250m of the Proposed Scheme unless a large group of ponds with good connective habitat linked to the soft estate in which case locally extend to 500m • Hazel dormouse within 200m • Roosting bats within 20m • Badger within 30m • Otter, Water vole and White clawed crayfish, only where impacts could arise as part of the SMP proposals, 100m upstream and 100m downstream of the works • Up to 50m adjacent to soft estate, habitat suitable for breeding birds, reptiles and any other protected or notable faunal species or groups (e.g. Section 41 Priority Species) (Ref 6.2)

Legislation, Policy and Guidance

6.3.3. 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 (Ref 6.3)
- Mammal Society, 1989: Surveying Badgers(Ref 6.4);

- A Survey of British Natural History- Badger, 2010(Ref 6.5);
- Water Vole Conservation Handbook, 3rd Edition, 2011(Ref 6.6),
- The Dormouse Conservation Handbook, 2nd Edition, 2006; (Ref 6.7)
- The Bat Conservation Trust, 2016: Bat surveys for professional ecologists good practice guidelines 3rd Edition(Ref 6.8);
- Highways England, 2015: Our plan to protect and increase biodiversity;
- Wildlife and Countryside Act 1981(Ref 6.9) (as amended);
- The Conservation of Habitats and Species Regulations 2017(Ref 6.10); and
- Protection of Badgers Act 1992(Ref 6.11)

Baseline Information and Data Sources

6.3.4. Information on statutory European and national sites designated for nature conservation was obtained from the following sources:

- The Multi-Agency Geographic Information for the Countryside (MAGIC) website (www.magic.gov.uk); and
- Joint Nature Conservation Committee (JNCC) website (http://jncc.defra.gov.uk/).

6.3.5. Information was obtained from the Highways England Environmental Information System (EnvIS) database (accessed in 2018), legally protected and notable species data and information regarding non-statutory sites designated for nature conservation was requested from the following organisations:

- Area 9 Managing Agent (Kier);
- Peoples Trust for Endangered Species (PTES);
- Warwickshire Biological Records Centre (WaBRC);
- Warwickshire Dormouse Conservation Group (WDCG);
- Worcestershire Biological Records Centre (WoBRC).

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 between October 2018 and April 2019. Details of the ecological surveys can be found in **Appendix C.1**.

6.3.8. Due to seasonal and access constraints approximately 1% of the total area within the potential ZoI have not been subject to ecological surveys (see Appendix C.1). These areas will not be surveyed as they are small areas within junctions.

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 nesting birds;
- Assessment of habitat potential for badgers (Meles meles) and where possible, a search for signs of badger activity including setts, tracks, hairs, foraging holes and latrines (Ref 6.12) , (Ref 6.13)
- Assessment of trees and structures that could support roosting, foraging and commuting bats within the Zol (Ref 6.14)
- Assessment of habitat potential for reptiles and amphibians, in particular great crested newts (Triturus cristatus); and
- Assessment of habitat potential for other notable species (such as plants, invertebrates and other mammal species).

6.3.10. Great crested newt Habitat Suitability Index (HSI) assessments on 153 ponds/ditches located within 250m of the soft estate were carried out in spring 2019 (see Appendix C.1). Due to the unseasonably dry conditions experienced in Summer 2018, HSI surveys were not undertaken in

Autumn 2018 to allow pond water levels to return to normal. Further great crested newt surveys (eDNA and population class assessments) were undertaken between April and June 2019 (ref 6.15).

6.3.11. A preliminary bat roost appraisal of one structure subject to works during construction was undertaken in July 2019 (see Appendix C.1).

6.3.12. Hazel dormouse nest tube and footprint tunnel surveys also commenced between M42 J3 and J3a in April 2019 and were completed in October 2019 (see Appendix C.1)

6.3.13. 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) (see Ecological Survey Report Chapter 10 on invasive species).

Valuing Receptors

6.3.14. For the purpose of this assessment, the value of each ecological feature 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 (Ref 6.16), or sites that meet the published selection criteria for International or European designated sites but are not themselves designated as such; • 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). • 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. • Notable areas of key/priority habitats identified in the Warwickshire, Coventry and Solihull Local Biodiversity Action Plan; 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

Value	Examples of resource valuation based on geographical context
	International or European Value
	areas for restoration or re-creation of priority habitats; and notable areas of key/priority habitat listed within the Highways Agency's BAP.
	County
Medium	• Local Wildlife Sites (LWS) 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 (within Ecosites and not already designated); • 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; • Areas of habitat; or populations/ communities of species considered to appreciably enrich the habitat resource within the local context (such as veteran trees), including features 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 as small ponds, scrub or populations of notable species widespread in the local area.

6.3.15. Important ecological features carried through to assessment are those considered to be of local value and above. Ecological features valued 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 toad and hedgehog, may still be subject to legal protection. As such, they may still require mitigation or compensation measures as outlined in Section 6.7.

Magnitude of Impacts

6.3.16. This assessment takes into account both on-site impacts and impacts to adjacent and more distant ecological features. Impacts may be adverse or beneficial to the receptor, 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.

6.3.17. The magnitude of impact during the construction and operational phases is subject to professional judgement on the 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[6]

Magnitude of Impact	Typical Criteria Descriptions
Major	**Adverse** - Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features 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, features or elements. **Beneficial** - Benefit to, or addition of, key characteristics, features 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, features or elements. **Beneficial** - Minor benefit to, or addition of, one (maybe more) key characteristics, features 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, features or elements. **Beneficial** - Very minor benefit to or positive addition of one or more characteristics, features or elements.
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

6.3.18. With regard to considering the magnitude of impact on receptors due to changes in ambient concentrations of NO_x, 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

6.3.19. The effect on an individual ecological feature is categorised as 'significant' or 'not significant' at the level at which the feature 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 feature are categorised on a five point scale in line with IAN 130/10 (see **Table 6-4**).

Table 6-4: Significance of Effects (IAN 130/10)

Significance category	Typical descriptors of effect
Very large	An effect on one or more feature(s) of international, European, UK or national value.
Large	An effect on one or more feature(s) of regional value.
Moderate	An effect on one or more feature(s) of county value.

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

Significance category	Typical descriptors of effect
Slight	An effect on one or more feature(s) of local value or features within the survey area.
Neutral	No significant effects on important nature conservation features.

6.3.20. **Table 6-5** has been used as a guide to assist the professional judgement of the biodiversity assessor in deciding the significance of effects on ecological receptors. Moderate, large or very large effects are considered significant. However, the overall effect of the Proposed Scheme can be insignificant despite localised effects of significance.

Table 6-5: Significance of Effect for Biodiversity Categories (Ref 6.17)

Resource Valuation	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

Stakeholder Engagement

6.3.21. Discussions have been undertaken with the following stakeholders:

- PTES were consulted in August 2018 regarding the suitability of footprint tunnels as a valid survey technique for hazel dormouse. PTES agreed that footprint tunnels would be suitable and are in fact a more effective survey tool within scrub and hedgerow habitats than traditional survey methods.

Limits of Deviation

6.3.22. The spatial extent over which the assessment conclusions would remain unchanged should those SMP assets with a potential to cause a significant impact be moved has been judged. Consequently, where an asset such, as an emergency area, is proposed to be repositioned during detailed design beyond the Limit of Deviation (LoD), then an “evaluation of change” assessment would be undertaken to confirm that the scheme is not environmentally worse than the design as assessed in the EAR.

6.3.23. The potential effects from any later repositioning of large infrastructure elements upon designated assets and protected species has been considered with a judgement being made on whether the environmental management requirements could change. This has been presented as a GIS shape file for the scheme for use by the Delivery Partner.

Assumptions and Limitations

6.3.24. The assumptions and limitations taken into account during this assessment are detailed in the baseline and assessment section of this report.

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;
- Hazel dormouse;
- Bats;
- Badger;
- Riparian species;
- Reptiles;
- Breeding birds;
- Terrestrial invertebrates; and
- Invasive plant species.

Designated Sites

6.4.2. There are no International or European designated sites for nature conservation within the Study Area.

6.4.3. There are four Sites of Special Scientific Interest (SSSI), which are considered to be of very high value, within the Study Area (see Figure 6.3) these are:

- River Blythe SSSI: designated due to its wide range of natural structural features and substrate types and is a rare important example of this type of habitat in lowland Britain, being one of the most botanically rich rivers in lowland England. Some units within SSSI are assessed in 2010 as 'unfavourable – recovering' and some as 'unfavourable – no change'.
- Windmill Naps SSSI: designated due to presence of lowland mixed oak ancient semi-natural woodland, a habitat type now rare in lowland Britain. This SSSI was assessed as being in 'Favourable' condition in 2009.
- Clowes Wood and New Fallings Coppice SSSI: designated due to being ancient woodland that supports an important breeding bird population. This SSSI was assessed as being in 'Favourable' condition in 2011.
- Monkspath Meadow SSSI: designated due to being the best example of a species-rich unimproved hay meadow in the West Midlands. This SSSI was assessed as being in 'Favourable' condition in 2012.

6.4.4. Twelve locally designated sites, Local Wildlife Sites (LWS), which are considered to be of medium value, are located within 200m of the Proposed Scheme or are hydrologically linked to the Proposed Scheme and therefore fall within the EZoI (see Figure 6.3), these are:

- Clarksland's Coppice LWS: ancient woodland present;
- Floodgate Meadows LWS: grassland with notable species present;
- Chambers Coppice LWS: ancient deciduous woodland that is valuable for birds and butterflies;
- Bissell's Coppice LWS: ancient woodland present;
- Jonathans Coppice LWS: ancient woodland present;
- Old Grove Wood and Acorn coppice LWS: presence of ancient semi-natural dry acid woodland and ancient replanted woodland;
- Box Tree Farm LWS: presence of traditionally managed hay meadows and two wooded ponds;
- Blythe Valley Country Park LWS: presence of watercourse, semi-improved grassland and meadows;
- Monkspath Wood LWS: presence of species-rich unimproved hay meadow;
- River Alne LWS: the river and its banks provide valuable habitat for various species;
- Fore Country Park LWS: presence of grassland and invertebrate interest; and
- Sanderfield Wood LWS: presence of oak and hazel woodland.

6.4.5. Ten other locally designated sites lie within the Study Area but outside the EZoI for the Proposed Scheme with no ecological pathways connecting them to the Proposed Scheme. Therefore, the following sites will not be considered further in this assessment:

- Arnold's Wood West LWS;
- Hockley Heath Churchyard (St. Thomas) LWS;

- Lapworth Churchyard LWS;
- The Reddings, Farm Meadows LWS;
- Brooklin LWS;
- Illshaw Heath Meadows LWS;
- Winterton Farm Wood and Meadow LWS;
- Tapster Lane Meadows LWS;
- Mountford Farm Meadow LWS; and
- Parlour Coppice LWS.

Notable and Other Habitats

6.4.6. The following ancient woodland sites, which are considered to be of high value, have been identified as being within 15m of the highway boundary or hydrologically connected to the Proposed Scheme:

- Blackoak wood, within Highways England boundary for 80m and abutting the scheme for 150m;
- Checkley's Coppice, within Highways England boundary for 60m;
- Windmill Naps, within 15m of the scheme for 380m;
- Wood's Coppice, within Highways England boundary for 20m;
- Clarksland Coppice, abutting the scheme for 250m;
- Bissell's Coppice, within Highways England boundary for 225m;
- Jonathan's Coppice, within Highways England boundary for 160m;
- Jonathan's Coppice, abutting the scheme for 80m;
- Unnamed woodland north east of Old Grove Farm; within Highways England boundary for 300m; and
- Arnold's Wood/Chalcot Wood, within Highways England boundary for approximately 250m and abutting the scheme for 750m.

6.4.7. The following Habitats of Principal Importance (Ref 6.18) have been identified adjacent to the Proposed Scheme:

- Deciduous woodland, adjacent to the scheme in multiple locations throughout, which is considered to be of medium value for the purpose of this assessment.

6.4.8. One Habitat of Principal Importance has been identified within the footprint of the Proposed Scheme. This is broad-leaved deciduous woodland qualifies as a Habitat of Principal Importance listed within Section 41 of the Natural Environment and Rural Communities Act 2006. This is located close to the Highways England boundary in areas where ancient woodland has been considered to be on the network by Natural England. However, this habitat is degraded caused by the construction of the M42 and ongoing management as part of an active motorway. The ecology walkover surveys identified a variety of common habitats within the soft estate, identified on Figure 6.1.

6.4.9. Notable Species

6.4.10. The following notable species (Ref 6.19), which are considered to be of high value for the purposes of this assessment, were recorded from desk study data within the study area:

- Great crested newt;
- Bats, including records of Daubenton's bat, noctule, common pipistrelle, soprano pipistrelle, brown long-eared bat, serotine and Natterer's bat;
- Hazel dormouse;
- Otter;
- Water vole; and
- Nesting and foraging bird species notable for their conservation concern status including records of barn owl and kingfisher.

6.4.11. Other species that are legally protected, that are known or highly likely to be present within the Proposed Scheme or in habitats adjacent to the Proposed Scheme include badgers and reptiles.

6.4.12. There is also potential for hedgehog and common toad to be present within and adjacent to the Proposed Scheme, having been recorded at ponds at 10-GCN-88 and 10-GCN-59 in small numbers. 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 common toad are not considered further within this assessment.

Great Crested Newts

6.4.13. The survey methodology and results are provided in Appendix C.1, with a summary of survey methodology and results to date outlined below.

6.4.14. The scoping report identified 145 ponds/ditches for further assessment. During the ecological walkover surveys a further 8 ponds were identified. Great crested newt Habitat Suitability Index (HSI) assessments were therefore carried out on a total of 153 ponds/ditches. Following the HSI assessment, 84 ponds/ditches were scoped out of further assessment due to 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.

6.4.15. Environmental DNA (eDNA) surveys have been carried out on 69 ponds/ditches located within 250m7 of the soft estate in April 2019. Further great crested newt surveys, including presence/absence and population size assessments were undertaken at three ponds between April and June 2019.

6.4.16. The presence/absence and population size assessments concluded that there are no aquatic breeding habitats present within the soft estate and two within 50m and a further one within 250m suitable to support breeding great crested newt (see Table 6-6). The terrestrial habitats within the Proposed Scheme may support foraging, sheltering and dispersing great crested newts.

Table 6-6: Ponds/Ditches with Great Crested Newt Confirmed

Waterbody Id	Pond Location	Approx. Grid Ref	Population Size	Distance to Highway Boundary (m)
10-GCN-153	East of Illshaw Heath adjacent to WB carriageway	413843, 274114	Small	26
10-GCN-146	Blythe Valley Park adjacent to EB carriageway	414049, 274735	Small	40
10-GCN-142	Blythe Valley Park adjacent to EB carriageway	414209, 274930	Small	177

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. Construction works that may give rise to disturbance beyond that experienced under operational conditions are identified to take place at some of the underbridges, overbridges and culverts. Preliminary Roost Assessments (PRAs) have been completed at structures and trees potentially impacted by the Proposed Scheme in July 2019 to determine their potential for use by bats as roost sites. Table 6-7 and Table 6-8 below indicate structures and trees that have been assessed as having moderate or high bat roost potential, and therefore may require further survey.

[7] Where a large meta population was anticipated with good habitat connectivity to the proposed scheme then the survey area was extended up to 500m.

Table 6-7: Potential for Bat Roosts in Structures/Buildings

Id	Structure Name	Structure Type	Description of Features	Suitability
PBR L1	River Blythe Subway	Subway	Cracks in concrete and expansion joints	Moderate

Table 6-8: Potential for Bat Roots in Trees

Id	Tree Species	Location	Description of Features	Suitability
PBR L2	Oak	Bissell's Wood - SP08127291	12 bat boxes and mature trees	High
PBR L3	Oak	Near Bournville Catering Company – SP08417301	Cracks and splits in trunk and limbs at multiple locations	Moderate
PBR L4	Dead tree of unknown species	Unnamed woodland near M42 J3a – SP1227972106	Torn limb approximately 5m high facing south	Moderate
PBR L5	Oak	Unnamed woodland near M42 J3a – SP1228772122	Small hole next to split bark at approximately 5m facing west and lots of loose bark	Moderate
PBR L6	Oak	Unnamed woodland near M42 J3a – SP1230272114	Two split branches, one of each overhangs the soft estate despite the tree itself being outside HE boundary	Moderate
PBR L7	Dead birch	Unnamed woodland near M42 J3a – SP1236972127	Split on trunk approximately 6m high facing south	Moderate
PBR L8	Ash	Jonathan's Coppice near M42 J3a – SP1290872170	Lots of woodpecker holes	High
PBR L9	Horse Chestnut	Plantation woodland between M42J3a and M40 J16 – SP1422271715	2 callus holes facing east on smaller of the two horse chestnut trees in the area	Moderate
PBR L10	Dead tree of unknown species	Plantation woodland between M42J3a and M40 J16 – SP1419171744	Split within branch facing west approximately 12m up. Also large hole in trunk facing west approximately 6m up. Ash is in corner of a field just off network but overhangs onto the network.	Moderate
PBR L11	Oak	Farmland just off access track north of School Road between M42 J3a and J4 – SP1351473963	Tree is off network. Large areas of peeling and loose bark all over the tree.	Moderate
PBR L12	Oak	Farmland just off access track	Tree just off network. Split on small dead	Moderate

Id	Tree Species	Location	Description of Features	Suitability
		north of School Road between M42 J3a and J4 – SP1352173982	branch facing north east, approximately 4m up. Woodpecker hole on branch facing south east approximately 6m up.	
PBR L13	Oak	Farmland near Ilshaw Heath between M42 J3a and J4 – SP1356374126	Oak a few metres off network perpendicular field boundary. 2 Callus roll, one 4m up facing south east and another smaller one at 3m	Moderate
PBR L14	Oak	Farmland near Ilshaw Heath between M42 J3a and J4 – SP1356174109	Tree in hedge line several meters off network perpendicular to motorway. Split is formed where dead branch comes out of tear wound. Approximately 3.5m facing north.	Moderate
PBR L15	Oak	Highways boundary between M42 J3a and M42 J4. – SP1356573642	Oak in bramble on highways boundary. First split in main trunk 4m up. Second split on dead branch near crest of canopy approximately 10m up.	Moderate
PBR L16	Oak	Farmland south of Obelisk Farm between M42 J3a and M40 J16 – SP1444471585	Tree just off network in field. Split where two dead branches meet approximately 3m up. Flies seen coming out. Another split in dead branch facing south approximately 7m up.	Moderate
PBR L17	Oak	Farmland south of Obelisk Farm between M42 J3a and M40 J16 – SP1446471594	Off network tree in field, callus roll at 2.5m facing south west and a branch cavity at 3.5m facing east	Moderate
PBR L18	Oak	Highways boundary between M42 J3a and M42 J4. – SP1356573642	Torn off branch with broken dead branch protruding, potentially gaps at base. Approximately 4m facing south east. Callus roll at 10m potentially superficial but difficult to tell.	Moderate

6.4.18. At present, the above features are of at least local conservation value/biodiversity importance on the basis that maternity roots of less common bat species are highly likely to be absent (due to the features being of limited suitability for maternity roosts). No emergence/re-entry surveys have been carried out therefore the final roost status of the structures/trees is unknown at present. As a result, the precautionary principle has been applied and therefore it is assumed that these features are of high value. If these structures/trees are due to be impacted by the works, further surveys will be required between May and September 2020, prior to construction works commencing, to confirm the value of these features for bats.

6.4.19. It is recommended that removal of any trees identified as providing bat potential (as detailed in Table 6-8 above) is undertaken between November and February (inclusive) as the features identified are not considered to be suitable for hibernation. All features should be inspected by a suitably qualified ecologist immediately prior to removal (as detailed within the OEMP) to confirm the absence of bats.

Hazel Dormouse

6.4.20. Woodland and scrub habitats within the soft estate provide suitable habitat for hazel dormouse and records indicate that dormouse are present in the wider landscape. WDCG returned 228 records of dormouse at Windmill Naps Wood SSSI, which abuts the scheme on the westbound carriageway of the M42 between J3a and J3, between 2009 and 2016. Three habitat compartments (Windmill Naps SSSI, M42 southbound soft estate and M42 northbound estate) have been surveyed, based on habitat connectivity to this woodland.

6.4.21. A series of dormouse surveys were undertaken in areas of suitable habitat within and immediately adjacent to the soft estate within the three habitat compartments in accordance with standard methodology (Ref 6.20) for the species between April and October 2019. The surveys comprised a nest tube survey complemented by footprint tunnels and a nut search survey, the latter of which was carried out concurrently with the collection of all equipment in October 2019.

6.4.22. The surveys have recorded the presence of dormouse (individual dormice, dormouse nests and footprints) within two of the surveyed areas and thus the species is present within suitable habitat at the following locations:

- Windmill Naps SSSI
- M42 Southbound soft estate

Badger

6.4.23. The terrestrial habitats within the Proposed Scheme 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.

6.4.24. No records of badger setts were returned from WDCG within or immediately adjacent to the Proposed Scheme. However, two confirmed outlier badger setts were identified along the soft estate and within 30m of the Proposed Works during the walkover survey. An additional potential badger sett, which was not accessible due to dense scrub vegetation, was also found within the soft estate (see figure 6.3) associated within the southbound offslip at M40 J16. The survey was able to access approximately 99% of the soft estate, with a full inspection of an area of impenetrable scrub near M40 J16 not being possible and a few areas within junctions being inaccessible due to live carriageways being present. Badgers are not of conservation concern and are considered likely to be prevalent in the wider landscape and are considered to be of conservation value at the Scheme level only.

Otter, Water Vole and White-Clawed Crayfish

6.4.25. The presence of waterways within the study area provide opportunities for the presence of otter and water vole that are supported by the local records search. Records indicate that the following species are present within or adjacent to the Proposed Scheme in the following locations:

- **Otter:** River Blythe is recorded as having otter present in 2013;
- **Water vole:** Spring Brook is recorded as having water vole present in 2016;

6.4.26. No surveys for otter or water vole have been undertaken to date. However, surveys for these species will be undertaken as part of detailed design and will be targeted at locations where construction will be undertaken within 8m of watercourses, at crossings over the River Blythe and Spring Brook, to determine presence/likely absence of these species.

6.4.27. No records exist for white-clawed crayfish being found within any of the watercourses in the vicinity of the Proposed Scheme. This species is considered absent from this geographical area and is therefore not considered further in this assessment.

Reptiles

6.4.28. No presence/absence surveys for reptiles are proposed as the presence of common species has been assumed based on desk study records and the habitats present within the soft estate, which are considered to be of conservation value at a local level.

Breeding Birds

6.4.29. Habitats within the highways boundary were assessed for their suitability to support nesting 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. Consequently, breeding birds are not considered further within this assessment. Any breeding birds present on site will be safeguarded through measures within the OEMP.

6.4.30. While barn owl are known to be present within the surrounding landscape, the habitats present within the Proposed Scheme do not provide suitable nesting or roosting sites for this species and are therefore not considered further within this assessment.

Terrestrial Invertebrates

6.4.31. The habitats within the soft estate comprise species poor semi-improved grassland, scattered/dense scrub and broadleaved/mixed plantation woodland and are considered to be unlikely to provide the diversity required to support an invertebrate community of special interest (i.e. containing notable or rare species). Consequently, invertebrates are not considered further within this assessment.

Invasive Plant Species

6.4.32. Himalayan balsam and Japanese knotweed have been identified within the soft estate (see Figure 6.3).

Future Baseline

6.4.33. The soft estate will continue be managed in line with standards associated with an active motorway and no changes to the management of adjacent SSSIs are proposed or envisaged. As a result, the baseline is not expected to change significantly in the future.

6.5. Assessment of Effects

6.5.1. The following ecological receptors have been identified within the ZOI and are considered to be of greater than scheme value, as such these receptors have been assessed further in this section:

- Designated sites;
- Notable and other habitats;

- Great crested newt;
- Hazel dormouse;
- Bats'
- Riparian species; and
- Reptiles.

Construction Effects

Designated Sites

6.5.2. Construction of the Proposed Scheme would not have a significant effect on any of the SSSIs within ZOI as although Windmill Naps SSSI and River Blythe SSSI are immediately adjacent to the scheme it is considered that pollution prevention measures and root protection zones will ensure there are no direct impacts.

6.5.3. Of the twelve locally designated sites within the ZOI, the Proposed Scheme would not cause any loss of habitat from beyond the soft estate, therefore the magnitude of impact would be negligible resulting in a slight adverse effect, which is not significant. Only in the case of the following sites are works to be undertaken in the immediate vicinity that could have an indirect impact:

- Clarksland Coppice LWS – site clearance and subsequent construction activities;
- Bissell's Coppice LWS – site clearance and subsequent construction activities;
- Jonathans Coppice LWS - site clearance and subsequent construction activities;
- River Alne LWS – site clearance and subsequent construction activities;
- Old Grove Wood and Acorn Coppice LWS – site clearance and subsequent construction activities;
- Box Tree Farm LWS – site clearance and subsequent construction activities;
- Blythe Valley Country Park LWS – site clearance and subsequent construction activities; and
- Fore Country Park LWS - site clearance and subsequent construction activities.

Notable and Other Habitats

6.5.4. The Proposed Scheme will not have a significant effect on the conservation status of identified Priority Habitats beyond the soft estate and no rivers or ponds would be modified during the works.

6.5.5. The Proposed Scheme requires the clearance of habitats within the soft estate involving the removal of low quality deciduous and mixed plantation woodland including, but not limited to ash, pedunculate oak, horse chestnut and Scot's pine. These areas are not representative of the habitat quality that is generally associated with Habitats of Principal Importance and the magnitude of impact is considered to be minor resulting in a slight adverse effect, which is not significant.

6.5.6. The Natural England dataset records ancient woodland within Highways England boundary in seven locations. Surveys undertaken on the verge in these locations have indicated that these areas are not currently ancient woodland and are most likely a mapping error. The proposed Scheme requires vegetation clearance within three of these locations, near Checkley's Coppice, Bissell's Coppice and north east of Grove Farm (see Table 6-9 below). Such clearance would create gaps in the continuity of habitats within the soft estate; some that would be permanent where clearance is needed for footway access to gantries and other structures. Further consultation with Natural England is therefore required to confirm the results of the site survey and that loss of such habitat would not constitute a significant effect.

Table 6-9: Loss of Priority or Notable Habitats

Priority and Notable Habitat	Principal Locations	Permanent Loss (ha)	Temporary Loss (ha)	Other Impacts
None	n/a	n/a	n/a	n/a

Great Crested Newts

6.5.7. Construction of the Proposed Scheme would not have a significant effect on the favourable conservation status of the local populations of GCN that are confirmed to be present in three waterbodies within 250m of the Proposed Scheme.

6.5.8. It is assumed that GCN 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, only small areas of habitat would be removed and ecological connectivity will be maintained the magnitude of impact on this species is considered to be negligible resulting in a slight adverse effect, which is not significant. Hence any disturbance of individual GCN affected by the works, such as through the loss of resting places, would be unlikely to have adverse consequences for that individual's chance of survival and/or breeding success as measures would be taken to reasonably ensure the favourable conservation status of the local population. However, a licence from Natural England is required prior to any construction activities taking place in any habitat considered to be used by GCN and all conditions of this licence followed for legal compliance.

Hazel Dormouse

6.5.9. Construction of the Proposed Scheme would not have a significant effect on the favourable conservation status of the local population of hazel dormouse.

6.5.10. The presence of hazel dormouse has been confirmed at Windmill Naps SSSI and M42 southbound soft estate. The survey investigations identified individual dormice, dormouse nests and footprints at these locations.

6.5.11. The Proposed Scheme would not result in fragmentation or isolation of populations of dormouse, as vegetation along the highway boundary would be retained as a minimum. However, approximately 8ha of suitable dormouse habitat, particularly in the vicinity of Windmill Naps wood, is anticipated to be temporarily lost and may be being used by dormouse for breeding, shelter or foraging, which is considered to be a moderate magnitude of impact. In the absence of mitigation this would constitute a moderate adverse effect, which is significant.

6.5.12. Phased vegetation clearance and minimisation of vegetation clearance in areas where hazel dormouse are present, landscaping designed for optimal benefit for hazel dormouse post construction and incorporation of dormouse nest tubes and/or boxes are likely to be required as part of any licence agreement with Natural England, to provide a slight beneficial effect for dormice. The location of Electrical interfaces (EIs) has also been designed to avoid habitats used by hazel dormouse and to minimise the requirement for vegetation clearance as much as possible.

6.5.13. Due to the dormouse population in Windmill Naps Wood being reintroduced, it has limited resilience being relatively isolated within the surrounding landscape, which is predominantly arable in nature and therefore unsuitable for hazel dormice, compared to a naturally occurring population. There is therefore a lack of suitable alternative habitat for dormice should habitat within the soft estate be lost. As a result, mitigation proposals are likely to require advanced planting on adjacent third-party land (to be secured and delivered through the Natural England licensing process) to enhance adjacent habitats, which should be established 2-3 years prior to vegetation clearance within the verge in this area. These measures would reduce the magnitude of impact to minor, resulting in a slight adverse effect, which is not significant, rising to a slight beneficial effect in the long term once landscape planting has become established.

Bats

6.5.14. The Proposed Scheme would not have a significant effect on the favourable conservation status of the local population of bats.

Records and survey data indicates that the habitats adjacent to the Proposed Scheme are utilised by a range of commuting and foraging bats, predominately pipistrelle species. For the purpose of this assessment, presence of bat roost(s) within structures and trees with bat roost potential that may be impacted by works associated with the Proposed Scheme has been assumed until emergence/re-entry surveys can confirm the presence/absence or roost status of the structures. PBRL1 at River Blythe Subway is unlikely to be impacted based on the current scheme design. Access has been refused to woodland near M42 J3 that contains bat boxes according to information received from Area 9 Managing Agent, however as these are off the active network they are unlikely to be impacted by the Proposed Scheme. In addition PBRL 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 16 and 17 are located within 30m of the Proposed Scheme but off network and unlikely to be impacted, however measures will need to be put in place to prevent indirect impacts through damaging tree roots and disturbance from lighting during construction. PBRL 6 is located off network but is immediately adjacent to the network with branches overhanging and therefore there is potential for the Proposed Scheme to impact this roost directly and indirectly. PBRL 15 and 18 are on network and have the potential to be impacted directly and indirectly by the Proposed Scheme. If the presence of a bat roost is confirmed in any of the PBRLs a mitigation strategy will be developed to ensure that the loss of resting places or breeding/hibernating habitat to ensure the favourable conservation status of the local population for the species affected. However, a licence from Natural England is required prior to any construction activities that may damage/destroy a roost or disturb bats in their roost and all conditions of this licence followed for legal compliance.

6.5.15. Vegetation clearance and temporary lighting from construction works may reduce the overall availability of suitable foraging and commuting habitat for bats, constituting a minor magnitude of impact and therefore resulting in a slight adverse effect, which is not significant. However, habitat temporarily lost and/or impacted by 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) for bats available in the wider landscape surrounding the Proposed Scheme.

Badger

6.5.16. Surveys undertaken to date reveal the presence of two confirmed and one potential outlier badger setts within the soft estate.

6.5.17. Under the current design the three setts will not be directly impacted due to the location of the proposed works. All of the identified setts occur within 30m of known works and would be subject to precautionary working methods, to minimise disturbance.

6.5.18. Although the setts are not being directly impacted there may be a requirement for temporary exclusion or permanent closure of badger setts during the construction period to avoid the risk of killing, injuring or disturbing any badgers that may be using setts within 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, 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.

6.5.19. Vegetation clearance and construction works would lead to temporary and permanent loss of foraging habitats within the soft estate, which would constitute a minor magnitude of impact on this species and result in a slight adverse effect, which is not significant. However, 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 within the wider landscape for badgers to use for foraging.

Riparian Species

6.5.20. Construction activities along or in close proximity to watercourses where otter and/or water vole are present have the potential to impact upon these species. Surveys for these species will be undertaken as part of detailed design and any impacts mitigated and secured through an EPS licence from Natural England if required. Construction noise and lighting could also cause temporary disturbance to otter and water vole, discouraging foraging or commuting leading to a temporary

fragmentation of habitats along affected watercourses. However, this would only be a small section of available foraging habitat and for a short duration and would therefore constitute a minor magnitude of impact, resulting in a slight adverse effect which is not significant. Also, as otters are inquisitive animals they may be attracted onto work sites to investigate creating a risk of becoming trapped. However, this would be controlled with construction good practice

6.5.21. A pollution incident or run-off from the construction activities may affect these species in the short-term. Good site management practices and standard pollution prevention measures would be implemented to avoid pollution incidents from occurring. Site compounds and storage areas would be sited away from watercourses and waterbodies (at least 8m) as specified in the OEMP.

Reptiles

6.5.22. While no surveys have been undertaken for common reptile species, suitable habitat has been identified in the vicinity of M42 J3, Spring Brook, M42 J3a and Blythe Valley Park. The presence of reptiles has therefore been assumed in low numbers and they will be safeguarded through appropriate habitat management detailed within the OEMP. The temporary loss of habitat during construction would constitute a minor magnitude of impact on this species, resulting in a slight adverse effect, which is not significant.

Operational Effects

Designated Sites

6.5.23. With regard to nationally designated sites, while there would be no land take effects, the assessment of additional nitrogen deposition described in Section 5: Air Quality indicates that there will not be a significant impact upon any nationally designated site. The Coleshill and Bannerly Pools SSSI is designated as 'Fen, Marsh and Swamp – Lowland' and at present it is considered to be 'unfavourable – recovering'. The critical level and critical load were predicted to be exceeded in either DM or DS scenarios, especially at locations within 50m from the kerb of the M42. However, during the last assessment (1st October 2017) and followed up by the last site check (3rd November 2017), the northern area of this SSSI, where exceedance was predicted, was almost completely underwater. It has been recommended that the unfavourable condition map for this SSSI unit would need to be corrected to reflect this and that a fen community is no longer present at this location. As there is no habitat that is sensitive to nitrogen deposition in the area where exceedance was predicted, it is not anticipated there would be a significant impact upon Coleshill and Bannerly Pools SSSI even if the nitrogen deposition increased above an imperceptible level. In terms of hydrological impact pathways to SSSIs, the Proposed Scheme would not alter the volume or quality of runoff and thus the conservation status would be unchanged (as detailed in Section 9: Water Environment).

6.5.24. No cumulative impacts are expected upon any sites.

Protected Species

6.5.25. No significant effects on any protected species are anticipated, as a result of the operation of the Proposed Scheme. No significant change to the risk of water pollution incidents is forecast nor would the scheme cause a change to the quantity of de-icer required hence there would be no significant risk to riparian species.

Notable Habitats

6.5.26. No significant effects on notable habitat adjacent to the Proposed Scheme are anticipated as a result of the operation of the Proposed Scheme. However, although no Priority Habitats are present within the boundary of the Proposed Scheme in seven areas Natural England have classified ancient woodland within the Highways England boundary and any permanent loss or impacts to these areas would result in a significant impact.

6.6. Design, Mitigation and Enhancement Measures

6.6.1. As noted above, the Proposed Scheme would not give rise to significant impacts upon designated sites, habitats or species. Nevertheless, a series of further surveys and measures are to be undertaken to inform the protected species licencing that would be required for bats, hazel dormouse, otter and water vole. 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, Table 6-10 provides an overview of the these measures.

Table 6-10: Design, Mitigation and Enhancement Measures

Receptors	Measures	Rationale
National sites		
Windmills Naps SSSI River Blythe SSSI	• Embedded control measures to ensure no impact upon the water quality of the River Blythe SSSI and protection of tree roots and prevention of dust to ensure no impact upon Windmill Naps SSSI	To prevent indirect impacts upon nationally important designated habitat.
Local sites		
Fore Country Park LWS, Blythe Valley Country Park LWS, Box Tree Farm LWS, Old Grove Wood and Acorn Coppice LWS, Bissels Coppice LWS, Clarksland Coppice LWS, River Alne LWS and Jonathans Coppice LWS	• Embedded control measures to ensure no impact upon the water quality, protection of tree roots and prevention of dust to ensure no impact upon any habitats within LWS in close proximity to the scheme.	To prevent indirect impacts upon county important designated habitat.
Notable habitats		
Deciduous woodland	• Deciduous woodland areas will be protected according to British Standard BS 587.	To prevent damage to tree roots and stems during works and protect notable or valuable trees.
Ancient woodland		
Ancient woodland	• Ancient woodland areas will be protected according to British Standard BS 587. • Buffer zones for earthworks within 15m of ancient woodland would be established (Ref 6.21).	To prevent damage to tree roots and stems during works and protect notable or valuable trees.
Other habitat	• Habitats impacted during construction will be re-planted and/or left to recolonise naturally (where appropriate). • Planting plans will be designed to compensate for the floristic and structural diversity of the habitats lost during construction, which on	To achieve no net loss of biodiversity as required by the HE Biodiversity Plan.

Receptors	Measures	Rationale
	maturity will provide a greater area of valuable habitat than that lost. • Scalloped edging offering a more floristically interesting herbaceous layer would contribute to the National Pollinator Strategy (Ref 6.22). • Wildflower grassland to be sown on low nutrient soils in suitable locations throughout the scheme. • 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.	
Protected species		
Great crested newts	• EPS licence for works within 250m of ponds with confirmed GCN presence (10-GCN-142, 10-GCN-146 and 10-GCN-153) which would involve the installation of exclusion fencing and pitfall traps/refugia to translocate any GCN within habitat impacted by the Proposed Scheme into adjacent habitat. These works would be undertaken under the supervision of a suitably qualified ecologist (EPS licence holder or accredited agent). • Destructive search of habitats within 250m of GCN ponds under the supervision of a suitably qualified ecologist. • Habitat enhancements within translocation receptor areas, including log piles and hibernacula (if required).	To comply with legislation and meet licensing requirements of Natural England.
Bats	• A tree climbing inspection of PBRL 6, 15 and 18 (and other trees if the scheme design changes) assessed as having either moderate or high bat roost potential prior to felling or pruning • Minimise lighting disturbance during April to September to reduce impacts on foraging / commuting routes. This should include utilising directional LED luminaires using a warm white spectrum (ideally less than 2700 Kelvin) to reduce blue light component. Luminaires should feature peak wavelengths higher than 550nm. Only using luminaires with an upward light ration of 0%. As a last resort accessories such as baffles, hoods or louvres can be used to reduce light spill. • EPS licence for exclusion of bats if any bat roosts are identified within trees or structures impacted by the Proposed Scheme. If a licence is required, replacement roosting opportunities, such as bat boxes, are likely to be required.	To comply with legislation and meet licensing requirements of Natural England.

Receptors	Measures	Rationale
Dormouse	• EPS licence for works affecting any habitat where dormice confirmed to be present (Windmill Naps SSSI and M42 southbound soft estate). This is likely to require a two-stage clearance method, with clearance of vegetation down to 300mm between November and February, followed by stump removal between May and September. • Vegetation clearance would be undertaken in a manner to fully maintain the ecological function of each of the specific individual dormouse home ranges. • Construction lighting would be directed away from dormouse habitat. • Dormouse nesting boxes to be provided within habitat adjacent to Windmill Naps Wood. Monitoring requirements would be determined by the scale of impact on the dormouse population (to be confirmed by further surveys), but is likely to comprise monthly checks between April and October.	To comply with legislation and meet licensing requirements of Natural England.
Riparian species	• Measures to protect riparian habitat and watercourses from disturbance and pollution would be put in place. • Avoid the use of lighting within habitat used by otter, with restrictions on night-time works in these areas. • Phased vegetation clearance under the supervision of an ecological clerk of works and fingertip search of the area (if required).	To comply with legislation, best practice and meet licensing requirements of Natural England.
Badger	• Checks will be undertaken prior to vegetation clearance/pre-construction works to confirm if badgers setts are present and their current activity status. • Measures to prevent badgers becoming trapped in any pots, piping, chemical containers or wire mesh would be undertaken. • All excavations should be covered overnight. Where this is not possible a suitable plank or similar should be positioned to allow badgers to exit the excavation. • Disturbance or closure of a sett would be undertaken under a Natural England development licence and would require installation of exclusion fencing and one way exclusion gate(s) and an exclusion period of 21 days (between 1st July and 30th November).	To comply with legislation, best practice and meet licensing requirements of Natural England.
Reptiles (widespread species)	• A suitably qualified ecologist would supervise vegetation clearance in areas potentially supporting reptiles during March to September.	To comply with legislation and best practice.

Receptors	Measures	Rationale
	• Creation of "open areas" on south facing slopes to increase basking opportunities and creation of log piles and hibernacula.	
Nesting birds	• Clearance of suitable nesting habitat during breeding bird season would be completed under a watching brief. • If an active nest is identified an exclusion zone must be set up and works suspended in this area until any chicks have fledged the nest. • No specific measures for Schedule 1 birds required.	To comply with legislation and best practice.
Schedule 9 invasive plant species	• Checks will be undertaken prior to vegetation clearance/pre-construction works to confirm the presence/absence of any invasive plant species. • Non-native invasive species would be subject to avoidance measures within a written method statement. If removal is required this would be undertaken by a specialist contractor.	To comply with legislation and best practice.

6.6.3. Standard good practices, as the CIRIA Environmental Good Practice on Site Guidelines (Ref 6.23), would be implemented during the construction phase to minimise harm to ecological features 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 Precautionary Method of Working (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.
- Appropriate storage of materials, equipment and machinery ensuring vehicles are kept off retained habitats in the soft estate.

6.6.4. The planting 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:

- Installation of additional dormouse boxes and planting adjacent to Windmill Naps Wood SSSI within Highways England soft estate to enhance connectivity for the local dormouse population. Hazel dormouse is known to be present within Windmill Naps Wood, located between junctions 3 and 3a of the M42. Dormice were released in this location in 2010 as part of a programme aiming to halt the decline in the species. Recent monitoring surveys indicate that the population is still doing well, but there are no boxes outside of the woodland, which may be reducing the chances of the population spreading into adjacent habitat. Enhancement measures for hazel dormouse would therefore comprise providing dormouse nest boxes in suitable patches of vegetation as well as planting of new connecting hedgerows to link up suitable habitats with adjacent protected sites on a landscape-scale;
- Re-wilding of the River Blythe SSSI (as part of the objective to improve SSSIs on the network) along this section, which has previously been channelized. This would encourage greater biodiversity enhancements for riparian mammals such as otter, that are known to use the River, as well as supporting Warwickshire's Living Landscapes Project. A Designated Fund application has been submitted regarding this;

- Creation of invertebrate-friendly habitats including wildflower-rich grassland (as part of the objectives to created more species-rich grassland and enhance connectivity) of benefit to insects in line with the National Pollinator Strategy and Buglifes B-Lines project. This would also create valuable foraging habitat for bats. At present this is confined to within Highways England soft estate; and
- Habitat management within Coleshill and Bannerley Pools SSSI to re-estblish areas of 'Fen, Marsh and Swamp – Lowland' habitat that have become inundated with water over recent years. A Designated Fund application has been submitted regarding this.

6.6.5. The above measures will ensure that the Proposed Scheme delivers beneficial biodiversity outcomes and contributes to the ecological objectives if funded by Highways England.

6.7. Residual Effects

6.7.1. No significant residual effects on designated sites, notable habitats or notable species are anticipated as a result of the Proposed Scheme once mitigation measures have been implemented.

7. Landscape, Visual and Cultural Heritage Effects

- There are no nationally designated landscapes within the study area.
- There are no designated landscapes across the scheme. However, there are Ancient and Semi – Natural woodland and Ancient replanted woodland a number of which are located throughout the study corridor and lie adjacent to the highway.
- There would be minor adverse magnitude of impact on the identified close context study corridor character areas resulting in slight adverse effects.
- Effects on the Local Character areas or the National Character Area of Arden would not be significant.
- There are no World Heritage Sites, Registered Battlefields or Registered Historical Parks and Gardens within the study area.
- Visual effects on cultural heritage assets are limited. These will be kept to a minimum by the considered retention of vegetation during site clearance. There will be no permanent residual effects on the setting of heritage assets.
- Construction effects on landscape and visual amenity would be short term and not significant. Adverse effects in year of opening would be reduced by mitigation planting in the short to medium term and would not be significant.
- The Proposed Scheme is considered to have a long term neutral effect in terms of landscape and visual amenity.
- Mitigation planting is proposed across the scheme to replace removed vegetation
- Enhancement opportunities across the scheme are limited to improving species mix, connectivity with existing vegetated links.

7.1. Introduction

7.1.1. This section 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.

7.1.2. The Proposed Scheme passes through the Green Belt to the south-east of Birmingham. The area consists of a mixture of hedgerow lined pastoral and arable fields interspersed with small woodlands, farmsteads and villages overlying very gently undulating topography.

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

- The landscape setting of 3 potentially susceptible landscape character areas;
- Views from residential property locations most likely to be susceptible to a change in view as a result of the Proposed Scheme. In particular properties on Forshaw Heath Lane, Wood End Lane, Pound House Lane, (including West, North and East Lodges), Umberslade Road, Tinkers Lane, and Kineton Lane;
- Views from Public Rights of Way (PRoW) that run in close proximity to and cross the Proposed Scheme; and
- Potential impacts on the landscape setting of designated cultural heritage assets identified for further assessment within the cultural heritage section of the Scoping Report.

7.1.4. The supporting appendices are:

- Appendix D.1 – Landscape and cultural heritage BIM table

7.1.5. Supporting plans include:

- Figure 7.1 – 7.6 Landscape Appraisal
- Figure 7.7 – 7.15 Landscape Viewpoint photographs
- Figure 7.16 Cultural Heritage Features

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

Professional Competency Landscape and Visual

Name	Grade and Company	Expertise and Professional Qualification
Debbie Taylor	Environmentalist Amey Consulting	Worked in the heritage sector for over 15 years as a Curatorial Archaeologist and an Archaeological Consultant. MA in Archaeological Heritage Management and BA(Hons) in Archaeology and Medieval Studies. Has worked on a variety of highways scheme, including the A47 improvement schemes for Highways England.
Mary O'Connor	Associate Director WYG	Has professional expertise, developed over 30+ years, in the field of landscape planning and environmental impact assessment. Active also in developing best practice guidelines being a member of the Advisory Panel for the 3rd edition (GLVIA3). FLI: Chartered Landscape Architect & Fellow of the Landscape institute, PIEMA: Practitioner Member of the Institute of Environmental Management & Assessment
Donna Vinnels	Landscape Architect WYG	Worked within the landscape industry for 20 years with 8 years of consultancy and landscape and visual impact assessment experience including previous motorway schemes. BSc (Hons) in Landscape Design
Marcus Pinker	Landscape Architect WYG	8 years' experience as a landscape architect including 6 years working on landscape and visual assessments. MA (distinction) in Landscape Architecture and BSc (Hons) in Mapping Science, CMLI: Chartered Landscape Architect

7.2. Scoping

7.2.1. This assessment has been undertaken in accordance with the conclusions of the Environmental Scoping Report (Ref 7.1) 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. The Environmental Scoping Report states in paragraph 3.4.13 that "as there are no national landscape character areas that are sensitive have been identified they are thus scoped out of the assessment". Paragraph 7.5.8 states that "all four county LCA's identified by Worcestershire and Warwickshire County Council within the study area, are considered to, bearing in mind the nature of the proposed interventions, have a high capacity to receive the proposed scheme, and are therefore not potentially susceptible to change". The assessment considers effects on the local landscape character of the study corridor. Following review of the proposals at DF2 and DF3 to confirm this assessment, details of visual receptors that are excluded or have changed are listed in Table 7.1.

7.2.2. The Environmental Scoping Report concluded that the Proposed Scheme may 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 new highway infrastructure including new and upgraded gantries, new running lanes, remotely operated temporary traffic management sign (ROTTM signs) 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: Change to Potentially Susceptible Visual Receptors Recorded in Scoping Report and Table 7-2: Change to PRoW Receptors Recorded in Scoping Report). Receptors have been removed from consideration where conditions identified on site, that may not have been apparent in the desk study, were identified that reduced their sensitivity or value, or their susceptibility to change. The viewpoints that are considered to be of high sensitivity and where the

view is potentially susceptible to change are presented in Table 7.10 Potentially Sensitive Landscape Receptors, Table 7.11 Visual Receptors and on Figure 7.1.

Table 7-1: Change to Potentially Susceptible Visual Receptors Recorded in Scoping Report

Id	Location	Observation	Additional or Deletion from Scoping Report
PSVR1	Covers 3 residential properties and a commercial building on Forshaw Heath Lane	Workers in commercial building less sensitive than those of the residential properties. Motorway and proposed gantries may be visible from properties if soft estate vegetation removed. Construction of new lay-by visible from southernmost property if soft estate vegetation removed.	Changed
PSVR4	Abbey Farm, The Common	Orientated towards B road, vegetation around site and intervening hedgerow between farm and motorway, which is in a cutting	Deleted
PSVR11	Lapworth Grange, Church Lane	Motorway in deep cutting with mature intervening trees	Deleted
PSVR12	Old Grove Farm, Umberslade Road	View of J3A from residential property (listed building) – location of proposed gantries in view	Additional
PSVR13	Nuthurst Road north of Harrison's Farm	Glimpsed views from minor road of motorway and site of proposed gantry to north	Additional

Table 7-2: Change to PRoW Receptors Recorded in Scoping Report

Id	Location	Observation	Additional or Deletion from Scoping Report
PRoW5	West of The Common, west-bound side	Combined with PRoW4	Changed
PRoW14	Bridleway between Stratford Road and Nuthurst Farm	Open and unfiltered views to north towards motorway. Proposed gantry locations visible	Additional

7.2.4. The assessment of effects on the setting of designated heritage assets is restricted to the listed buildings presented in Appendix D.1 of this EAR. This included sites within a 300m study area (Ref 7.2).

7.2.5. The following aspects were scoped out of the assessment:

- Historic assets between 300m and 1km were assessed for exceptional sensitivity such as long-range historic views during the scoping study, with none identified and were thus scoped out.
- Non-designated heritage assets due to the nature of the works within an existing context of operational motorway.
- Night-time surveys or assessment as no significant changes to the lighting regime along the scheme length and as a result lighting will not give rise to a significant adverse effect.

7.2.6. The designated cultural heritage assets identified within the Environmental Scoping Report as having a potential to have their setting affected by the Proposed Scheme (see Figure 7.1) were confirmed by a site visit. No assets were removed from further consideration.

7.2.7. Table 7-12 presents those cultural heritage assets for which an assessment has been undertaken

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 heritage asset 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 identified within the Environmental Scoping Report, within which locations where changes as a result of construction or operation may be experienced have been identified. As visual effects would be generated within the existing highway boundary and would largely be experienced by receptors located within 300m of the motorway, visual effects beyond this, up to and more than 1km distance, are generally considered negligible. The exception is where there are views from high ground towards the motorway to the south-west of the M40 where visual effects would be experienced by receptors up to 600m from the motorway.

7.3.3. The chainages used on the Proposed Scheme are:

- 0+000 to 8+800 M42 J3a to J3a and then M40 to J16;
- 0+000 to 1+619 M42 J3a east-bound north-bound link;
- 0+000 to 1+762 M42 J3a south-bound west-bound link;
- 0+000 to 1+762 M42 J3a west-bound north-bound link;
- 0+000 to 0+780 M42 J3a south-bound east-bound link; and
- 0+000 to 3+000 M42 J3a to J4.

Cultural Heritage

7.3.4. The study area for cultural heritage assets is based on a 1km offset of the Proposed Scheme although a buffer of 300m has been imposed for primary consideration of their setting.

Legislation, Policy and Guidance

7.3.5. 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 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

7.3.6. The assessment methodology uses guidance set out in DMRB, Volume 11, Section 3, Part 2 (HA 208/07).

Baseline information and data sources

7.3.7. Data sources used in this assessment include:

- Ordnance Survey 1:25,000 scale maps;
- Google Earth and Street View to check as appropriate;
- M40/M42 Interchange Environmental Scoping Report, May 2018;

- National Tree Map data to determine the likely structure and integrity of existing vegetation within and outside the boundaries of the road corridor;
- MAGIC for landscape designations, listed buildings, ecological designations and Local Plans for conservation areas and Green Belt coverage.;
- National Heritage List for heritage designations, including World Heritage Sites, Listed Buildings, Scheduled Monuments and Conservation Areas, Registered Battlefields and Registered Parks and Gardens (Ref 7.3) ; and
- The Setting of Heritage Assets, Historic Environment Good Practice Advice in Planning (Ref 7.4).

7.3.8. 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:

- Warwickshire County Council (1993) Warwickshire Landscapes Project; and
- Solihull Borough Landscape Character Assessment (2016).

7.3.9. There is a degree of overlap between the two landscape character assessments identified above. The Solihull Borough Landscape Character Assessment only covers a very small proportion of the scheme. For the purposes of this report and to ensure consistency across the study area, 'Warwickshire's Landscape Project' has been used which covers the entire study area. This has been cross checked with the Solihull Borough Landscape Character Assessment which determined that the character area description remains the same across both documents for the overlap area.

7.3.10. Confirmation received from the relevant Local Planning Authorities has confirmed that no new Conservation Areas or extensions to existing Conservation Areas have been approved since 2014.

7.3.11. Site visits were made in February 2019 to carry out the landscape, visual amenity and heritage setting assessments from publicly accessible areas. The survey time was selected during winter months to enable assessment to be undertaken in the absence of leaf cover.

7.3.12. In accordance with a Simple Assessment and to make the assessment proportionate to the Proposed Scheme, visual effects have been considered in broad terms. Key representative viewpoints have been assessed to illustrate the visual effects from a range of visual receptors surrounding the Proposed Scheme. These encompass, and occasionally expand upon, the receptors identified within the Environmental Scoping Report.

7.3.13. Visual amenity and heritage setting effects have been assessed from publicly accessible vantage points at key representative viewpoints. 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 Amenity Assessment Criteria

Valuing Receptors

7.3.14. The criteria which determines the sensitivity of identified landscape and visual receptors are set out in

7.3.15. Table 7-3.

Table 7-3: Landscape and Visual Sensitivity Criteria (Ref 7.5)

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	• 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

Sensitivity	Landscape - typical criteria descriptors	Visual – typical criteria descriptors
	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.	recreation is enjoyment of the countryside (such as Country Parks, National Trust or other access land etc.)
Moderate	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).

Characterising the Magnitude of Impacts

7.3.16. 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 (see **Table 7-4**). Definitions relating to the magnitude of landscape impact are defined in IAN 135/10.

Table 7-4: Magnitude of Impact - Landscape Criteria (Ref 7.6)

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.

7.3.17. The scale, type and duration of impact which the Proposed Scheme would bring to key representative viewpoints have been assessed in accordance with Simple Assessment. The criteria defined in **Table 7-5** have been used to define the magnitude of visual impact within this assessment.

Table 7-5: Magnitude of Impact - Visual Criteria (Ref 7.7)

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.

Characterising the Significance of Effects

7.3.18. 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 7-6** supported by professional judgement.

Table 7-6: Significance of Effect for Landscape and Visual Receptors (Ref 7.8)

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
Moderate	Neutral	Neutral/ Slight	Slight	Moderate	Moderate/ Large
Low	Neutral	Neutral/ Slight	Neutral/ Slight	Slight	Slight/Moderate
Negligible	Neutral	Neutral	Neutral/ Slight	Neutral/ Slight	Slight

7.3.19. Assessment schedules in **Section 7.5** record and describe each assessed landscape area, key viewpoints and the setting of cultural heritage assets 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

Valuing Heritage Asset Receptors

7.3.20. 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.

7.3.21. The criteria outlined in **Table 7-7** 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.

Table 7-7: 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.	• 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	• Designated historic landscapes of outstanding interest. • Undesignated landscapes of outstanding interest. • Undesignated landscapes of high quality and importance,

Value	Archaeological Assets	Historic Buildings	Historic Landscape Character
	• Assets that can contribute significantly to acknowledged national research objectives.	not adequately reflected in the listing grade. • Conservation areas containing very important buildings. • Undesignated structures of clear national 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).
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.

Characterising the Magnitude of Impacts

7.3.22. The criteria outlined in **Table 7-8** 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.

Table 7-8: 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.
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.

Characterising the Significance of Effects

7.3.23. Assessment of significance of effects on heritage assets follows a similar approach to reach a value for significance of effect as shown in **Table 7-6** above. The approach is based upon the guidance in DMRB Volume II section 3 Part 2 (HA208/07), The Setting of Heritage Assets and professional judgement. Detailed description of the historic asset setting and the impacts are provided in Table 7.12.

7.3.24. Where a choice of two 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.

Stakeholder Engagement

7.3.25. At this stage of assessment, no stakeholders were contacted.

Assumptions and Limitations

7.3.26. 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 key representative viewpoints so that the assessment is proportionate to the scale of the proposals. However, due to the nature of the predominantly rural landscape surrounding the Proposed Scheme there are some viewpoints that represent individual properties or farmsteads. 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;
- **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. 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 professional judgement and use of aerial photography. 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. Sensitive receptors were identified and assessed on a worst case scenario.
- **Replacement planting:** This assessment has been provided on the basis that replacement native tree and shrub planting will be implemented in areas cleared for construction and where sight lines, available space and safety requirements allow. This has been reflected in the assessment and professional judgement has been used to identify assumed extents of reinstated planting;
- **Winter effects:** The site survey work was undertaken in February 2019, at a time when deciduous vegetation was in not in leaf, allowing winter effects to be assessed;
- **Tree Survey:** A tree survey has not been undertaken. Therefore, the locations of trees that will be saved 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 identify the line of the works extents. It is anticipated an arboriculturist, or other appropriately qualified professional, will 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;
- **Tree Preservation Orders:** Information from Local Authorities regarding TPOs was included in the ESR (May 2018), although digital data for Tree Preservation Orders (TPO) was not available from Bromsgrove District Council. TPO data was available from Solihull Metropolitan Borough Council, and Stratford-on-Avon District Council which is considered. Identified TPOs in the 300m study corridor are shown on the Site Appraisal drawings. Woodland and trees within and bordering the soft estate and within the study corridor have been considered in this assessment.
- **Environmental barriers:** This assessment assumes that all existing environmental barriers shown to be retained in the design would be removed and replaced in situ, which represents the worst-case scenario. This is because the need to remove and replace barriers is reliant on design confirmation, which was not available at the time of assessment. Temporary visual intrusion during construction and the extent of existing vegetation loss would theoretically result in an increased impact if the barriers are not 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/ environmental barriers, gantries and associated features. It has been assumed that environmental 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 detailed treatment of verge slopes and retaining structures within the working area are not known at the time of this assessment so cannot be fully assessed at this stage.

- Offsite works: The locations of the construction compound and other offsite works have not been identified at this stage and therefore have not been assessed within this EAR.

7.3.27. The following assumptions and limitations are applicable for the assessment of heritage effects during construction and operation of the Proposed Scheme:

- As no new lighting is proposed between Junction 16 of the M40 and the interchange effects on heritage assets from lighting have been scoped out.
- No vegetation removal is proposed on the east-bound carriageway between marker posts PT.97 and PT.99 adjacent to the Grade II listed East Lodge and Gatepiers, beyond the highway boundary.

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 section of the Proposed Scheme crosses through three landscape character areas, Arden Pastures, Arden Parklands and Ancient Arden. The landscape within which the scheme is located is not covered by any national designation. There are several SSSI's in the study area, notably at Windmill Naps which abuts the southern boundary of the M42 between J3 and J3a, and the River Blythe SSSI, which meanders across the north-western part of the study area but does not cross the M42 until north of J4. All the study area apart from the Blythe Valley development area, lies within the Birmingham Green Belt.

7.4.3. Throughout the study area the landform gently undulates, the hills slightly gaining in height and steepness towards the south. The Stratford upon Avon Canal crosses the study area from the north-west to the south-east, emphasising the generally flat nature of the terrain.

7.4.4. Small to medium sized pastoral and arable fields divided by overgrown hedgerows with numerous mature hedgerow trees, predominantly oak, define the area. The agricultural land is interspersed by scattered farmsteads, hamlets and deciduous copses, many of which are ancient woodland. The area is served by a dense network of minor roads and lanes and is crossed by A roads and the M40/M42 connecting it to the wider area. The Birmingham to Stratford upon Avon railway crosses the western part of the study area.

7.4.5. Hockley Heath, in the far east, is the only notably sized settlement in the study area and is focused around the convergence of the A3400 and the Stratford upon Avon Canal. Wood End, in the south-west, has ribbon development consisting of large detached properties along its approach roads. Blyth Valley Business Park, in the north of the study area, is the only major employment area in the study area and its character of large offices and shrub lined roads is at odds with the rest of the area.

7.4.6. A description of the soft estate within the areas and the landscape condition, value and importance of the LCAs are summarised in **Table 7-9**.

7.4.7. The locations of the landscape areas, key representative viewpoints and cultural heritage assets are indicated on Figure 7.1-7.16. All Highly Sensitive Visual Receptors identified in the Environmental Scoping Report are also indicated for reference.

Table 7-9: Summary of Landscape Character

LCA	Description	Soft Estate	Value
Warwick-shire Landscape Project: Ancient Arden	• A small scale farmed landscape with a varied, undulating topography, characterised by an irregular pattern of fields and narrow, winding lanes.	• The east-bound side of the M40 has a strong band of semi-mature trees along its boundary. The west-bound side is predominantly open with only a few areas of dense scrub in the soft estate. • This section is not lit.	Good condition. High value and of regional importance
Warwick-shire Landscape Project: Arden Pastures	• A small scale, enclosed landscape, often pervaded by suburban influences and characterised by small fields, typically bordered by mature hedgerow trees.	• Covers two separate sections of the M42, to the west of J3a and to the north of J3a. • The former has intermittent planting along its soft estate, with vegetation being at its densest when adjoining woodlands, when the road is in cutting, or adjacent to over-bridges. Elsewhere hedgerows of various densities line the highway boundary. • The section to the north of J3a overlaps with the Solihull LCA areas. Here, the majority of the north-bound carriage was a reasonably strong band of semi-mature trees on its soft estate. South-bound, the soft estate is more open with a hedgerow a typical feature on its narrow extent. • The western section is not lit, the northern section is fully lit.	Good condition. High value and of regional importance
Warwick-shire Landscape Project: Arden Parklands	• An enclosed, gently rolling landscape defined by woodland edges, parkland and belts of trees.	• The character area is centred around the interchange of the M42 and M40. • Large parts of the soft estate contain semi-mature trees, many on embankments. Elsewhere, hedgerows are common where the soft estate is narrower. • The junction roads and the M42 to their north are lit. The M40 to the east and M42 to the west are not lit.	Good condition. High value and of regional importance

Historic Environment

7.4.8. The Environmental Scoping Report identified five designated heritage assets located within 300m where there was the potential for their setting to be affected by the Proposed Scheme (Table 7-12). Three of the designated heritage assets are geographically and historically associated with each other, they are the Obelisk, Obelisk Farmhouse and the East Lodge of Umberslade Hall.

Existing Vegetation

7.4.9. The motorway runs through predominantly pastoral agricultural land which consists of small to medium sized fields bounded by mature and unmaintained hedgerows. Mature hedgerow trees, mostly oak, are a common feature, as are small blocks of deciduous woodland. There are two larger blocks of woodland to the south of the M42 between J3 and J3a (west-bound side) and north-east of M42 J3a (south-bound side).

7.4.10. Umberslade Park to the south-west of the M40 (west-bound side) is a parkland landscape containing mature trees and copses on undulating grassland. Blythe Valley Park, to the south-west of M42 J4 (north-bound side), surrounds a modern business park. The park consists of semi-mature deciduous trees and open spaces with the maintained business park landscape in its centre. Immediately to the west of the business park a new large-scale housing development is currently under construction.

7.4.11. The existing highway vegetation comprises largely even-aged densely spaced broadleaved trees and shrubs that are likely to have been planted following the construction of this section of the network. The height and density of this planting is largely dependent on the type and depth of

earthworks, i.e. where space allows there are more tree species; and where narrower, shorter shrub mixes are found. There are occasional areas along the length of the Proposed Scheme where there is little or no planting. The result is occasional views into the motorway corridor from the surrounding landscape, particularly when abutting more rural areas along the corridor.

7.4.12. The existing motorway varies between being in a low cutting, on a low embankment or at ground level over the length of the Proposed Scheme. The largest cuttings are on the M42 midway between J3 and J3a on either side of Spring Brook and on the M40 at J16. Where the M42 crosses Spring Brook and a railway line between J3 and J3a, and the Stratford-upon-Avon Canal and a minor road between J3a and J4, are the only embankments with overbridges on the motorways. The overbridges of J3a are the most raised elements of the existing motorway, although these are set amid woodland and are visible from limited locations. Aside from adjacent to the canal, all minor roads and the junctions pass over the motorways. The only public right of way to cross the motorway on a footbridge is to the east of Blythe Valley Park (south of M42 J4), while there are two underpasses where public footpaths cross the motorway at Spring Brook, between M42 J3 and J3a and between Umberslade and Obelisk Farm between M40 J16 and M42 J3a.

7.4.13. The highway boundary is generally marked by a wooded post and rail fence with wire mesh, backed by a hedgerow, typically of blackthorn or whitethorn. Cutting and embankment slopes are predominantly wooded, while there are several areas, adjacent to agricultural land, where the motorway is at ground level that have no woody vegetation between the verge and the fence. The embankments and cuttings around all the junctions in the study area are well wooded.

7.4.14. As a result of the maturity and extent of vegetation along the motorway, views towards traffic and infrastructure along it are frequently screened from adjacent visual receptors and in these locations vegetation is meeting the current environmental objectives. The notable exception to this is on two sections of the M40 where a public footpath follows the highway boundary, immediately to the east of J3a on the east-bound side and west of the J16 on the west-bound side. In these locations the public footpaths are separated from the motorway by either a gappy hedgerow or just a fence, which allows for open views directly onto and along the motorway corridor. Mitigation and enhancement proposals, taking into consideration Highways England Licence and RIS environmental objectives, are documented in sections 7.6 and chapter 11 as well as the Outline Environmental Management Plan (OEMP).

7.4.15. A total of 14 areas of ancient woodland have been identified on Figures 7.1 – 7.15 within 300m of the Proposed Scheme, with the following abutting the Proposed Scheme:

- Blackoak Wood, north-east of M42 J3, 200m along slip road;
- Checkley's Coppice, 600m east of M42, J3, 100m along east-bound carriageway;
- Windmill Naps, 1.2km east of M42 J3, 450m along west-bound carriageway;
- Woods Coppice, 1km west of M42 J3a, 40m along east-bound carriageway;
- Clarksland Coppice, 550m west of M42 J3a, 250m along west-bound carriageway;
- Bissell's Coppice, west of M42 J3a, 220m along east-bound carriageway;
- Ancient woodland ID1410809, west of M42 J3a, 150m along south-bound carriageway;
- Ancient woodland ID1410807, south of M42 J3a, 160m along west-bound carriageway;
- Chalcot Wood and Arnold's Wood, east of M42 J3a, 800m along south-bound carriageway; and
- Ancient woodland ID1410672, west of M42 J3a, 300m along north-bound carriageway.

7.4.16. Identified TPO (Tree Preservation Order) trees within the 300m study corridor of the Proposed Scheme are shown the Site Appraisal drawings. The identified TPOs are situated outside of the soft estate and would not be affected by the proposed works as they are outside of the works area. All woodland blocks and trees within and bordering the soft estate and within the study corridor have been considered within this assessment.

Visual Influence

7.4.17. The study has included within the site appraisal a Zone of Visual Influence (ZVI). Although a detailed visibility analysis was scoped out of the study, the ZVI was delineated from topographical information, aerial photography and observation on site of the factors enabling or restricting visibility of the Proposed Scheme. It demonstrates the limited effects of the Proposed Scheme on the wider area, focusing the assessment on affected receptors.

Visual Amenity

7.4.18. The motorway is not bordered by any suburban residential estates. Individual residential properties are located adjacent to the highway boundary at:

- West side of Forshaw Lane, M42 west-bound side, east of J3;
- West side of Wood End Lane, M42 west-bound side, between J3 and J3a;
- Lilac Cottage, Tinkers Lane, M42 south-bound side, between J4 and J3; and
- East Lodge on Pound House Lane, M40 west-bound side, east of M42 J3a.

7.4.19. Aside from the residential properties listed above that are adjacent to the highway boundary, there are other properties within 300m of the motorway that may be impacted by the Proposed Scheme. These include houses near the M42 (from J3 to J4) on Forshaw Heath Lane, Juggins Lane, Poolhead Road, Wood End Lane, Umberslade Road, Dyers Lane and Kineton Lane, and on the M40 (from J16 to M42 J3a) on Pound House Lane.

7.4.20. The study area is traversed by a moderately dense PRoW network, the vast majority of which is public footpaths. There are no long distance paths either crossing the motorways or within 300m of them. Public footpaths cross the motorway in underpasses at Spring Brook (between J3 and J3a on the M42) and between Obelisk Farm and Umberslade Park (between J16 on the M40 and J3a on the M42), while a public footpath crosses the M42 on a footbridge just to the south of J4 and to the east of Blythe Valley Park. A towpath with public access also follows the northern bank of the Stratford-upon-Avon Canal, which passes beneath the M42 shortly to the north of J3a.

7.4.21. Although the rural landscape is relatively open and flat, the combination of the woodland blocks, hedgerow trees and the vegetation within the soft estate, helps to screen or filter views to the motorway and traffic.

Representative Viewpoints

7.4.22. Representative viewpoints have been selected to identify visual effects on the Highly Sensitive visual receptors.

Sensitivity of Resource

7.4.23. The sensitivity of the identified landscape, visual receptors and heritage assets is recorded in **Table 7-10**, **Table 7-11** and **Table 7-12**.

Receptor details

7.4.24. The following Tables 7-10 – 7-12 set out the Landscape, Visual and Heritage receptors identified, with notes of the Baseline conditions, Observations from field survey, the Mitigation/ Enhancement Potential at each location, its Distance (m) from highway boundary, and the assessed receptor Sensitivity. Table 7-11 Visual Receptors contains some other details related to viewpoints and factors affecting the view.

7.4.25. Table 7-10 addresses the landscape character and characteristics of each section of the motorway corridor, up to 300m from the centreline, and the Warwickshire LCA/s in which it lies. Length of exposure: For receptors viewing from a PRoW, the length of exposure refers to the length of the PRoW from which a view of the motorway is available. For residential receptors, it refers to the length of the motorway that is visible from the property.

Table 7-10 : Potentially Sensitive Landscape Receptors

ID	Location (chainage)	LCA	LCA Baseline	Observation from field studies	Mitigation/ Enhancement Potential	Distance[8] (km)	Sensitivity
PSLR1	M42 0+500 to 2+400	LCA: Arden Pastures	• A gently rolling topography • A well defined pattern of small fields and paddocks • Numerous mature hedgerow trees • Permanent pasture often grazed by horses • A network of minor lanes often with ribbon development • Many place names ending in Heath	Land cover comprises of flat arable farmland divided by tree lines containing mature oaks with numerous copses of deciduous woodland, many of which are ancient. Scattered and mixed built form including residential housing, commercial and industrial buildings, a sports facility, and a park home development, create a fractured pattern to the landscape. M42 either at ground level or in shallow cutting. When adjacent to farmland the soft estate is lightly vegetated, elsewhere there is dense scrub or semi-mature trees. Aside from in open farmland, vegetation in the landscape creates separation from the M42, although the presence of the motorway still affects the tranquillity.	EB where properties or PRoWs are adjacent or close to the highway boundary. Trees in the soft estate and hedgerows when adjacent to farmland.	2.0km	Moderate
PSLR2	M42 2+400 to 4+000	LCA: Arden Pastures	• A gently rolling topography • A well defined pattern of small fields and paddocks • Numerous mature hedgerow trees • Permanent pasture often grazed by horses • A network of minor lanes often with ribbon development • Many place names ending in Heath	Gently rolling hills on either side of Spring Brook. M42 in cutting through hills and embankment over the brook. Dense scrub and trees on the soft estate in the cuttings and on the embankment slopes. Land cover consists of pastoral farmland with scattered residential properties and small to medium sized fields bounded by hedgerows. No areas of woodland or copses and mature hedgerow trees generally only found along side roads. The landscape pattern is irregular but not sinuous, with boundaries generally being straight but rarely perpendicular. The motorway cuttings and their vegetation aid in creating a degree of isolation in the surrounding area from its presence, although it still has a strong influence on the tranquillity of the area.	EB where properties or PRoWs are adjacent or close to the highway boundary. Trees in the soft estate.	1.6km	Moderate

[8] For the landscape assessment, this is the length of the motorway corridor being assessed.

ID	Location (chainage)	LCA	LCA Baseline	Observation from field studies	Mitigation/ Enhancement Potential	Distance[8] (km)	Sensitivity
PSLR3	M42 4+000 to M40 6+600 and M42 J3a 0+000 to 1+500	LCA Arden Parklands	• Middle distance views enclosed by woodland edge • Belts of mature trees associated with estate lands • Many ancient woodlands, often with irregular outlines • Large country houses set in mature parkland • Remnant deer parks with ancient pollard oaks • Thick roadside hedgerows, often with bracken	A flat landscape in which the slip roads of J3a are the only raised elements. Land cover is a mixture of small ancient woodlands and farmland. To the south, the latter is arable and medium to large fields divided by gappy hedgerows. To the north of the motorway the farmland is predominantly pastoral and consists of small fields divided by hedgerows with numerous mature trees. The woodlands and hedgerows form the pattern of the area, with occasional farmsteads being the only built form present beyond the motorway. Where the motorway passes through woodland the soft estate is densely vegetated, through farmland a hedgerow along the highway boundary in commonplace. Where woodland is present, it forms a strong landscape element which assists in creating a level of tranquillity that is not present in the open farmland areas.	Trees in the soft estate where space allows, hedgerows elsewhere and when adjacent to farmland.	1.6km + 1km	Moderate
PSLR4	M40 6+600 to 8+700	LCA: Arden Pastures and Ancient Arden	• A gently rolling topography • A well defined pattern of small fields and paddocks • Numerous mature hedgerow trees • Permanent pasture often grazed by horses • A network of minor lanes often with ribbon development • Many place names ending in Heath • A varied undulating topography	Land cover is predominantly pastoral farmland on undulating topography. More open than the other character areas with the medium sized fields divided by gappy or low hedgerows, which often follow an irregular course. Mature hedgerow trees are also less common. No notable woodlands and copses are rare. Variations occur in the landscape pattern at Umberslade Park, a parkland landscape, in the north-west, and an area of Christmas tree plantation in the south-east. M40 passes through deep cuttings to the north-west and south-east of area, the slopes of which are well treed with semi-mature trees. The soft estate in the central section is predominantly open with occasional patches of scrub. The relative openness or enclosure created by these features has a large effect on the tranquillity of the surrounding areas. Umberslade Park, an obelisk at Obelisk Farm and a couple of nearby listed buildings form a relatively strong historic environment in the northern part of the area.	EB where properties or PRoWs are adjacent or close to the highway boundary. Trees in the soft estate where space allows and hedgerows when adjacent to farmland.	2.2km	Moderate

ID	Location (chainage)	LCA	LCA Baseline	Observation from field studies	Mitigation/ Enhancement Potential	Distance[8] (km)	Sensitivity
			• A network of winding lanes and trackways often confined by tall hedgebanks • An ancient irregular pattern of small to medium sized fields • Hedgerow and roadside oaks • Field ponds associated with permanent pasture • Many place names ending in Green or End				
PSLR5	M42 0+000 to 3+000	LCA: Arden Pastures	• A gently rolling topography • A well defined pattern of small fields and paddocks • Numerous mature hedgerow trees • Permanent pasture often grazed by horses • A network of minor lanes often with ribbon development • Many place names ending in Heath	The majority of the area is covered in small, mostly regular shaped pastoral fields which contain a high density of mature trees in their hedgerows, which form the landscape pattern. The flat landform contains few buildings away from the small settlement of Illshaw Heath, which lies to the west of the area. There are no woodlands in the area although there are a few deciduous copses and some notable vegetation on the M42 soft estate, particularly to its west. The soft estate on its eastern side has few areas with established vegetation. These features create a rural identity to the area, although this is being encroached on by Blythe Valley Park to the north-west. The soft estate vegetation plays an important role in providing a degree of tranquillity to the residential area at Illshaw Heath.	EB where properties or PRoWs are adjacent or close to the highway boundary. Trees in the soft estate where space allows and hedgerows when adjacent to farmland.	3.1km	Moderate
PSLR6	M42 1+600 to 3+000	LCA: Arden Pastures	• A gently rolling topography • A well defined pattern of small fields and paddocks • Numerous mature hedgerow trees • Permanent pasture often grazed by horses	A small area in the north-east of the study area consisting of Blythe Valley Park, a commercial estate comprising of office buildings and car parks surrounded by a band of public open space, a landscape pattern typical of this form of development. A large housing development is currently being constructed to the west of the park. The development has put an emphasis on green infrastructure connectivity and strong tree lines are	Trees in the soft estate.	1.5km	Low

ID	Location (chainage)	LCA	LCA Baseline	Observation from field studies	Mitigation/ Enhancement Potential	Distance[8] (km)	Sensitivity
			• A network of minor lanes often with ribbon development • Many place names ending in Heath	present both within the development and surrounding it. The number of trees and the buildings help to create the strongest degree of separation between the area and the motorway in the study area.			

Table 7-11 : Visual Receptors Potentially Sensitive to Visual Intrusion

ID	Location	No. of Receptors	LCA	Observation	Existing View	Existing Barrier	Mitigation/ Enhancement Potential	Nearest carriageway	Distance (m)	Length of Exposure (est.) (m)	Sensitivity
PSVR 1	Forshaw Heath Lane	3 residential properties and 1 commercial property	LCA: Arden Pastures	Views of the motorway from the rear of the 3 residential properties are currently filtered or screened by soft estate vegetation. Motorway in a cutting to the west at J3. EA would be visible from rear of southernmost property.	Row of conifers screens the view from the property adjacent to the motorway on the west-bound side. Seasonal filtered views through deciduous vegetation from the remaining properties and commercial unit, the latter being adjacent to the east-bound carriageway.	No	Environmental fence and replacement planting where removed	M42 east-bound and west-bound	Adjacent	Up to 560m	High

ID	Location	No. of Receptors	LCA	Observation	Existing View	Existing Barrier	Mitigation/ Enhancement Potential	Nearest carriageway	Distance (m)	Length of Exposure (est.) (m)	Sensitivity
PSVR 2	Wood End Lane	3 residential properties on west side of northern end of lane	LCA: Arden Pastures	Motorway in cutting immediately to the north with dense deciduous woodland on embankment. Vegetation removal on embankment may create a view of the motorway.	All three properties face east, which allows for a filtered and oblique view towards the motorway about 500m to the east, where it crosses an embankment across Spring Brook.	No	Environmental barrier along top of embankment adjacent to property	M42 west-bound	Adjacent	Up to 500m	High
PSVR 3	Earls-Brook Farm, Wood End Lane	1 residential property	LCA: Arden Pastures	Replacement gantry to west of Spring Brook – vegetation clearance may make it more visible. New gantry	Filtered views from rear of property towards short stretch of motorway as it crosses Spring Brook on an embankment with cuttings on either side. Embankment partly wooded.	No	Replacement planting along soft estate boundary	M42 west-bound	260m	Approx. 350m	Moderate
PSVR 5	Lilac Cottage, Tinkers Lane	1 residential property	LCA: Arden Pastures	Existing conifers form an important barrier between the property and the motorway. Existing EA shortly to north with no screening on the soft estate.	Mature conifer hedge between the property and the adjacent motorway with closed board fence between trees and VRS. Motorway slightly elevated.	No	Retain screening conifers. Higher fence.	M42 south-bound	Adjacent	Approx. 150m	High
PSVR 6	Illshaw Heath Farm and Kineton Lane	Approx. 25 residential properties	LCA: Arden Pastures	Apart from the farm, all properties face east towards the motorway. No proposed gantries or EAs in visible area.	Filtered and glimpsed views through gappy hedgerows and soft estate vegetation towards motorway, where traffic movement is partially visible. Motorway in a shallow cutting (approx. 2m lower)	No	Ensure gaps in vegetation are planted with screening vegetation.	M42 north-bound	160m	Up to 460m	Moderate

ID	Location	No. of Receptors	LCA	Observation	Existing View	Existing Barrier	Mitigation/ Enhancement Potential	Nearest carriageway	Distance (m)	Length of Exposure (est.) (m)	Sensitivity
PSVR 7	West Lodge and West Cottage, Brown's Green	2 residential properties	LCA: Arden Park-lands	Mature trees to north of Pound House Lane filter or partly screen views from the properties towards the motorways. Proposed gantries may be partly visible.	View towards the motorway (J3a) partly filtered by site vegetation and trees on Pound House Lane. Elevated sections of junction visible where views are available.	No	Strengthen planting on fly-over embankments.	M42 west-bound and M40 west-bound	400m	Up to 850m	Moderate
PSVR 8	North Lodge, Brown's Green	5 residential properties	LCA: Arden Park-lands	Proposed gantries at M42 J3a may be visible. Vegetation clearance on embankments would increase visibility of traffic movement.	Relatively open views from the rear of three properties across the intervening farmland towards J3a. Visibility of traffic movement partially filtered by trees on the soft estate.	No	Strengthen planting on fly-over embankment	M40 west-bound	200m	Up to 820m	Moderate
PSVR 9	East Lodge, Bramhope Pound House Lane	2 residential properties	LCA: Arden Park-lands	Existing mature trees, including conifers, and environmental fencing between properties and motorway. Existing gantry nearby to the east.	Existing mature trees and an environmental screen direct view from the properties towards the motorway. An oblique view to the south-east across farmland affords a distant view of a proposed new gantry.	Yes	Retain environmental barrier and mature trees	M40 west-bound	Adjacent	80m	High
PSVR 10	Obelisk Farm, Pound House Lane	1 residential property	LCA: Arden Park-lands	Proposed gantry and EA to south would be visible. Vegetation and landform screen views of the motorway to the west from the property.	Landform obscures the motorway in views to the west, the direction which the property is oriented. An existing gantry is visible in an oblique view to the south, with a glimpsed view of the motorway further to the south-east.	No	Additional planting in soft estate to the south on the M40 west-bound side.	M40 west-bound	190m	190m	Moderate

ID	Location	No. of Receptors	LCA	Observation	Existing View	Existing Barrier	Mitigation/ Enhancement Potential	Nearest carriageway	Distance (m)	Length of Exposure (est.) (m)	Sensitivity
PSVR 12	Old Grove Farm, Umber-slade Road	4 residential properties	LCA: Arden Park-lands	Eastern property the only one with views towards the motorway. Proposed gantries in centre of view.	View of J3A from residential property (listed building) – location of proposed gantries in view Movement of traffic visible against a wooded backdrop across a flat agricultural field. View partially filtered by intervening hedgerow.	No	Strengthen planting in soft estate	M42 north-bound	280m	340m	Moderate
PSVR 13	Nuthurst Road south of the M40 as it climbs the hill towards Harrison's Farm	Users of minor road	LCA: Arden Park-lands / Ancient Arden	Minor road on high ground to south of M40. Proposed gantries, EA and gantry to be removed within section of motorway visible.	Glimpsed view through roadside trees across the lower land to the north, which includes the M40. Existing motorway gantries and signs prominent features in the view.	No	None	M40 west-bound	400m	Up to 600m	Moderate
PRoW 1	PRoW between Forshaw Heath Lane and Poolhead Lane	Users of public footpath	LCA: Arden Pastures	Runs adjacent to motorway for 180m. Existing environmental barrier. Proposed new gantries nearby on west-bound carriageway.	The existing environmental barrier ensures that the motorway and its traffic are not visible where the footpath runs parallel with the highway boundary. However, further to the west filtered views are available through the soft estate vegetation, while to the east, a deciduous hedgerow along the soft estate boundary is the only obstacle in the view across an	Yes	Retain environmental barrier and planting between PRoW and VRS	M42 east-bound	Adjacent	870m	High

ID	Location	No. of Receptors	LCA	Observation	Existing View	Existing Barrier	Mitigation/ Enhancement Potential	Nearest carriageway	Distance (m)	Length of Exposure (est.) (m)	Sensitivity
					open field towards the motorway.						
PRoW 2	Public footpath between Forshaw Heath Lane and Tyler's Grove	Users of public footpath	LCA: Arden Pastures	Western 330m of footpath runs parallel to the motorway on top of an embankment. Vegetation removal here would open up views from the path across the motorway and two proposed gantries. Further east, proposed gantries and EAs would be visible across intervening farmland.	In the section of footpath parallel to the motorway, the view towards the road is heavily filtered by dense vegetation on the soft estate. To the east, as the footpath runs along the side of a field and heads away from the motorway, open views are available towards the motorway across the agricultural land to the north-east.	No	Ensure that vegetation removed where the footpath runs parallel to the motorway is replaced, potentially also with an environmental barrier.	M42 west-bound	Adjacent	610m	High
PRoW 3	Public footpath between Tyler's Grove and Poolhead Lane	Users of public footpath	LCA: Arden Pastures	Proposed gantry and gantry to be removed adjacent to footpath. Proposed EAs to west screened by vegetation.	Public footpath follows an access track along the top of an embankment that drops approximately 5m to the motorway cutting. Filtered view of the motorway through soft estate vegetation.	No	Replace any soft estate vegetation that is removed	M42 west-bound	Adjacent	440m	High
PRoW 4	Public footpath between Wood End Lane and The	Users of public footpath	LCA: Arden Pastures	Motorway in cutting at western and eastern ends and on embankment over Spring Brook between. Several proposed	Traffic screened by hedgerow along soft estate boundary when motorway in cutting. Elevated section across embankment provides views along motorway from higher sections of the footpath to the west and east.	No	Replace any soft estate vegetation that is removed	M42 west-bound	Adjacent	500m	High

ID	Location	No. of Receptors	LCA	Observation	Existing View	Existing Barrier	Mitigation/ Enhancement Potential	Nearest carriageway	Distance (m)	Length of Exposure (est.) (m)	Sensitivity
	Common (B4102)			gantries and EA on east-bound side.							
PRoW 6	Public footpath between Small Lane and railway line	Users of public footpath	LCA: Arden Pastures	Dense and mature soft estate vegetation for much of the length of the footpath. Exception is along the section that follows the sewage works access road. Proposed EA and gantry in this area.	View of motorway screened by vegetation and topography on western and eastern sections of footpath. Central section, along the sewage works access road, runs along the highway boundary. Vegetation removal here would create open views along the motorway corridor and of proposed EA and gantries.	No	Replace any soft estate vegetation that is removed	M42 east-bound	Adjacent	430m	High
PRoW 7	Bridleway that runs between Tithe Barn Lane and Umber-slade Road	Users of bridleway	LCA: Arden Park-lands	Motorway in shallow cutting when adjacent to PRoW – approximately 2-3m deep. Soft estate not very wide. Proposed EA and gantries adjacent to PRoW.	Dense deciduous hedgerow along highway boundary heavily filters views into the motorway corridor.	No	Replace any soft estate vegetation that is removed	M42 westbound	Adjacent	810m	High
PRoW 8	Stratford-upon-Avon Canal and towpath	Users of Stratford-upon-Avon Canal and towpath	LCA: Arden Pastures	Canal in densely wooded cutting, views from it and the towpath focussed along its alignment.	Existing barrier on bridge screens views of traffic from towpath and canal when heading south-bound. North-bound receptors can see traffic crossing the bridge for a short period. External views are	North-bound	Environmental barrier on north-bound side	M42 north-bound and south-bound	Adjacent	150m	High

ID	Location	No. of Receptors	LCA	Observation	Existing View	Existing Barrier	Mitigation/ Enhancement Potential	Nearest carriageway	Distance (m)	Length of Exposure (est.) (m)	Sensitivity
					screened by topography and vegetation.						
PRoW 9	Public footpath between Blythe Valley Park and Stratford Road	Users of public footpath	LCA: Arden Pastures	No proposed gantries or EAs in area visible from footpath. Gantry to be removed shortly to south	Open views both into and along the motorway corridor from the footbridge and where the footpath runs parallel to the highway boundary. Sections with no intervening vegetation between on the soft estate in the latter area.	No	None as openness is part of the character of the area	M42 north-bound and south-bound	Adjacent	350m	High
PRoW 10	Public footpath between Cut Throat Lane and Spring Lane	Users of public footpath	LCA: Arden Park-lands	Proposed gantry near eastern end of path. Motorway in a cutting at this location.	Semi-mature trees in soft estate on eastern section where motorway in cutting. West of this the highway boundary is defined by a fence with no screening vegetation.	No	Hedgerow in soft estate where space allows	M40 east-bound	Adjacent	990m	High
PRoW 11	Public footpath between Pound House Lane and Umber-slade Park	Users of public footpath	LCA: Arden Park-lands	Footpath climbs hill to south-west towards Umberslade. Proposed new gantries, gantries to be removed and EA on section of visible motorway.	As the footpath climbs the hill towards Umberslade open views, occasionally framed by mature parkland trees, are available over the motorway to the east. There is little soft estate planting to screen the motorway, its traffic or its infrastructure.	No	Hedgerow in soft estate where space allows	M40 west-bound	Adjacent to 750m	820m	High

ID	Location	No. of Receptors	LCA	Observation	Existing View	Existing Barrier	Mitigation/ Enhancement Potential	Nearest carriageway	Distance (m)	Length of Exposure (est.) (m)	Sensitivity
PRoW 12	Public footpath between Pound House Lane and Nuthurst Road	Users of public footpath	LCA: Arden Park-lands	Proposed gantry and EA near the south-eastern end of the footpath. Existing sign near the centre of the path is proposed to be removed.	From the highpoint of the footpath near the obelisk an open view is available to the south and along the motorway corridor. Topography screens north-western part of motorway from the footpath.	No	Hedgerow in soft estate where space allows	M40 east-bound	40m-125m	590m	High
PRoW 13	Public footpath between Nuthurst Road and Stratford Road (A3400)	Users of public footpath	LCA: Ancient Arden	Footpath follows M40 J16 slip road alignment and joins motorway edge to the west. Proposed gantry nearby and further to the west.	Trees and cutting screen the motorway from the footpath near J16. Further west, as the slip road joins the main carriageway, open views are available along the motorway corridor. Soft estate vegetation is intermittent and gappy.	No	Hedgerow in soft estate where space allows	M40 west-bound	Adjacent	760m	High
PRoW 14	Bridleway between Stratford Road (A3400) and Nuthurst Road	Users of bridleway	LCA: Ancient Arden	Elevated viewpoint affords views across the shallow valley and farmland to the north. Location of proposed gantries visible.	Open view across the lower ground to the north, including the M40. Views along the motorway corridor to the north-west. Little vegetation on the soft estate to screen the motorway.	No		M40 west-bound	450m	280m	Moderate

Table 7-12 : Cultural Heritage Receptors Potentially Sensitive to Setting Impacts

Report ID (NHLE No.)	Historic Receptor	Receptor Description	Heritage Asset	Existing Setting	Existing Barrier	Mitigation/ Enhancement Potential	Nearest carriage way	Distance (m)	Sensitivity
DHR1 (1382419)	Obelisk at Umberslade	The significance of the Grade II listed Obelisk is its dominance within the landscape overlooking the shallow valley in which the motorway lies. It forms an integral part of the designed landscape associated with the Grade II* listed Umberslade Hall. It was erected in 1749 for the First Lord Archer of Umberslade and was specifically located to form an 'eye-catcher' from the Hall and its landscape park.	Grade II Listed Building	The Obelisk stands with a field above the M40, which runs along a shallow valley, and is highly visible to the passing traffic. The dominance of the asset within the landscape reflects its historic significance in views from the Grade II* Umberslade Hall and its landscape park.	No	The dominance of the Obelisk in its landscape should be maintained.	East-bound	111m	Medium
DHR2 (1382418)	Obelisk Farmhouse	The Grade II listed farmhouse is orientated roughly north-south and its front elevation faces towards the Pound House Lane road bridge and the existing gantry. The farmhouse pre-dates the erection of the Obelisk so that whilst there is group value, due to their proximity and historic ownership, the farmhouse does not appear to have been intended to form part of the historic views from Umberslade Hall.	Grade II Listed Building	The existing landform and mature vegetation results in there being no views of the motorway from the principal elevation of this building. There are no other significant views of the motorway from the property. The side elevation which faces south towards the motorway has limited fenestration and this view is clearly not of historic significance.	No	N/A	East-bound	213m	Medium
DHR3 (1382422)	East Lodge including Gatepiers	The Grade II listed East Lodge to Umberslade Park dates to the late 19th century making it a late	Grade II Listed Building	The asset is screened from the motorway by a wood panelled fence and mature	Yes	Replace any vegetation cover which	West-bound	70m	Medium

Report ID (NHLE No.)	Historic Receptor	Receptor Description	Heritage Asset	Existing Setting	Existing Barrier	Mitigation/ Enhancement Potential	Nearest carriage way	Distance (m)	Sensitivity
		addition to the designed landscape. It originally stood on the south side of a crossroads, with lanes west to Tanworth-in-Arden and east past Obelisk Farm. It now stands on a minor lane which terminates at the motorway.		vegetation on third party land. A modern property was built to the south east providing a degree of further screening of the motorway.		may be lost as part of any change to the existing.			
DHR4 (1382432)	Olive Cottage	The thatched cottage was originally two 17th Century houses, later merged and altered in the 19th and 20th centuries. It stands on the A3400 Stratford Road to the south of the 18th Century Grade II Lapworth Hill Farmhouse.	Grade II Listed Building	The asset is screened from the motorway by mature vegetation on third party land	No	N/A	East-bound	250m	Medium
DHR5 (1382480)	Benson's Barn and Country Cottage	Early 18th century barn and stable, converted into 2 houses around 30 years ago. It stands on Umberslade Road near J3A, adjacent to the late 17th/early 18th century Grade II Old Grove Farmhouse	Grade II Listed Building	The asset is screened from the motorway by mature vegetation	No	N/A	North bound	300m	Medium

Future Baseline

Landscape and Visual

7.4.26. Without the Proposed Scheme being undertaken, vegetation within the soft estate would grow and become mature. This would require maintenance over time to thin out the existing woodland to enable the stronger or desirable specimens to survive. Clearance tolerances along the verge would need to be retained, which would result in the clearance of vegetation establishing itself within this area. Hedgerows would become mature, and in the process become denser and, if left unmaintained, considerably higher.

7.4.27. Refer to Chapter 10 Assessment of Cumulative Effects for identified development proposals that may introduce new receptors or shield existing receptors.

Cultural Heritage

7.4.28. There will be no change to existing conditions in the future in the absence of the Scheme.

7.5. Assessment of Effects

7.5.1. The assessment is based on the following drawings:

- M40/M42 Interchange General Arrangement, Rev P03, Issue for DF3, 12/03/19; and
- Site Clearance, Rev P02, Issue for DF3, 08/03/19.

7.5.2. Viewpoints are represented in Figures 7.7-7.15.

Construction Effects

7.5.3. This section considers construction effects on the landscape, visual amenity and heritage. It is considered that the adverse effects during the construction period would relate to vegetation removal and the subsequent activity in relation to construction of elements associated with the scheme proposals including signage, gantries, new lighting columns, new VRS and central reservation. The assessment has taken into account the existing context of the highway and considers the change in height in some elements of the proposals such as the increased height of signs on gantries.

7.5.4. The impacts of the construction period are considered to be generally of short-term duration, except for tree removal, where the impact would be of a moderately longer duration as replacement vegetation establishes and matures. Although the effects identified may be assessed as Large or Very Large (as defined in Tables 7-4 – 7-6), because of the short duration, they would not be “significant effects”.

Landscape Effects During Construction

7.5.5. This assessment is based on the Vegetation Site Clearance plans provided at DF3 (noted above in 7.5.1). These plans which include additional areas of vegetation clearance required for structures, including environmental barriers and general bank regrading covering approximately 70ha, this is to be revised at DF4 and be provided in GIS format. It should be noted that these plans may not account for all clearance required for the Proposed Scheme, however, where possible potential clearance areas have been considered for the assessment.

7.5.6. Vegetation removal for the Proposed Scheme entails the majority of vegetation on the soft estate between the pavement edge and the highway boundary. The only exceptions to this are:

- around and within J3a where the soft estate is considerably wider, where the proposed clearance is generally between 4m and 8m from the pavement edge;
- the cutting and embankment to the east of Poolhead Lane on the M42 (east-bound 2+400 to 3+500) where a narrow strip of vegetation at the top of the embankment and foot of the cutting is proposed to be retained; and
- on the M42 north-bound between Tinkers Lane and School Road (M42 north-bound chainage 0+600 and 0+900) where an 8m strip of vegetation is proposed to be retained beyond a 15m extent of clearance.

7.5.7. Soft estate vegetation is a landscape receptor of moderate sensitivity, as although not designated, it plays an important role in screening the motorway, providing links between the hedgerows and woodlands that were severed by the motorway construction, and contributes to the green infrastructure of the area. Loss of existing vegetation within the highway boundary would cause a moderate adverse magnitude of impact within the study area during construction, because it contributes towards the surrounding landscape pattern, provides amenity value and performs an important visual screening function. This would be subject to further assessment if the Proposed Scheme changes materially.

7.5.8. Construction activities, involving the clearance of vegetation, the movement of vehicles, and the construction and installation of proposed features, would be contained within the highway boundary, limiting the impact within the wider study area. The size of the area affected would be limited, on the M42 this would be to up to about 300m from the highway boundary due to the relatively flat topography and the number of mature trees and woodlands in the surrounding landscape. On the M40 it would be to up to about 500m from the highway boundary due to the more undulating nature of the surrounding topography. The landscape upon which the construction activities would have an impact is a receptor of medium sensitivity and the magnitude of impact due to construction activities would be moderate.

Landscape assessment

7.5.9. The study character area PSLR1, which covers the M42 to the east of J3 and as far as Poolhead Lane, is a landscape receptor of moderate sensitivity. During the construction period, the removal (partial loss) of the majority of soft estate vegetation, the construction of EAs and the introduction of additional gantries to the area, which would be noticeable new features, would create a moderate adverse magnitude of impact. The character of this area would experience a moderate adverse significance of effect during the construction period.

7.5.10. PSLR2, which approximately covers the M42 between Poolhead Lane and The Common, is a moderately sensitive landscape receptor. Construction work in much of this area would be contained within the motorway cuttings, although there is a proposed gantry and EA on the embankment section. The construction of these, together with the removal of most of the trees within the soft estate, would create a moderate adverse magnitude of impact. This would create a moderate adverse significance of effect during the construction period.

7.5.11. PSLR3 is a local character area in which trees and woodland play an important role. The removal of trees within the soft estate, particularly along the highway boundaries and overbridge embankments, would create a more open landscape and from a moderate adverse magnitude of change during construction activities. Proposed gantries in this area are consistent with the baseline conditions and as such, would not create any impacts beyond their construction. The significance of effect on this area during the construction period would be moderate adverse.

7.5.12. A lot of the soft estate within the local character area PSLR4, which covers the M40 part of the study area, has a baseline condition that is predominantly open. The notable exception is in the north-west of the area where soft estate vegetation plays an important role in creating separation between the motorway and nearby properties. Although the removal of the soft estate vegetation in this location would be a major adverse magnitude of change, overall when taking the whole character area into

consideration and the proposed changes to the motorway infrastructure, the magnitude of change would be moderate adverse. The resulting significance of effect would be moderate adverse during the construction period.

7.5.13. Within this local character area PSLR5, which covers most of the M42 between J3a and J4, soft estate vegetation is comprised of either maturing trees or seasonal vegetation and grasses. The former plays an important screening role between the motorway and properties in Illshaw Heath and Tinkers Lane. Although the removal of these trees would create a major adverse magnitude of impact on the setting on these receptors, when taken as a whole the vegetation removal and minimal changes to the motorway infrastructure in the Proposed Scheme would form a moderate adverse magnitude of impact. Due to the removal of soft estate vegetation, the significance of effect would be moderate adverse during the construction period.

7.5.14. PSLR6 covers Blythe Valley Park to the south-west of M42 J4. In this area the soft estate vegetation is backed onto by similar planting in the park. Although the removal of vegetation in the soft estate would alter the immediate road setting, it would not be apparent from within the park and the existing intervening trees would continue to screen the motorway. There would be no change in areas with no trees in the soft estate. During the construction period this would create a minor adverse magnitude of impact and a slight adverse significance of impact.

Visual Effects During Construction

Table 6-13 Significance of visual effect during construction

ID	Location	No. of Receptors	Sensitivity	Magnitude of Impact	Significance of effect – during construction
PSVR1	Forshaw Heath Lane	3 residential properties and 1 commercial property	High	Moderate – Soft estate vegetation clearance would increase the visibility of the motorway. Construction, particularly relating to the EA at J3, visible from residential properties.	Moderate
PSVR2	Wood End Lane	3 residential properties on west side of northern end of lane	High	Moderate – Clearance of soft estate vegetation would increase visibility of motorway from properties, more so to the east as the motorway is in cutting adjacent to the receptors. Proposed EA and gantry in sightline.	Moderate
PSVR3	Earls-Brook Farm, Wood End Lane	1 residential property	Moderate	Minor – Receptor far enough from motorway so proposed vegetation clearance partially increased visibility of the motorway and views of construction activity would be filtered by intervening hedgerows.	Slight
PSVR5	Lilac Cottage, Tinkers Lane	1 residential property	High	Moderate – Amount of vegetation clearance important as receptor is located very close to the highway boundary. Any clearance will increase visibility of the motorway although the only construction activity in the area would be the potential construction of an EB.	Moderate

ID	Location	No. of Receptors	Sensitivity	Magnitude of Impact	Significance of effect – during construction
PSVR6	Illshaw Heath Farm and Kineton Lane	Approx. 25 residential properties	Moderate	Minor – Although soft estate vegetation clearance would increase the visibility of traffic on the motorway, views are partially filtered by roadside vegetation and are mid distance.	Slight
PSVR7	West Lodge and West Cottage, Brown's Green	2 residential properties	Moderate	Minor – Vegetation clearance on the soft estate would increase visibility of the motorway and traffic using it. Proposed gantries and their construction would also be visible. There is an advantage of distance between receptors from the motorway being just outside 300m corridor.	Slight
PSVR8	North Lodge, Brown's Green	5 residential properties	Moderate	Minor - There would be increased visibility of the motorway due to vegetation clearance, although limited construction activity would be apparent in the mid distance. Views from the properties are either framed or oblique.	Slight
PSVR9	East Lodge, Bramhope Pound House Lane	2 residential properties	High	Major – Removal of the trees on the soft estate would create near and open views towards the motorway that did not previously exist. Although a low bund is present, this would not be sufficient to screen views of all traffic or of nearby construction activity.	Large
PSVR10	Obelisk Farm, Pound House Lane	1 residential property	Moderate	Minor – Views from the property towards the motorway are oblique and it is in the mid distance. However, vegetation removal and construction of EAs and gantries would be visible in both directions along the motorway.	Slight
PSVR12	Old Grove Farm, Umberslade Road	4 residential properties	Moderate	Minor – Views from the properties are filtered by an intervening treeline. The soft estate vegetation is also already sparse in this location, its clearance would create minimal additional visibility. Construction of new gantries would be visible.	Slight
PSVR13	Nuthurst Road south of the M40 as it climbs the hill towards Harrison's Farm	Users of minor road	Moderate	Minor – A glimpsed view and from a distance sufficient to decrease the motorways prominence within the view. Vegetation clearance on the soft estate would not be easily discerned, although the upper extents of construction of proposed gantries would be visible.	Slight
PRoW1	PRoW between Forshaw Heath Lane and	Users of public footpath	High	Major – The footpath runs along the highway boundary, construction activity, including EB installation, vegetation clearance and new gantries, are proposed in close proximity to the footpath.	Large

ID	Location	No. of Receptors	Sensitivity	Magnitude of Impact	Significance of effect – during construction
	Poolhead Lane				
PRoW2	Public footpath between Forshaw Heath Lane and Tyler's Grove	Users of public footpath	High	Moderate – Although a short section of this footpath is adjacent to the highway boundary from where the clearance of soft estate vegetation would be prominent, along the majority of its length the motorway is either already visible or screened.	Moderate
PRoW3	Public footpath between Tyler's Grove and Poolhead Lane	Users of public footpath	High	Major – the removal of soft estate vegetation would give users of the footpath open views across and along the motorway, including of gantry construction. These views would be available for the length of the footpath adjacent to the motorway.	Large
PRoW4	Public footpath between Wood End Lane and The Common (B4102)	Users of public footpath	High	Major- the removal of soft estate vegetation would give users of the footpath open views across and along the motorway, including of gantry construction. These views would be available for most of the length of the footpath where it is adjacent to the motorway.	Large
PRoW6	Public footpath between Small Lane and railway line	Users of public footpath	High	Major – Although the motorway is in cutting for much of its proximity to the footpath, where it isn't the removal of vegetation and construction of an EA and a gantry would be immediately adjacent to the footpath.	Large
PRoW7	Bridleway that runs between Tithe Barn Lane and Umberslade Road	Users of bridleway	High	Moderate – The removal of the highway boundary hedgerow and scrub on the soft estate would allow for unfiltered and open and views of the motorway form a large proportion of the footpath. EA and gantry locations are proposed adjacent to the footpath.	Moderate
PRoW8	Stratford-upon-Avon Canal and towpath	Users of Stratford-upon-Avon Canal and towpath	High	Minor – As the canal is in a tree lined cutting where it passes beneath the motorway, views available from it of the motorway are restricted to the overbridge. The removal of vegetation on the soft estate will not have a large impact on views from the towpath.	Slight
PRoW9	Public footpath between Blythe	Users of public footpath	High	Minor – To the west the footpath is in woodland and changes on the motorway would not be apparent to users. To the east, the footpath follows the highway boundary	Slight

ID	Location	No. of Receptors	Sensitivity	Magnitude of Impact	Significance of effect – during construction
	Valley Park and Stratford Road			but there is little existing vegetation, so its clearance would not noticeably increase visibility of the motorway. There is no construction proposed in this area.	
PRoW10	Public footpath between Cut Throat Lane and Spring Lane	Users of public footpath	High	Moderate – There is currently little vegetation on the soft estate, its removal would not change the views of users of the paths notably. The construction of one gantry would be visible but is in a cutting.	Moderate
PRoW11	Public footpath between Pound House Lane and Umberslade Park	Users of public footpath	High	Moderate – A large section of the motorway is visible to users of the footpath, including the location of a proposed gantry and EA. Although there is little soft estate vegetation along most of the visible motorway, its removal where it is present would be noticeable.	Moderate
PRoW12	Public footpath between Pound House Lane and Nuthurst Road	Users of public footpath	High	Minor – As there is little vegetation on the soft estate to be cleared, the views from the footpath would remain similar after its clearance. However, gantry and EA construction would be visible to the south of the footpath.	Slight
PRoW13	Public footpath between Nuthurst Road and Stratford Road (A3400)	Users of public footpath	High	Minor – The removal of the existing sparse vegetation in the soft estate would not create noticeably more open views to users. There would only be a small amount of construction activity in the visible area.	Slight
PRoW14	Bridleway between Stratford Road (A3400) and Nuthurst Road	Users of bridleway	Moderate	Minor – Although the viewpoint provides an open and panoramic view, the motorway is already a noticeable component within it. Soft estate vegetation and gantry construction would be noticeable but would not be notable activities.	Slight

7.5.15. Much of the adverse construction period effects relates to the necessary existing vegetation removal and subsequent activity in relation to construction of additional elements associated with the scheme proposals such as signage, gantries, new lighting columns, new VRS and central reservation elements.

7.5.16. During construction there would be 5 visual effects of large adverse significance from 5 key representative viewpoints, these include: PSVR9, PRoW1, PRoW3, PRoW4 and PRoW6 because of:

- Removal of vegetation on the soft estate has created open views of the motorway;
- Close full views of construction activity over a distance, such as along a footpath;
- Have views of more than one element under construction;
- Construction is on embankment; and
- Little screening or open views to construction activity.

7.5.17. Visual effects of moderate adverse significance would arise for 7 key representative viewpoints, comprising: PSVR1, PSVR2, PSVR5, PRoW2, PRoW7, PRoW10 and PRoW11 because of:

- Partial screening of construction from intervening vegetation;
- Where some elements of construction would be visible, such as installation of environmental barriers where they are not currently located, or construction partially concealed in cutting; and
- Where construction is seen within the context of the existing motorway.

7.5.18. Elsewhere there would be visual effects of slight adverse significance.

7.5.19. It is considered that all the initial adverse effects experienced except for vegetation removal during the short term construction period would not be deemed significant and would reduce once construction is complete.

Lighting Effects

7.5.20. For the M42 north of J3a lighting during construction would be set within the context of existing lighting on the motorway. For the M42 between J3 and J3a and the M40 between J16 and the M42 J3a, which is unlit, lighting required during the construction period will be determined by the Delivery Partner. 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 key representative viewpoints.

Construction Effects - Heritage Assets

7.5.21. The proposed works would not cause any significant effects on the setting of any of the heritage assets during construction. This is because the setting of the heritage assets that contributes to their significance will not be affected by the proposals. Intervening mature vegetation currently screens the Grade II listed East Lodge from the motorway corridor and this will not be removed during the construction period.

7.5.22. The Proposed Scheme avoids directly affecting the historic relationship between Obelisk and Umberslade Hall's landscape park, which despite a lack of current intervisibility remains important to the historic significance of these two assets. The removal of the existing VMS will create some brief and minor disturbance to the south of the Obelisk but will provide a benefit to the overall setting however this is partially offset by the construction of the gantry to the east which will add another infrastructure element. This is set at a further distance to the heritage assets thereby the magnitude of impact upon all three heritage assets is considered as no change, therefore the significance of effect is Neutral.

Operational Effects

7.5.23. The operational effects of the Proposed Scheme upon landscape, visual amenity, lighting and heritage are presented in terms of the effects in the winter of the opening year (year 1) and the design year (year 15).

Operational Effects – Landscape and Visual

Landscape Effects - Year 1

7.5.24. The operational landscape and visual amenity effects in winter Year 1 following Proposed Scheme completion, has been assessed as a 'reasonable worst case' scenario since the vegetation would not be in leaf and planting would be immature and ineffective in contributing to the landscape fabric and as visual screening.

7.5.25. Following vegetation loss within the highway boundary and before mitigation planting matures the additional infrastructure would slightly increase the prominence of the motorways within the study corridor where existing vegetation is removed, however, this would be dependent on the extents of retained vegetation and the existing landscape infrastructure outside of the highway boundary. Areas of removed vegetation will be replaced with mitigation planting where feasible, although full replacement will not be possible in order to satisfy footprint, sight line and safety requirements.

7.5.26. The conclusion of construction would see the removal of all machinery and cessation of activity associated with this phase. The motorways would revert to regular traffic use with an extra lane running in both directions for the majority of their length. The M42 between J3a and J4 would have permanent use of the hard shoulder rather than the peak time use of the baseline situation. This would spread the traffic load more evenly throughout the scheme. Although the proposals would add additional gantries to the character of the surrounding landscape and would create areas of lessened vegetation, this would be read in the context of the existing motorway and its infrastructure and would not create notable new landscape effects within the wider context.

7.5.27. 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 would not be significant. This is due to the existing presence of traffic, gantries and other infrastructure already influencing the context area of the motorways. Mitigation planting lacking maturity at this stage will provide future screening. Therefore, the magnitude of impact on the character areas identified by local councils and the three character areas identified along the motorway in the study area would be minor adverse and the significance of effects no more than slight adverse at operational year 1.

Landscape Effects – Year 15

7.5.28. In the longer term, mitigation 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 would be reinstated and there would be a small loss overall due to the new infrastructure within the soft estate.

7.5.29. Following maturation of the mitigation planting the additional infrastructure will be integrated into the motorway corridor and the prominence of the motorways 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 character of the broader landscape surrounding the corridor and the existing influence of the motorways, the anticipated small increase in their prominence would be barely perceptible and not alter the perception of the surrounding landscape.

7.5.30. The motorway corridor already has a strong influence on its surrounding environment and the effects associated with minor alterations to existing motorways in the context of a broader landscape would not be significant. This is due to the existing presence of traffic, gantries and other infrastructure already influencing the character of the study area. Following the establishment and maturing of mitigation planting, the magnitude of impact on the character areas identified by local councils and the 6 localised landscape character areas identified during the field survey, would be negligible and the significance of effects neutral to slight.

Visual Effects – Year 1

7.5.31. Key representative viewpoints are illustrated on Figures 7.7 - 7.15 during operation in winter Year 1. At this time construction activities, would have ceased and working areas and verges reinstated. There would remain increased visibility as a result of loss of vegetation along the road corridor and potentially an increase in traffic visible at closer proximity and increased width due to all lane running but the additional activity associated with construction would no longer be an element in views. 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 associated with gantries located in the verge.

7.5.32. The conclusion of construction would see the removal of all machinery and cessation of activity associated with this phase. The motorway would be operating functionally with an additional lane running in each direction for most of the site's length. Proposed planting would not yet be established. Although there would be no construction activity to be observed, the assessed receptors would experience a small change in their situation in the short term as although the motorway would still be a prominent, and often an additional or increased element in their views, there would no longer be any activity, movement, or equipment associated with construction visible. Overall the significance of effect which they experience would be reduced for these receptors.

7.5.33. There would be 8 viewpoints from which receptors would experience visual effects of moderate adverse significance during operation in winter Year 1 for viewpoints or for users of public rights of way, they would be PSVR1, PSVR2, PSVR5, PSVR9, PRoW1, PRoW3, PRoW4 and PRoW6. Receptors at the remaining 16 viewpoints would experience effects of slight adverse or neutral. Therefore, there would be no large or very large significant effects at Year 1 of Operation.

Visual Effects – Year 15

7.5.34. Key representative viewpoints are illustrated on Figures 7.7 - 7.15 during operation in summer Year 15. Of the 24 key representative viewpoints assessed, PSVR10 and PRoW12, at and adjacent to Obelisk Farm, would be the only location to experience a beneficial change in their views after 15 years, due to the removal of a VMS which is prominent in the baseline view. Receptors at the 22 remaining viewpoints would experience views consistent with their baseline conditions. There would therefore be no moderate or large long term adverse impacts as a result of the Proposed Scheme.

Lighting Effects – Year 1 and 15

7.5.35. Lighting effects during operation will be the same at Year 1 and Year 15, and both are reported here to avoid repetition.

7.5.36. Lighting across the scheme is currently limited to junctions and associated slip roads and the M42 northern section Junction 3a to Junction 4. The number of receptors currently affected by lighting is therefore limited. There will be no change to the extent of lighting or the heights of columns and unlit areas through the Proposed Scheme will remain unlit. 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.

7.5.37. There would be a settling of light levels once construction of the scheme is complete with the reduction in the need for more lighting. The removal of vegetation along the scheme would potentially create an increase in effects of lighting during year 1 which would remain until planting has become more established. However, existing lighting and the consequential light spill is already an experienced component of the motorway corridor by receptors within the study area. Alteration to the type of light source and retained location of individual columns within the existing extents of the lit corridor will result in no significant impacts on landscape and visual receptors due to the lighting proposals.

7.5.38. It is considered that the change in the type of lighting would not create enough determinable change by year 15 against the existing scheme for receptors that already experience light spill and would therefore generate no change from the existing situation for receptors.

Operational Effects - Heritage Assets

Heritage Assets Year 1

7.5.39. **Appendix D.1** details the effects on heritage assets. The Proposed Scheme would not cause any significant adverse effects on the setting of any of the heritage assets assessed during operation. This is because the setting of the heritage assets that contributes to significance will not be affected by the proposals. In relation to the Grade II East Lodge with Gatepiers the intervening mature vegetation screens these receptors from the motorway corridor.

Heritage Assets – Year 15

7.5.40. At Year 15 the planting along the highway boundary would have matured and would largely screen gantries from within the setting of all the heritage assets. The predicted residual magnitude of impact would be negligible adverse and the significance of effect neutral in Year 15 (for further details refer to Appendix D.1).

7.6. Design, Mitigation and Enhancement Measures

7.6.1. The Proposed Scheme involves the removal of most of the vegetation to an established motorway corridor that constitutes a part of the existing landscape character. Due to the nature of the works being carried out and the limitations of the extent of the soft estate, the majority of the vegetation along both carriageways would be broadly similar to the present situation following a 15-year time period, post clearance to achieve connectivity and integration with the existing landscape pattern.

Landscape and Visual

7.6.2. The following measures are embedded into the Proposed Scheme design and have formed an integral part of the assessment:

- Identified locations where loss of vegetation must be minimised or mitigated by visual screen to avoid views of the motorway for nearby sensitive receptors.
- SEO's from the landscape character assessment (as indicated in the BIM tables) have assisted with the design and have been encapsulated within development of the mitigation and enhancement proposals, especially: to manage and enhance the valuable woodlands, and hedgerows (SEO1) and to create new networks of woodlands and green infrastructure (SEO2).

7.6.3. The following mitigation principles will be applied to detailed design and construction and carried forward to the EMP:

- Mitigation proposals have been provided as per the information given at this stage. Alterations to these proposals are only considered to be required should infrastructure proposals change or where detail design stage denotes necessity;
- 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 an adverse impact this will be mitigated by the proposed landscape mitigation at DF3 and 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. 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 retain and protect belts of vegetation (SEO1, SEO2);
- Screen planting will be reinstated where existing screening vegetation is lost as a result of clearance to accommodate equipment and structures where there is sufficient space within the soft estate to do so. Screening value will be reinstated when mitigation planting matures (SEO2);
- Where it is considered, during further design, that sufficient replacement planting is not possible, due to engineering or space constraints and where receptors are susceptible to

impacts, alternative solutions to the design or the installation of a visual screen shall be explored;

- 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. For example: Acer campestre, Betula pendula, Corylus avellana, Crataegus monogyna, Ilex aquifolium, Prunus avium and Prunus spinosa (SEO2);
- The planting strategy will aim to reflect the existing local landscape character and reinforce the existing vegetation pattern across the scheme to avoid creating a disjointed landscape by maintaining vegetation connectivity and integration with the local landscape context (SEO2);
- Where feasible the installation of the environmental barriers will be undertaken in a manner to avoid/minimise existing vegetation removal. Environmental barriers are to consist of Close Board timber fencing to reach a minimum height of 2.4m;
- Where practical, opportunities to soften the appearance of environmental barriers through planting will be considered and developed through detailed design and/or through the retention of existing vegetation (SEO1, SEO2);
- Where the removal of screening vegetation would create open views of moving traffic, consideration would be given to the installation of close board timber environmental barriers for visual screening; 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 (SEO2).

Cultural Heritage

7.6.4. No specific heritage mitigation is required as no significant effects are anticipated. 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.

Limits of Deviation

7.6.5. The spatial extent to which the assessment conclusions would remain applicable for those SMP assets with a potential to cause a significant impact has been made. Where an asset such, as an emergency area, is proposed to be repositioned during detailed design beyond the Limit of Deviation (LoD), then an “evaluation of change” assessment would be undertaken to confirm that the scheme remains within the envelope of its consent and is not environmentally worse than the design as assessed in the EAR.

Enhancement Measures

Landscape and Visual

7.6.6. Areas of on-site enhancement (rather than mitigation) to meet the Highways England Licence and RIS environmental objectives, have been investigated to promote green infrastructure, integrate the Proposed Scheme into the wider landscape and enhance the local character and driver experience. The following measures have been identified and would be further developed as part of the detailed design process:

- 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 motorways pass, particularly adjacent woodlands, scrub, field boundary hedgerows and flight lines (SEO2):
- 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 (SEO2);

- Solid barrier fencing or earth mounding may be considered at further design stages to improve or constrain views of the motorway; and
- The following sections of environmental barriers have been identified to merit visual design and to reduce visual impact. These have been identified where it is considered that there are limitations within the soft estate to create required screen planting. Proposed barriers will be consistent with existing barriers and will be of a close board timber construction. Existing barriers that require temporary removal should also be replaced with same or equivalent fencing:

  New barrier

  - Beggars Roost, Forshaw Heath Lane, M42 west-bound side, in two sections chainage 0+500 to 0+640 and 700 to 0+800;

  Existing barriers to be replaced

  - Parkhomes and PRoW, M42 east-bound, chainage 1+050 to 1+125;
  - East Lodge, M40 west-bound, chainage 7+000 to 7+100; and
  - Lilac Cottage, Tinkers Lane, M42 south-bound, 0+450 to 0+550.

7.6.7. 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:

- Hedgerow along public footpath at Blyth Valley Park, M42 north-bound, chainage 2+350 to 2+600.

7.6.8. The above measures would also work towards a no net biodiversity loss. It should be noted these enhancement measures are not included within this assessment.

7.6.9. 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 D.1:

- Infill gaps to planting to close off views beyond the highway boundary particularly at locations where gantries are on embankment are in close proximity to visual receptors.

7.6.10. 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

7.6.11. No specific cultural heritage enhancement opportunities 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, EAs and CCTV/ Radar masts would slightly increase the influence of the scheme corridor as a feature through the landscape in the immediate context, directly following construction. From construction to operational Year 1 and in the short term there would be some adverse effects which will gradually reduce as

mitigation planting begins to establish. However, in the medium term and as mitigation planting matures, the majority of gaps created by initial clearance works during construction would have closed up. After 15 years with mitigation planting having matured, there would be no material changes to the way in which the 3 relevant character areas identified in the Warwickshire Landscape Character Assessment and the 6 site specific ones identified during site survey are perceived, and the effect on landscape character would be neutral.

Visual Effects

7.7.2. Views towards the Proposed Scheme would be restricted by existing intervening vegetation, natural landform, new and existing environmental barriers, proposed mitigation planting and where it is hidden from view in cuttings. For 2 receptors the Proposed Scheme would create beneficial effects in the removal of prominent VMS. For the remaining 22 visual receptors, long term visual effects would be limited and considered to be neutral as a result of being consistent with baseline conditions because the Proposed Scheme would be set within the context of the existing highway infrastructure and associated traffic movement but also due to proposed mitigation planting which will be of suitable native species in order to maximise establishment and growth rates to ensure continuous maturation from year 1 onwards. Mitigation planting would create conditions similar to the baseline.

Heritage Assets

7.7.3. The Proposed Scheme would not have any significant adverse effects on the setting of the surrounding cultural heritage assets assessed. The dominance of the Obelisk within the landscape should be maintained as part of any mitigation planting required as part of the Proposed Scheme.

7.7.4. Chapter 10 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. The Proposed Scheme, following the establishment of mitigation planting, would have no long term effects on the landscape character areas.

7.8.3. During construction, localised large adverse effects have been identified for 5 key visual locations, with moderate adverse effects impacting a further 7 visual locations. This is because of the close proximity of these receptors to the highway boundary resulting in alterations to views being more apparent. The construction effects are considered to be temporary and short term and, therefore, not significant.

7.8.4. This reduces to no large adverse and 8 moderate adverse locations at Year 1 of operation as a result of the conclusion of construction period and before mitigation planting can establish. With existing important screening vegetation retained across the scheme there will be a limitation on the significance of effects experienced Adverse effects will continue to reduce with development of infill and additional planting across the scheme, resulting in no locations following full establishment of mitigation at Year 15. When the Proposed Scheme is considered as whole, it is concluded that the overall long term effect would be negligible.

7.8.5. The Proposed Scheme would not have a significant effect on landscape and visual amenity. Overall in the long term, the Proposed Scheme is considered to have a residual neutral effect in terms of heritage, landscape and visual amenity.

8. Noise

- No residual significant adverse effects are anticipated from operational noise and vibration.
- The previously identified emergency diversion routes are the assumed to be the same as the tactical diversion routes to be used. The assessment of diversion routes therefore considers the emergency diversion routes. Closures will be required to facilitate the removal of existing, and construction of proposed new gantries.
- 7 noise Important Areas (nIAs) exist along the scheme.
- 4 noise Important Areas exist along the Affected Road Network (ARN).
- 310m of noise barrier to be temporarily removed, with 10 receptors within 100m.
- No new noise barriers are required to provide noise mitigation.
- 966 sensitive receptors in the study area would experience opening year perceptible improvements in noise.
- 1441 sensitive receptors would experience a change in day or night time, opening year, short-term noise levels.
- 43 receptors no longer above the significant observed adverse effect level (SOAEL) due to the scheme.
- 0 receptors with an increase above SOAEL
- 11 sensitive receptors are within 100m of potentially prolonged sources of construction noise at Juggins Lane, Woodend Lane, Forshaw Heath Lane and Pound House Lane.
- These locations may potentially be at risk of a *perceived* noise increase due to de-vegetation.
- No specific construction ground-borne vibration monitoring is deemed required due to distance to receptors.

8.1 Introduction

8.1.1. This section 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 Scoping Report and incorporates relevant new information and recent changes to Highways England guidance since the Scoping Report (Ref 8.1) was produced.

8.1.2. The chapter provides:

- A description of the assessment methodology, particularly the noise calculation area;
- A review of existing and future baseline conditions;
- An assessment of construction noise and vibration;
- An assessment of operational noise;
- Details of mitigation (where required) and measures to address the Noise Policy Statement for England (NPSE) (Ref 8.2);
- Measures to manage temporary construction noise and vibration.

8.1.3. The assessment is supported by the following information:

- Appendix E.1 Regulatory and policy framework;
- Appendix E.2 Baseline, constraints and opportunities;
- Appendix E.3 Noise assessment inputs;
- Appendix E.4 Assessment of Impact;
- Appendix E.5 Management of construction works.

8.1.4. The following figures support this chapter:

Figure 8.1 – Sensitive receptors within calculation area

Figure 8.2 – Short term noise changes DM2022 to DS2022

Figure 8.3 – Long term noise changes DM2037 to DS2037
Figure 8.4 – Emergency diversion routes
Figure 8.5 – Red and Amber engagement areas

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

Professional Competency Acoustics

Name	Grade and Company	Expertise and Professional Qualification
D. Marples-Wall	Environmentalist, Amey	5yrs experience, Postgraduate Diploma Acoustics and Noise control, AMIOA

8.2 Scoping

8.2.1. This assessment has been undertaken in accordance with the conclusions of the Scoping Report. However, there has been a change to the number of candidate noise barriers to be assessed and the methodology by which the assessment has been undertaken; noise barrier NNB0 has been scoped out as it is outside the area of study for ALR.

8.2.2. Topics scoped out of the assessment are:

- Operational ground-borne vibration: the road surface is not anticipated to be uneven or constructed from concrete slabs and therefore, ground-borne vibration is not anticipated to be significant;
- Airborne vibration: no receptors are within 40m of the new Lane 1 and, consequently, would not be expected to be affected by airborne vibration.

8.2.3. 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 SMP scheme, the assessment is presented in Appendix E.4.

8.2.4. The following aspects were scoped out as environmental management measures are included in the Outline Environmental Management Plan (OEMP):

Construction activities relating to devegetation, drilling and piling;

Pavement works, particularly those undertaken at night.

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;
- Stakeholder engagement;
- Assumptions and limitations.

Noise Calculation Area

8.3.2. The calculation areas for construction and operational noise modelling are identified on **Figure 8.1** and comprise the following:

- Construction noise: no significant adverse effects are expected beyond 300m from proposed construction activities and potential site compound locations.;
- Construction vibration: no significant adverse effects are expected beyond 100m from works to structures, pavement or piling operations;
- Operational Noise: a study area of 1km from the scheme, and a detailed calculation area of 600m from the scheme, were used. In addition, a calculation area of 50m from affected routes outside the 1km study area was used. Significant effects were determined to be a change in noise level of at least 1dB LA10,18h in the short-term or at least 3dB LA10,18h in the long-term (Ref 8.3).

Legislation, Policy and Guidance

8.3.3. The assessment has been undertaken with reference to current policy and regulatory framework (Appendix E.1) and in accordance with the following guidance:

- The guidance presented in DMRB HD 213/11 Rev. 1 Noise and Vibration (Ref 8.4) supported by Design Guide enhancements to reflect the characteristics of SMP schemes;
- Interim Advice Note (IAN) 185/15 (Ref 8.5) - 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';
- Guideline for Environmental Noise Impact Assessment, Institute of Environmental Management and Assessment, October 2014 (Ref 8.6);
- BS 5228 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise, British Standards Institution and Part 2: Vibration, British Standards Institution (Ref 8.7);
- Department of Transport Calculation of Road Traffic Noise (CRTN) (Ref 8.8) applied to the DMRB HD213/11 detailed assessment supplemented by the SMP Design Guide advice (Ref 8.9).

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 Defra noise Important Areas (nIA) taken from Government Open Data;
- Locations of existing noise barriers within the motorway boundary using the EnvIS, AVIS and SMIS databases, and imagery from Google Earth Pro (January 2019);
- Receptor locations and associated sensitivities from OS AddressBase Premium (March 2019) associated with the OS MasterMap database (December 2018) (Licence to Highways England);
- The location of Emergency Diversion Routes as provided by Highways England;

- A visual inspection of the condition of existing noise barriers, undertaken in February 2019;
- A review of the existing highway pavement regime from data recorded in Highways England pavement database (HAPMS).

8.3.6. Baseline conditions were established from:

- Computer noise modelling of the baseline noise levels from road noise sources in the calculation area for the future opening and design years;
- Information from Defra's Noise Action Planning Important Areas, Round 2 England, for noise Important Areas (nIAs);
- A visual survey of the existing environmental barriers

Traffic Data and Forecasting Scenarios

8.3.7. The cumulative, conservative traffic effects of the Proposed Scheme uses traffic data reflecting the extent of the calculation area and the available traffic models, i.e. traffic data as supplied by Systra (Appendix E3).

8.3.8. There are no Highways England or Local Highway Authority schemes that are expected to open within 18 months of each other and which might affect traffic within the affected road network.

8.3.9. The assessment of noise impacts comprised a comparison of the predicted noise levels using the proprietary software NoiseMap v5.2.10 for the following scenarios:

Short-term (difference in noise levels between DS-2022 and DM-2022);

Long-term DM (difference in noise levels between DM-2022 and DM-2037);

Long-term DS (difference in noise levels between DS-2037 and DM-2037);

A range of mitigation options, either 2.0m-high new noise barriers or 3.0m-high new noise barriers.

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 LA10,18h to EU noise indices for noise mapping' g is used for estimating night time noise. This is based on the 18-hour daytime predicted noise levels and the type of road. The night time traffic flows are "unconstrained" and therefore do not increase, in future-year scenarios, at the same rate as the day time flow.

8.3.11. Extensive engagement has been undertaken between the Air Quality team[9] and Traffic Modelling team. Further details on traffic data are provided in Appendix B.4, supporting chapter 6 Air Quality, as well as Appendix E.3.

Construction Noise and Vibration

8.3.12. The assessment of construction noise considered the following:

- Removal of gantries, directional drilling and piling: locations where a risk of disturbance being caused to nearby receptors has been identified.
- Construction compounds: while the locations of construction compounds are determined at Design Freeze 5 (DF5), the potential for local sensitive receptors to experience significant disturbance has been considered and documented in the Outline Environmental Management Plan (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 annoyance to local residents have been identified and control measures specified in the OEMP.

[9] The Air Quality team engaged with the Traffic Modelling team on behalf of the Acoustics team.

- Noise barrier replacement works: an assessment of predicted noise levels, at adjacent receptors where an existing noise barrier must be removed for an extended duration, has been undertaken and 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. While traffic speeds and distances to receptors will be reduced, the potential for a significant change in noise levels from that during the construction works, to when the scheme is open, has been assessed to be considered in traffic management decisions.
- Diverted motorway traffic: an environmental sensitivity assessment of the planned diversions has been undertaken, identifying those locations where heavy goods vehicle (HGV) traffic could give rise to disturbance, with potential mitigation recorded in the OEMP. Diverted motorway traffic is anticipated during gantry removal.

8.3.13. Potential construction noise and vibration levels were calculated using source data for typical construction equipment in accordance with the guidance in BS 5228-1 (see assumptions in **Appendix E.3**) supplemented by prior experience. The method used was that presented in BS 5228-1 Table E.1 and Annex F.

Provision of Noise Barriers

8.3.14. During the assessment, the existing condition of noise barriers was considered; situations where a barrier is required to avoid a significant effect were identified and the 'candidate' barriers were examined for their engineering deliverability, value for money and other benefits to determine whether they are to be incorporated into the scheme as proposed noise barriers.

8.3.15. 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 E.3**.

8.3.16. In selecting those barriers with a positive Value for Money outcome, consideration has been given to the landscape impact and the number of receptors receiving a beneficial reduction to below night time significant observed adverse effect level (SOAEL) values, amongst other factors. Where multiple barrier heights are viable and where a marginal difference in their Value for Money exists, then the difference in costs and benefits are considered along with any other non-monetised implications.

Magnitude of Impacts

8.3.17. The magnitude of impact of construction noise on residential receptors is classified in accordance with the descriptors in **Table 8-1**, while that for non-residential receptors is similarly assessed when those spaces were deemed particularly sensitive to noise.

8.3.18. In terms of construction-induced vibration, some effects on human receptors may occur at low levels of vibration (see **Table 8-2)** and, hence, the onset of potential adverse effect, the SOAEL, has been taken to be 1mm/s.

8.3.19. The magnitude of operational noise effect is based on a comparison of the increase or decrease in noise levels between scenarios. The magnitude of noise impacts associated with a change in road traffic noise over the short- and long-term are presented in **Table 8-3**.

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

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 where explanation has been given to residents.	
10.0mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.	Moderate

A) The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the receptor.
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 expected, then an assessment in accordance with BS 6472-1 or -2, 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.

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

8.3.20. The EIA significance of the change caused by the Proposed Scheme is a function of the sensitivities of the affected receptors, the magnitude of change, combined with professional judgement which takes into account a range of other factors including:

- The absolute noise levels;
- The characteristics of the existing noise environment;
- The number of affected receptors;
- The duration of the impact;

- For non-residential receptors' the nature, times of use and design of the receptor.

8.3.21. Where a minor change in operational noise magnitude arises, this may be not significant. Nevertheless, consideration is given to whether changes in behaviour or response may occur such that a significant effect occurs. In the case of moderate magnitude of impact then, typically, a significant effect results unless it is concluded that there would be no change in behaviour or response to the noise or vibration change.

8.3.22. In terms of operational noise, the NPSE has increased focus on absolute noise levels; consequently, 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 regulations.

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, WHO, 2009 (Ref 8.10) for night-time values. Noise Insulation Regulations (Ref 8.11) Relevant Noise Level for daytime SOAEL. Guidelines for community noise, WHO, 1999 (Ref 8.12) for daytime LOAEL (from the 50dB $L_{Aeq,16h(7\text{-}23),outdoors}$ for the onset of moderate community annoyance).		

8.3.23. For construction noise **Table 8-5** shows the noise level thresholds for SOAEL used to indicate where a potential significant effect could arise. 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
Daytime weekday (07:00-19:00) and Saturdays (07:00-13:00)	75
Evenings weekday (19:00-23:00), Saturdays (13:00-23:00) and Sundays (07:00-23:00)	65
Night-time (23:00-07:00)	55
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.	

8.3.24. If the ambient noise level exceeds the SOAEL (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the predicted level from construction noise for the period increases the total ambient noise level by more than 3dB.

8.3.25. For residential and other sensitive receptors, construction noise or vibration constitutes a significant environmental effect if it is above SOAEL thresholds, determined for 10 or more days (or nights) in any 15, or for more than 40 days (or nights) in any six-month period. In other cases, these criteria are applied unless circumstances make them not appropriate. For example, noise (or time) thresholds may be exceeded, but affecting only a small part of the receptor e.g. a country park, or where the high noise level is experienced by the 'receptor' for a short time, such as users of a footpath.

8.3.26. With respect to the significance of construction vibration, levels of around 1mm/s may give rise to significant adverse effects on people (see **Table 8-6**); therefore, the SOAEL has been defined at this value. The threshold for cosmetic damage has been used as a threshold for significant adverse

effects for damage to buildings (12.5mm/s)[10], although in most cases much higher levels of vibration are required to cause structural damage.

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

Limits of Deviation

8.3.27. The spatial extent over which the assessment conclusions would remain unchanged, should those SMP assets with a potential to cause a significant impact be moved, has been determined. Consequently, where an asset, such as an emergency area, is proposed to be repositioned during detailed design beyond the Limit of Deviation (LoD), then an "evaluation of change" assessment would be undertaken to confirm that the scheme is not environmentally worse than the design, as assessed in the EAR.

8.3.28. In defining the LoD, account has been taken of the proximity of sensitive receptors, topography, screening etc. to determine whether the re-location of the asset in either direction would give rise to a change in the environmental risk. This has been presented as a GIS shape file for the scheme for use by the Delivery Partners.

Assumptions and Limitations

8.3.29. The assessment is based on the Proposed Scheme at DF3, as described in Chapter 2, with the assumptions and limitations presented in **Appendix E.3**.

Stakeholder Engagement

8.3.30. Stakeholder engagement will take place to reduce the impact of construction noise, as described in Table 8.28.

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 along with an appreciation of future baseline conditions that take account of both changes in road traffic and in land use.

8.4.2. **Figure 8-1** shows the location of the noise sensitive receptors within the noise and vibration calculation area, within which **Table 8-7** presents the number of receptors by type within 300m of the Proposed Scheme.

Table 8-7: Existing baseline receptors

Receptors	Within 100m	Within 300m	Receptors	Within 100m	Within 300m
Residential properties	11	101	Community facilities	1	3
Caravan sites	0	0	Public open space/amenity areas	0	0
Nursery	0	0	Places of worship	0	0

[10] See BS 5228-2: 2009+A1 2014

Educational facilities	0	0	Other sensitive premises	0	1
Health facilities	0	0	Designated heritage sites	0	0
Hotels	0	1			

Noise Important Areas

8.4.3. The location of the 7 noise Important Areas (nIA) within the calculation area for the scheme is presented in **Figure 8-2** with an estimate of the number of residential properties provided in **Table 8-8**.

Table 8-8: Estimated number of residential properties within road noise Important Areas

Noise Important Area (ID number)	Noise-making Authority	Location	No. of residential properties
7594	HE	Forshaw Heath Lane, Solihull	2
7495	HE	Poolhead Lane, Earlswood	10
7596	HE	Wood End Lane, Earlswood	4
7597	HE	Earlswood Common, Earlswood	1
7598	HE	Tinkers Lane, Waring's Green	3
7599	HE	Pound House Lane, Solihull	2
8234	HE	Stratford Road, Solihull	2

Existing environmental barriers

8.4.4. The Proposed Scheme currently provides noise attenuation, in the form of noise barriers, at the locations recorded in **Table 8-9**.

Table 8-9: Location of existing noise attenuation

Id	Location	Carriageway	Length (m)	Height (m)	ID nIAs	Condition	Asset Owner
ENB1	Earlswood M42 j3-j3a	EB	220	2	7594	Good	HE
ENB2	Kemp Green M40 j16	WB	90	2	7599	Good	HE

Existing pavement conditions

8.4.5. The existing surface course on the M42, between Junctions 3 and 3a, is predominantly thin surface course (TSC) (i.e. a low noise surface). Hot rolled asphalt (HRA) is predominant on the M40 J16 to M42 J3a.

8.4.6. It is predicted that there are no residential receptors within noise Important Areas where the existing road surface comprises concrete and 4 where it is currently hot rolled asphalt.

Future Baseline Conditions

8.4.7. A search was undertaken of the Planning Register for the neighbouring Local Planning Authorities for submitted or consented development proposals that may that meet the following criteria:

- Residential planning applications for 200+ houses within 1km of the scheme;
- Commercial or Industrial planning applications (B1, B2 and B8 only) within 1km of the scheme.

8.4.8. Developments identified as part of the future baseline i.e. currently under construction or committed, are included in Chapter 2, Proposed Scheme, section 2.6, Land use development proposals. Additional detail is provided in Chapter 10 Cumulative Effects.

8.4.9. While there would be no change to the motorway conditions in the opening year, there is the potential for additional residential receptors to be built within 300m of the Proposed Scheme (see Table 8-10). Development at the Blythe Valley site may provide up to 750 dwellings. This scheme is understood to have included specific noise mitigation measures.

Table 8-10: Proposed land use change

Planning Application Id	Local Authority	Location	No. of houses proposed	Distance from scheme (m)	Consented
PL/2016/00863/ MAOOT	Solihull MBC	Blythe Valley, Shirley, Solihull	750	200m	Yes

8.4.10. By the design year it is expected that the entire pavement would be resurfaced.

8.4.11. Traffic flows are predicted to increase between 2022 and 2037, resulting in elevated noise levels, irrespective of the scheme. The long-term changes in traffic noise levels, if the Proposed Scheme did not proceed, are presented in Table 8-11. A total of 1613 residential properties are located within the calculation area with 318 exceeding SOAEL values and 1247 exceeding LOAEL values at one or more façades, in one or more scenarios, for inclusion in the night time traffic noise assessment.

8.4.12. For the daytime period, 1060 residential properties were predicted to experience noise increases, 362 of which are negligible (within the 0.1 to 2.9 dB range). Of these properties 538 were predicted to be subject to changes ≥ 1.0 dB, ranging from 1.0 dB to 2.9 dB. The residential properties experiencing noise increases of ≥ 1.0 dB are principally adjacent to the scheme on Poolhead Lane, Juggins Lane, Earlswood Common and Wood End Lane.

8.4.13. For the night-time period, 1017 residential properties were predicted to experience noise increases, 165 of which are negligible. Of those noise increases 852 are predicted to be subject to changes ≥ 1.0 dB, with 273 ranging from 3.0 to 5.6 dB.

Table 8-11: Long-term traffic noise changes (DM2022 to DM2037)

Change in noise level		Daytime			Night-time
		Number of residential properties between LOAEL & 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 - 0.9	377	143	17	1
	1.0 – 2.9	188	93	4	211
	3.0 - 4.9	27	50	0	23
	5.0 +	0	0	0	0
No change	0.0	655	32	27	144
	0.1 - 0.9	0	0	0	0

Decrease in noise level, $L_{A10,18h}$	1.0 – 2.9	0	0	0	0 0
	3.0 - 4.9	0	0	0	0
	5.0 +	0	0	0	0

8.5 Assessment of Construction Noise and Vibration

8.5.1. The effects of construction noise and vibration have been assessed in terms of the general operations, site preparations for construction compounds, retaining walls and motorway closures.

8.5.2. Planned construction methods and scheduling will not be known until all relevant surveys, engineering and environmental constraints have been taken into account, a Delivery Partner has been appointed and construction methods defined. A risk-based assessment has, therefore, been undertaken based on typical construction activities and noise levels, reported in BS 5228-1 Annexes C and D, supplemented by prior experience (**Appendix E.3)**. These risks will be managed in the Construction Environmental Management Plan.

8.5.3. 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 assessment, therefore, considered 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;
- Vegetation clearance.

8.5.4. **Table 8-12** indicates the distances at which the SOAEL threshold of 55dB $L_{Aeq,8h}$ is exceeded, based upon the assumed equipment provided in Appendix E.3. It should be noted that some receptors are already subject to noise levels in excess of the SOAEL. SOAEL values for day as well as night time workings are identified with a darker shading.

Table 8-12: Indicative construction noise levels (day and night)

Phase	Activity	OEMP ID	Construction noise level dB $L_{Aeq,8h}$ at distance (m) from works (soft intervening ground)					
			10m	20m	50m	100m	200m	300m
Central reserve works	Removal of existing structures and installation of RCB.	NV032	78	72	62	58	52	48
Verge works	Demolition, clearance and stripping out of noise barriers (if required)	NV015	83	77	68	60	57	54
	Gantry installation (assumes percussive piling)	NV012	80	74	65	57	50	45
	Emergency area (assumes percussive piling)	NV012	83	77	63	56	48	44
Resurfacing works	Removal of existing surface	NV028	85	79	69	62	54	50
	Laying new surface	NV028	77	71	62	54	47	43

Phase	Activity	OEMP ID	Construction noise level dB $L_{Aeq,8h}$ at distance (m) from works (soft intervening ground)					
			10m	20m	50m	100m	200m	300m
Deveg	Devegetation	NV022	79	73	63	56	48	44
Road marking works	Road marking works	NV022	75	69	59	52	44	40
Signage works	Signage works	NV022	80	74	64	57	49	45
Notes:			Day SOAEL		75	Night SOAEL		55

Temporary Removal of Existing Noise Barriers

8.5.5. The temporary removal of noise barriers may be required at 2 locations affecting up to 42 residential receptors (

8.5.6. Table), potentially resulting in a temporary increase in noise levels. Assuming that these receptors are not protected by temporary barriers, then 5 properties may be exposed to an increase in noise levels, although this increase may be offset by the lower traffic speeds on the motorway during construction, while lanes 1 and 2 are not in use.

Table 8-13: Impact associated with temporary removal of existing noise barriers

Id	Location	Number of receptors	Construction noise level minus SOAEL ($L_{Aeq,T}$ dB façade)	Magnitude of impact	Significance of effect	Justification of significance conclusion
ENB1	Juggins Lane	2	< 0	Negligible	Neutral	Distance of works, temporary nature of works in these areas
	Forshaw Heath Lane	38	< 0	Negligible	Neutral	
ENB2	Pound House Lane	2	<0	Negligible	Neutral	
Total number of residential properties		42				

Piling Activities

8.5.7. Percussive piling may be used during the installation of gantries and noise barriers, as well as during the construction of Emergency Areas or other structures, such as retaining walls.

8.5.8. Receptors near to Emergency Areas and retaining walls (**Table 8-14**) are likely to experience piling for approximately 2 weeks in total.

8.5.9. Table 8-15 shows the anticipated vibration levels at different distance bands from the vibration-generating activities. The closest properties may experience vibration levels of between 2.3 mm/s and 7.5 mm/s. It is likely that vibration of this level in residential environments will cause complaint but can be tolerated with prior warning and where explanation has been given to residents.

8.5.10. Under difficult ground conditions the duration may increase to 3 weeks, but it is likely that less time will be spent driving the piles 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 effect.

8.5.11. 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 scheme evolves and the earthworks solution are established, so revisions to the assessment and mitigation measures may be required.

8.5.12. Piling works specifically in verges near nIAs 7596 (Wood End Lane), 7598 (Tinkers Lane) and 7599 (Pound House Lane) may give rise to a breach of SOAEL in both daytime and night-time works periods.

Table 8-14: Sensitive receptor distance bands for emergency area and gantries

Asset ID	Location	OEMP ID	Approx. chainage	Noise levels potentially above SOAEL				
				<20m	20-50m	50-100m	100-200m	200-300m
Emergency Areas								
M42 ERA EB1	Poolhead Lane	NV-006, 007, 014, 020	2250	0	0	1	7	2
M42 ERA WB2	Poolhead Lane	NV-006, 007, 014, 020	2250	0	0	1	7	3
M42 ERA EB2	Earlswood Common	NV020	4000	0	0	0	0	5
M42 ERA WB1	Earlswood Common	NV020	4000	0	0	0	0	5
M42 ERA NB1	Tinkers Lane	NV-006, 007, 013, 014, 020	900	1	0	1	0	1
M42 ERA NB2	Tinkers Lane	NV020	1200	0	0	0	1	7
M42 ERA NB3	Kineton Lane	NV020	1850	0	0	0	5	18
M42 ERA NB4	Kineton Lane	NV020	2300	0	0	0	2	2
M42 ERA SB2	Kineton Lane	NV020	2400	0	0	0	2	2
M42 ERA SB3	Kineton Lane	NV020	1700	0	0	0	5	12
M42 ERA SB4	Tinkers Lane	NV-006, 007, 014, 020	1050	0	0	1	2	1
Number of residential properties within distance bands				1	0	4	31	60
Gantries/Superspans								
G-M42-02	Poolhead Lane	NV020	1450	0	0	0	0	1
G-M42-03	Poolhead Lane	NV-006, 007, 014, 020	2100	0	0	1	4	4
G-M42-04	Woodend Lane	NV-006, 007, 014, 020	2950	0	0	1	3	3

Asset ID	Location	OEMP ID	Approx. chainage	Noise levels potentially above SOAEL				
				<20m	20-50m	50-100m	100-200m	200-300m
G-M42-04A	Woodend Lane	NV-006, 007, 014, 020	2675	0	0	1	1	3
G-M42-06	Earlswood Common	NV-006, 007, 014, 020	3750	0	0	1	4	3
G-M42-08	Tithe Barn Lane	NV020	4800	0	0	0	0	1
G-M42-09	Interchange	NV020	725	0	0	0	1	0
G-M42-13	School Lane	NV020	2300	0	0	0	9	12
G-M42-29	Juggins Lane	NV-006, 007, 014, 020	1150	0	0	4	6	8
G-M42-33	Juggins Lane	NV-006, 007, 014, 020	950	0	1	3	1	9
Number of residential properties within distance bands				0	1	11	31	44
De-vegetation								
-	Pound House Lane	NV-006, 007, 014, 020		2	0	0	0	0
-	Tinkers Lane	NV-006, 007, 014, 020	2100	2	0	0	2	0
Number of residential properties within distance bands				4			2	
Note all distances are to property facades hence gardens may be closer to the works.								

Table 8-15: Indicative construction vibration levels – percussive piling

Activity	Vibration level PPV (mm/s) at distance (m)			
	10m	20m	50m	100m
PPV from percussive piling	18.4	7.5	2.3	0.9
Number of residential properties within distance bands				
	0	4	6	12

Construction compound and vehicle recovery areas

8.5.13. The preferred location of the construction compound is not yet known. However, an assessment has been prepared based on activities likely to cause the greatest noise, typically during the day. In the case of the vehicle recovery areas, reversing vehicles and general noise associated with the recovery staff at night, can be of greatest concern to local residents. Recovery sites are likely to be close to either end of the scheme, potentially located beyond the immediate scheme area, to take advantage of an area of hard standing possibly within a commercial /industrial site. As such locations are a matter for determination by the Delivery Partner's sub-consultant it is not possible to determine whether any impacts may arise.

8.5.14. As noise levels could be in excess of the SOAEL (75dB $L_{Aeq,12h}$) (**Table 8-16**), it is recommended that compounds and recovery areas be at least 50m from nearby sensitive receptors to avoid significant effects. Those situations where SOAEL applies to day time as well as night-time workings are identified through the use of a darker shading in the table.

Table 8-16: Indicative noise levels during preparation associated with the construction compound

Activity	Noise level dB LAeq,12h at distance (m) from compound site (soft intervening ground)					
	10m	20m	50m	100m	200m	300m
Site clearance	81	75	66	58	51	46
Compound construction	85	79	69	62	54	50
Compound operation	60	54	45	37	40	25
Notes:	Day SOAEL		75	Night SOAEL		55

Traffic Management and Diversion Routes

8.5.15. During construction, it may be necessary to have motorway and carriageway closures to remove/install superspan gantries or MS4 gantries (see **Table 8-26**). While the diversion routes will require agreement with the Local Highway Authority, the existing Emergency Diversion Routes and receptors within 50m sensitive to night time traffic are described in Table 8-17 and presented in **Figure 8-4**, 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 area) – areas with a medium or low concentration of receptors within 50m of the diversion route or signalised junction.

8.5.16. As HGV traffic flows or the frequency of use of a diversion route is not known, so 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 disturbance would occur at nearby sensitive receptors possibly due to passage over an uneven road surface for example.

8.5.17. Where disturbance is expected to occur for a period of 10 or more days of working 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.

8.5.18. As it is not anticipated that any gantry installations or demolitions would have a duration of 10 or more days, a significant effect is not anticipated.

Diversion Route Id	Diversion Route	Motorway Closure	NIA on Diversion Route (Y/N)	Number of Sensitive Receptors (not houses)	Approx. no. of Residential Receptors	Potential Number of Closures	Potential Disturbance	Potential for Alternative Routes	Potential to exceed BS 5228
95	M40 J16 to M42 J4, via A3400	M40 J15 northound to M42 J3A northbound	Y	3	200	5	Risk of disturbance to residential properties at Stratford Road.	Yes	No
96	M40 J16 to M42 J4, via A3400	M40 J15 northbound to M42 J3A	Y	3	200	5	Risk of disturbance to residential properties at Stratford Road.	Yes	No
97	M40 J15 to M42 J3, via A46 & A435	M40 J16 northbound to M42 J3A	Y	3	467	5	Risk of disturbance to residential properties at Alcester Road, Birmingham Road.	Yes	No
98	M40 J15 to M42 J6, via A46, A4177, A452 & A445	M40 J16 northbound to M42 J3A	Y	8	519	5	Risk of disturbance to residential properties at Hatton Park, Balsall Common, and Heart of England School.	Yes	No
100	M42 J4 to M40 J16, via A3400	M42 J3A southbound to M40 J16	Y	3	200	5	Risk of disturbance to residential properties at Hockley Heath.	Yes	No
102	M42 J3 to M40 J15, via A435 & A46		Y	5	476	5	Risk of disturbance to residential properties at Alcester Road, Birmingham Road.	Yes	No

Diversion Route Id	Diversion Route	Motorway Closure	NIA on Diversion Route (Y/N)	Number of Sensitive Receptors (not houses)	Approx. no. of Residential Receptors	Potential Number of Closures	Potential Disturbance	Potential for Alternative Routes	Potential to exceed BS 5228
104	M40 northbound closure J16 to M42 J3A (for traffic from M40 to M42 South)	M40 J15 northbound to M42 J3A	Y	3	467	5	Risk of disturbance to residential properties at Alcester Road, Birmingham Road.	Yes	No
122	M42 J3 to M42 J3a, via A435, A46 & M40 J15	M42 J3 eastbound to J3A	Y	3	411	13	Risk of disturbance to residential properties at Henley in Arden, and Henley in Arden Baptist Church and Community Library.	Yes	No
124	M40 J16 to M42 J3, via A3400, A4189 & A435	M42 J3A westbound to J3	Y	3	413	13	Risk of disturbance to residential properties at Henley in Arden, and Henley in Arden Baptist Church and Community Library.	Yes	No
125	M42 J3a to M42 J3, via M42 J4, M42 J3a, M42 J16, A3400, A4189 & A435		Y	3	415	13	Risk of disturbance to residential properties at Henley in Arden, and Henley in Arden Baptist Church and Community Library.	Yes	No

Diversion Route Id	Diversion Route	Motorway Closure	NIA on Diversion Route (Y/N)	Number of Sensitive Receptors (not houses)	Approx. no. of Residential Receptors	Potential Number of Closures	Potential Disturbance	Potential for Alternative Routes	Potential to exceed BS 5228
127	via M40 J16 & M42 J3a (M40W - M42N link)	M42 J3A (M42E - M42N link)	Y	0	0	2	N/A	Yes	No
128	via M40 J16 & M42 J3a (M40W - M42W link)	M42 J3A (M42S - M42W link)	Y	0	0	2	N/A	Yes	No
129	via M42 J3 & M42 J3a (M42E - M42N)	M42 J3A (M40W - M42N link)	Y	1	6	1	Risk of disturbance to residential properties at Radford Road.	Yes	No
130	via M42 J3 & M42 J3a (M42E - M40E)	M42 J3A (M42S - M40E link)	Y	1	6	1	Risk of disturbance to residential properties at Radford Road.	Yes	No
131	via M42 J4 & M42 J3a (M42S - M40E)	M42 J3A (M42E - M40E link)	Y	0	2	2	Risk of disturbance to residential properties at Tinkers Lane.	Yes	No
132	via M42 J4 & M42 J3a (M42S - M42W)	M42 J3A (M40W - M42W link)	Y	0	2	4	Risk of disturbance to residential properties at Tinkers Lane.	Yes	No
133	M40 J16 to M42 J4, via A3400	M42 J3A northbound to M42 J4	Y	3	185	N/A	Risk of disturbance to residential properties at Hockley Heath.	Yes	No
134	M42 J3 to M42 J4, via M40 J16 & A3400		Y	5	226	N/A	Risk of disturbance to residential properties at Hockley Heath.	Yes	No

Diversion Route Id	Diversion Route	Motorway Closure	NIA on Diversion Route (Y/N)	Number of Sensitive Receptors (not houses)	Approx. no. of Residential Receptors	Potential Number of Closures	Potential Disturbance	Potential for Alternative Routes	Potential to exceed BS 5228
135	M42 J4 to M42 J3a, via A3400, M40 J16	M42 J4 southbound to M42 J3A	Y	3	198	1	Risk of disturbance to residential properties at Hockley Heath.	Yes	No
136	M42 J4 to M42 J3a, via A3400, M40 J16, M42 J3 & M42 J3a	M42 J4 southbound to M42 J3A	Y	4	206	N/A	Risk of disturbance to residential properties at Hockley Heath.	Yes	No

Assumptions:

- Two MS4 installations per off-peak carriageway closure.
- Two cantilever gantries installed per single direction carriageway closure.
- A single bridge demolition or major installation would require both direction carriageway closures with active traffic diversion.
- One weekend closure (Fri/Sun) per bridge demolition.
- One superspan removal per night
- Two full span gantry installations per night require both direction carriageway closure.
- 50m distance from diversion route is adopted for receptor counts.

Table 8-17 Estimate of the potential for diversion routes to exceed duration threshold **(see also Traffic Management Plan, document ref. HE551530-AMAR-GEN-SWI-RP-OP-000006)**

Vegetation Clearance

8.5.19. Vegetation clearance works would normally be undertaken during the day, with operations lasting for no more than a few days at any individual location. Consequently, no significant effect is typically encountered. However, noise from the use of chain saws and other plant can give rise to temporary annoyance, particularly when the removal of vegetation must be undertaken at night. As night time operations could occur, the OEMP identifies control measures for sensitive locations. This includes a commitment that night time working will only be undertaken in exceptional circumstances, with prior notification of residents. When night time working is unavoidable then the Delivery Partner shall demonstrate the measures taken to ensure there would be **no resultant significant effect**.

Overall Construction Effects

8.5.20. Significant temporary effects may be associated with the construction of Emergency Areas, particularly M42 ERA NB1, retaining walls as well as the temporary removal of existing noise barriers and diversion routes, unless these works are subject to effective management.

8.5.21. Based upon the findings of the assessment, Table 8-18 provides an estimate of the number of receptors potentially exposed to elevated levels of construction noise, during the day or night time, at key construction locations. Considering the proposed mitigation, the effects of construction are predicted to be neutral, provided effective deployment of the mitigation measures occurs.

Table 8-18: Potential construction effects on residential receptors

Location of sensitive receptors	SOAEL	Predicted construction activity noise level ($L_{Aeq,T}$ dB façade)	Level of enhanced stakeholder engagement required[1]	Estimated no. of receptors potentially exposed for 10 days in 15 days	Noise critical construction activity
Juggins Lane	75	77	Red	5	Piling at M42 ERA NB1
					Piling at gantry G-M42-33

8.6 Assessment of Operational Effects

8.6.1. This section details:

- Short-term changes in noise level;
- Long-term changes in noise level.

8.6.2. The acoustic modelling results can be found in **Appendix E-4.**

Short-Term Changes – DM2022 to DS2022

8.6.3. Replacement of the existing concrete and HRA road surface, on lanes 1 and 4, with a low noise surface would benefit approximately 1065 dwellings. The areas close to M40 (N of J16) and M42 (J3a-J4) are predicted to experience perceptible reductions in traffic noise, benefitting approximately 966 residents (Figure 8-2).

8.6.4. 218 residential properties would experience a negligible increase in noise level (within the 0.1 to 0.9 dB range), with a further 158 predicted to experience a minor increase in noise level ranging from 1.0 to 2.9 dB. These properties are largely situated adjacent to the carriageway and/or the Affected Road Network.

8.6.5. The residential receptors experiencing a predicted, potentially perceptible, minor adverse impact are within nIA 7598, the increase in noise being as a result of an increase in the average traffic speed, sufficient to cause a reallocation from one speed band to another within the model. Based upon the actual speed change, the increase in noise is anticipated to be less than 1dB.

8.6.6. No non-residential buildings are predicted to experience a perceptible increase in short-term Do-Something scenarios. All other dwellings and sensitive receptors are predicted to experience negligible noise impacts or no change in noise level.

Table 8-19: Short-term traffic noise changes (DM2022 to DS2022)

Change in noise level		Daytime			Night-time
		Number of residential properties between LOAEL & 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 - 0.9	66	11	40	0
	1.0 – 2.9	0	1	0	0
	3.0 - 4.9	0	0	0	0
	5.0 +	0	0	0	0
No change	= 0.0	294	86	17	142
Decrease in noise level, $L_{A10,18h}$	0.1 - 0.9	62	28	12	45
	1.0 – 2.9	41	17	2	70
	3.0 - 4.9	311	44	2	236
	5.0 +	0	0	0	0

Long-Term Changes – DM2037 to DS2037

8.6.7. The long-term changes in road traffic noise are shown in **Figure 8-3** and **Table 8-**20; 581 residential properties are predicted to experience a negligible increase in noise level (within the 0.1 to 2.9 dB range), and a further 1 property is predicted to experience a minor increase in noise level of 3.0 dB. This receptor is located close to the ARN carriageway.

8.6.8. For the night-time period, 559 residential properties are predicted to experience noise increases, 333 of which are negligible. Of those noise increases 194 are predicted to be subject to a change in noise ≥ 1.0 dB, ranging from 1.0 to 2.8 dB. The majority of residential properties predicted to experience noise increases of ≥ 1.0 dB are not on the Proposed Scheme, but on other roads which experience increases in traffic, both with and without the Proposed Scheme.

8.6.9. No non-residential or other receptors are predicted to be affected by perceptible long-term road traffic noise increases.

Table 8-20: Long-term traffic noise changes (DM2037 to DS2037)

Change in noise level		Daytime			Night-time
		Number of residential properties between LOAEL & SOAEL	Number of residential properties above SOAEL	Number of other sensitive receptors	Number of residential properties above SOAEL
Increase in noise level, LA10,18h	0.1 - 2.9	156	22	41	0
	3.0 – 4.9	1	0	0	0
	5.0 - 9.9	0	0	0	0
	>=10.0	0	0	0	0
No change	= 0.0	352	91	17	117
Decrease in noise level, LA10,18h	0.1 - 2.9	55	34	6	37
	3.0 – 4.9	82	10	3	72
	5.0 - 9.9	691	50	2	238
	>=10	0	0	0	0

Traffic Noise Annoyance

8.6.10. The results of the Traffic Noise Annoyance assessment are included in Appendix E.4

8.6.11. Without the scheme, 952 residential properties are predicted to experience increases in traffic noise annoyance, compared to approximately 605 residential properties with the Proposed Scheme.

8.6.12. 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 SMP infrastructure. While the area of vegetation clearance will not be not confirmed until detailed design, 5 possible locations of substantive vegetation clearance, that could make motorway traffic visible to nearby residents, will be 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

8.7.1. The Proposed Scheme delivers the following outcomes in support of the Noise Policy Statement:

- Aim 1 - To avoid significant adverse noise effects: An assessment of existing noise barriers, generally located at noise Important Areas, and low noise surfacing on lanes 1 and 4, has predicted a long-term benefit to 99 residents who would no longer be exposed to levels above SOAEL (see **Error! Reference source not found.**21). It will not be possible to reduce noise levels below SOAEL at 304 locations, due to their location outside of the ARN and distance from the motorway network.
- Aim 2 - To mitigate and minimise adverse noise effects: 94 residents are predicted to experience reduced noise levels, albeit still above SOAEL, with a further 828 residents predicted to be exposed to reduced noise levels between LOAEL and SOAEL. See Table 8-20.
- Aim 3 - To improve the noise environment where possible: SMP schemes can consider onsite and offsite measures within the remit of sustainable development. Measures were considered, but not included for the reasons summarised in Table 8-21.

Table 8-21: Noise Important Area rectification measures

NIA Id	Number of dwellings	Number of dwellings – Opening Year with Scheme							Rectification measure proposed	Mitigated/not mitigated
		Increase		Decrease			Bought below SOAEL	Lowered but above SOAEL		
		>0 to 1 dB	1 to 3 dB	>0 to 1 dB	1 to 3 dB	>3dB				
7594	2	2	0	0	0	0	No	Yes	Re-paved with low noise TSC	Mitigated due to Lanes 1 and 4 repaved with low-noise surfacing.
7495	10	0	10	0	0	0	No	No		
7596	4	2	2	0	0	0	No	No		
7597	1	0	1	0	0	0	No	No		
7598	3	0	0	0	0	3	No	Yes		
7599	2	0	0	0	0	2	No	Yes		
8234	2	0	0	0	2	0	No	Yes		

8.7.2. The Proposed Scheme is not forecast to cause a non-EIA significant change in noise levels at any properties on the Affected Road Network (ARN) as a result of altering the exposure of receptors to noise levels above SOAEL.

8.7.3. The OEMP has set out a requirement for the Handover Environmental Management Plan to advise Highways England's Operations Directorate of these locations so that discussions can be held on how the Directorate or the Local Highway Authority may respond

Table 8-22: Acoustic measures considered but not recommended

Location	Measure considered	Reason not adopted
1613 receptors on ARN	Acoustic barriers	Poor acoustic performance, poor Value for Money outcome

Management of Operational Noise

8.7.4. There is no requirement for mitigation measures in the form of acoustic barriers for operational noise as the maximum increase at the opening year is predicted to be 2.0 dB. There is, however, a need to address stakeholder concerns over the perception of increased noise, even where no quantitative increase in noise occurs, as there are 5 locations where vegetation removal would expose residents to views of the traffic. Consequently, consideration of the introduction of a visual screen while the vegetation becomes established is recommended, to assist in addressing the perception of traffic noise. As part of a planting strategy, these locations would be examined to determine whether the planting strategy would perform as well as a visual screen in reducing concerns over noise.

8.7.5. 5 candidate noise barriers identified in the Scoping Report were examined to determine whether they represented value for money. No additional barriers were deemed financially justifiable. Of the 5 candidate noise barriers, Table 8-23 records that none of the candidate barriers are being considered further as the benefits are lower than their costs (see Appendix E-4).

Table 8-23: Scoped out rectification measures

Measure	Location	VfM less than 1
NNB1	Portway, M42 J3 slip	Yes
NNB2	M42, Dwellings on Poolhead Lane	Yes
NNB3	M42, Dwellings on Wood End Lane	Yes
NNB4	M42, Dwellings on Tinkers Lane	Yes
NNB5	M42, Hockley Heath	Yes

8.7.6. Other measures to be taken to reduce noise levels in line with Government policy include:

- Resurfacing of Lanes 1 and 4 for the opening year;

8.7.7. It is not proposed that there would be any changes to the existing acoustic barriers.

8.7.8. An initial assessment has been undertaken of those properties that may meet the following four conditions, to qualify for consideration of a grant towards noise insulation, under the Noise Insulation Regulations 1975 (as amended 1988):

- Be within 300m of the Proposed Scheme;
- Experience a "relevant" noise level of at least 68dB LA10,18h (façade);
- Show a noise increase between the "relevant" noise level and the "prevailing" noise level of at least 1dB(A);
- The contribution to the increase in the "relevant" noise level from the Proposed Scheme alone must be at least 1dB(A).

8.7.9. This initial assessment indicates that 21 properties may qualify for a grant towards noise insulation measures. The locations of which are presented in Table 8-24:

Table 8-24: NI Regulations Qualifying Properties

House No./Name	Address	Postcode	X	Y	Façade
Peacocks	Billesley Lane	B48 7HE	407319.7	272830.4	NW
Arden Cottage	Earlswood Common	B94 5SQ	411178	272526	S
Bredon	Earlswood Common	B94 5SQ	411183	272466	S
Arden Croft	Forshaw Heath Lane	B94 5LH	408468	272793	N
Forshaw Lodge	Forshaw Heath Lane	B94 5LJ	408322	273053	S
Moorfield Farm	Lilley Green Road	B48 7HD	406910	272884	N
1	Poolhead Lane	B94 5EN	409480	272756	SW
2	Poolhead Lane	B94 5EN	409484	272752	SW
3	Poolhead Lane	B94 5EN	409490	272747	SW
4	Poolhead Lane	B94 5EN	409494	272743	SW
5	Poolhead Lane	B94 5EN	409497	272732	SW
6	Poolhead Lane	B94 5EN	409501	272728	SW
7	Poolhead Lane	B94 5EN	409510	272725	S
8	Poolhead Lane	B94 5EN	409514	272723	S
9	Poolhead Lane	B94 5EN	409522	272719	SW
10	Poolhead Lane	B94 5EN	409528	272715	SW
16	Westgrove Avenue	B90 4XN	414003	276495	S
Endeavour	Wood End Lane	B94 5DT	410294	272517	E
Far View	Wood End Lane	B94 5DT	410299	272527	E
Tudor Lodge	Wood End Lane	B94 5DT	410299	272544	NW
Willow House	Wood End Lane	B94 5DT	410308	272567	N

Replacement of Existing Noise Barriers

8.7.10. Delivery of the Proposed Scheme will require the temporary removal of 2 existing noise barriers (see Table 8-25) affecting approximately 6 receptors. While the duration during which the noise barriers would be absent is not known, the nature of the works to be undertaken is. An initial method statement to illustrate how the works could be undertaken, so that disturbance to the residents would be minimised, sets out the following:

- The application of best-practice construction methods to ensure that disturbance to residents is minimised, as far as is reasonably practicable;
- A maximum length of noise barrier that would be removed before sequential replacement follows;
- The initial method statement would outline those construction options that could lead to a reduced environmental impact while not causing undue disruption or impact upon the construction works;
- Where space permits, the deployment of temporary noise barriers;
- That the affected residents are notified of the construction activity prior to a barrier being removed;
- Where practicable, replacement of existing noise barriers before constructing new noise barriers.

Table 8-25: Temporary removal of noise barriers

Barrier Id	Barrier details	Location	NIA	No of dwellings within 50m	Noise critical works activity	Feasibility of temporary noise barrier	Expected Period without noise barrier
ENB1	Length: 220m Height: 2m	M42 EB	7594	5	Piling for gantries/ERA	Feasible	2 weeks total
ENB2	Length: 90m Height: 2m	M40 WB	7599	1	None	Not required	2 weeks total

Noise and Vibration Generating Activities e.g. Piling

8.7.11. The construction of Emergency Areas, retaining walls in the vicinity gantries, CCTV and EI cabinets and gantries have the potential to require percussive piling, with that for retaining walls being likely to affect individual receptors for the longest duration. Noise from piling arises both from the preparatory works, including vegetation clearance and construction of a crushed stone piling mat, as well as from the activity itself.

8.7.12. An alternative approach to sheet piles is the use of H-sections sunk with panels inserted between the 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 include temporary noise barriers or the offer to residents of alternative accommodation during peak disruption.

8.7.13. While efforts have been taken to locate Emergency Areas and to select geotechnical solutions that minimise the need for piling activities near residential areas, road safety design considerations reduce the available options. Opportunities to adopt low disturbance solutions, such as modular construction, would be explored post-DF3. Based upon current geotechnical information, the potential locations generating high noise levels could affect approximately 52 receptors (see Table 8-26

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), where ground conditions permit, and use of temporary noise barriers and piling shrouds;
- Agreement, with Local Environmental Health Officers, of criteria for the undertaking of significantly noisy or vibration-causing operations near to sensitive locations;
- 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 days;
- 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, potentially 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 8-26**. “Nearby” is taken to apply to dwellings within approximately 50m of the works

Table 8-26: Construction activities at risk of disturbing local residents

Id	Location	Works	NIA	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								
M42 ERA NB1	Tinkers Lane	New ERA construction	7598	1	1	Piling	TBC	Feasible	Pile wraps feasible
M42 ERA EB1	Poolhead Lane	New ERA construction	7595	0	7	Piling	TBC	Feasible	Pile wraps feasible
M42 ERA WB2	Poolhead Lane	New ERA construction	7595	0	7	Piling	TBC	Feasible	Pile wraps feasible
	Retaining Walls								
M42 ERA NB1	Tinkers Lane	Removal of retaining wall	7598	1	1	Excavation			
M42 ERA EB1	Poolhead Lane	Removal of retaining wall	7595	0	7	Excavation			
M42 ERA WB2	Poolhead Lane	Removal of retaining wall	7595	0	7	Excavation			
	Gantries, CCTV, Cabinets								
G-M42-03	Poolhead Lane	Removal/installation of gantry	7595	0	5	Piling			
G-M42-04	Woodend Lane	Removal/installation of gantry	7596	0	4	Piling			
G-M42-33	Juggins Lane	Removal/installation of gantry	7594	1	4	Piling			
	Vegetation Clearance								
-	Pound House Lane	Vegetation clearance	7594	2	0	Chainsaws			

Id	Location	Works	NIA	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
-	Tinkers Lane	Vegetation clearance	7598	2	2	Chainsaws			

Construction and recovery compounds

8.7.16. The assessment of construction and recovery compounds is to be undertaken by the Delivery Partner within the CEMP. 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 annoyance to local residents.

Diversion routes

8.7.17. **Figure 8.4** illustrates the current emergency diversion routes, the locations of sensitive receptors within 50m of each route and potential alternative routes. Error! Reference source not found.**27** 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 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 vehicle body-rattle may be an issue;
- Liaison with local highway authorities to ensure that planned use of diversions do not conflict with other planned maintenance works, to explore alternative routing, localised pavement resurfacing or temporary re-phasing of traffic lights;
- Minimising risk of disturbance by changes to traffic light sequences and/or local renewals of the road surface to reduce vehicle body-rattle;
- Advanced notification of the communities adjacent to proposed diversion routes;
- Advertising of full motorway closures, reducing the amount of night time traffic.

Table 8-27: Estimate of number of carriageway or full motorway closures

Motorway Link	No. superspan removals	Closures for bridges	No. new superspan gantries	Carriageway	New MS4	Potential closures (inc. emergency)
M42 J3 to J4	8	0	9	Northbound	0	18
				Southbound	0	18
• Two MS4 installations per off-peak carriageway closure. • Two cantilever gantries installed per single direction carriageway closure. • A single bridge demolition or major installation would require both direction carriageway closures with active traffic diversion. • One weekend closure (Fri/Sun) per bridge demolition. • One superspan removal per night • Two full span gantry installations per night require both direction carriageway closures.						

Stakeholder Engagement

8.7.18. The extent to which construction noise gives rise to annoyance 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 8.28** 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, 2 red and 2 amber engagement level areas have been identified, amounting to approximately 21 receptors (see **Table 8.29** and **Figure 8-5**).

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 level and duration).

Table 8-28: 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; • Construction compounds.	• Highways England to host specific local engagement meetings; • Delivery Partner to secure views of local residents and other stakeholders in advance of deciding on working method; • Delivery Partner to maintain awareness of local residents of intrusive work activities timetable using multiple media[11]; • Notice to be provided to local residents 14 days in advance of any intrusive works commencing; • Notice to be provided to local 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 local residents 14 days in advance of commencement of all-lane running (ALR); • A temporary telephone hotline to Manager of intrusive works is to be available 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 with potential to cause annoyance; • Recovery compounds • Construction of central reserve RCB.	• Delivery Partner to maintain awareness of local residents of intrusive work activities timetable using multiple media[12]; • Notice to be provided to local residents 14 days in advance of any intrusive works commencing; • Notice to be provided to local 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 local residents 14 days in advance of commencement of ALR; • A local resident's hotline to be provided to stakeholder engagement Manager in addition to publicising the Highways England customer support number; • Feedback from residents to be sought on completion of works.
Green Level	Locations within night	• Notice to be provided to local residents 14 days

[11] The Delivery Partner is to respect the equalities and diversity principles in engagement with local residents.
[12] ibid.

	time SOAEL envelop during the construction works.	in advance of changes to traffic management activities where a >3dB change in noise levels at receptors would occur; • Notice to be provided to local residents 14 days in advance of commencement of ALR; • Local resident's hotline to be provided to stakeholder engagement Manager.

Table 8-29: Location of tiered stakeholder engagement areas

Stakeholder Id	Location	Approx. No of dwellings	Critical works activities
Red engagement level areas			
RELA1	Tinkers Lane	2	ERA construction; gantry removal/installation
RELA2	Juggins Lane	12	Gantry removal/installation
Amber engagement level areas			
AELA1	Juggins Lane	5	Resurfacing, night works
ALEA2	Pound House Lane	2	De-veg, night works

8.8 Residual Effects

8.8.1. Based on adoption of the mitigation measures outlined in **Section** Error! Reference source not found., there are no predicted permanent significant adverse residual effects resulting from the operation of the Proposed Scheme.

8.8.2. During the operational phase, 736 out of a total of 1613 sensitive receptors in the calculation area are predicted to experience short-term major noise decreases in the opening year, 102 moderate decreases and 128 minor decreases. Additionally, 158 receptors are predicted to experience a minor increase in noise. The noise changes at the remaining sensitive receptors are shown to be negligible or no change.

8.8.3. Over the long-term, 1 receptor is predicted to experience a minor increase, with 95 receptors calculated to experience a minor decrease and 743 to experience a moderate decrease. All other receptors are subject to negligible or no change in long-term noise level. The Proposed Scheme is also considered to have a neutral effect for dwellings located within NIA, as no perceptible impacts are predicted.

8.8.4. The construction phase has the potential to cause significant noise effects at some 52 receptors. However, the Delivery Partner shall demonstrate, through provision of method statements and mitigation measures in the CEMP, that no significant effects will arise at the following key locations:

- Tinkers Lane;
- Juggins Lane

8.9 Summary

8.9.1. The Proposed Scheme is envisaged to give rise to some temporary adverse effects during construction activities, principally associated with piling and vegetation clearance works near the two red engagement areas previously described. Deliverable management measures have been proposed within the OEMP and these have translated into the Works Information as appropriate. The key management measures detailed in the OEMP comprise:

- Use of best practice construction methods on site during all works;
- Selection of low-emission plant where possible;
- Use of temporary barriers or hoardings;
- Engagement with key receptors and stakeholders.

8.9.2. The Proposed Scheme is predicted to reduce the number of people exposed to noise levels in excess of the daytime and night-time SOAEL from 421 to 304, with Monkspath residents, to the northwest of J4 of the M42, gaining particular benefits. Other residents would experience an increase in opening year noise levels (DM-DS) of between 1 – 3 dB where it has not been possible to provide additional noise mitigation; 11 of these would experience a noise level above SOAEL.

9. Water Environment

- The Proposed Scheme route crosses floodplain as it passes over eight watercourses, including the River Blythe (Main River) and the Stratford-Upon-Avon canal, at 15 crossing locations. Approximately 9% of the route passes directly through land with the potential to be affected by flood water.
- The Proposed Scheme requires widening of the road deck area within several flood plain affected sections.
- Although changes to traffic flow were conservatively estimated in excess of 20% on two of the road links with outfalls assessed, these changes have not been found to increase the risk of water quality deterioration on receiving watercourses. As a result no significant effects have been recorded in relation to changes in traffic flow, the pollutant loading of road drainage and impacts to receiving watercourses.
- Three locations have demonstrated potential flood risk impacts as a result of the DF3 embankment earthworks: Junction 3 westbound off-slip road; M40 both sides within the interchange (Junction 3a); and, the M40 northbound side (90m west of Nuthurst Lane) despite the utilisation of retaining walls. No other significant residual adverse effects upon road drainage and the water environment have been identified from the Proposed Scheme. However, the Flood Zone locations and their sensitivity to embankment build-outs have been documented. To ensure no residual effects remain, build out into these areas by the scheme has to be identified and mitigated.
- Opportunities to enhance the conditions at the existing Priority outfalls will be investigated as part of the ongoing design development and will form part of the assessment. This assessment ensures all the Highways England objectives for water

9.1 Introduction

9.1.1. This chapter focusses on the issues associated with floodplain encroachment caused by the Proposed Scheme at watercourse crossing locations and examines the potential impact on water quality the scheme may have on watercourses that receive highway related runoff.

9.1.2. The study area covers two sections of the M42 and one section of the M40. The first section extends from the off-slip road at Junction 3 of the M42 up to the intersection with the M40 at Junction 3a; the second extends from the M42 Junction 3a intersection down to Junction 16 of the M40; and the third section covers the stretch of road north of the intersection to M42 J4. This study is focussed on the 11 watercourse crossing locations and the associated floodplains that are crossed by, or adjacent to, the Proposed Scheme.

9.1.3. The following figures support this chapter:

- Figure 9.1 – Flood Risk for Rivers
- Figure 9.2 – Surface water flood risk
- Figure 9.3 – Flood risk sensitive locations by 10m cross section

9.1.4. An outfalls assessment is supplied as Appendix F.

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

Name	Grade and Company	Expertise and Professional Qualification
John Ravening	Water Quality Lead, Arup	Chartered Environmental Water Manager (CWEM) and full member of Chartered Institution of Water and Environmental Management (CIWEM) BSc (Hons) Joint Geology and Physical Geography MSc Environmental Water Management. Experience includes leading assessment of the water environment and flood risk on large infrastructure projects for 17 years. Project involvement has included M1 widening J21 – 31, Smart Motorways Projects M1 21 – 25, M1 J10 – 16 and M25 J10 - 16

Professional Competency Water

9.2 Scoping

9.2.1. The Scoping report (M40/M42 Interchange Environmental Scoping Report MP0280-HEX-EGN-ZZ-AS-KK-0001) considered the implications of the proposed works upon water quality and focussed on the ecological status of local watercourses, groundwater and surface water abstractions, and documented the existing motorway drainage outfalls and culverts. The scoping report identifies the main sources of flood risk to the scheme and highlights the need to mitigate any perceived losses to the flood plain affected by the scheme.

9.2.2. Temporary construction effects linked to potential changes in water quality, surface water discharges, groundwater receptors and Water Framework Directive (WFD) considerations have been scoped out of the assessment, as per the scoping report. However, an assessment of the existing and proposed quality of highway runoff related to the operation of the motorway has been necessary to ensure that impacts are identified, and appropriate levels of pollution control are embedded into the design. This will ensure that there are no significant effects.

9.2.3. An outfall assessment has been required to fulfil the verification process described in the Scoping Report. The outfall assessment has involved assessing each outfall by applying assessment method A to assess surface water receptors and method C for groundwater receptors as described in Design Manual for Roads and Bridges, Volume 11, Section 3, Part 10 HD 45/09. These methods have been applied as they are the standard methods applied to Highway England projects. They have been developed by Highways England to explore the impact and risk of highway related runoff on the water environment. Implementation of this helps ensure that the scheme is in accordance with the WFD and the associated domestic legislation and regulations and that the state of the water environment is maintained.

9.2.4. Locations demonstrating a sensitivity to flood risk have been identified. This information has been used to determine the impact of the scheme on existing flood plain storage and to identify mitigation.

9.2.5. Works at the existing structures that convey watercourses under the existing motorway in the study area have been minimised. As such the scale and scope of the hydrogeomorphological and ecological condition will not affect the WFD status of any of the watercourses in the study area. Therefore, a full WFD assessment has been scoped out although sensitivity of the receptor waterbodies is considered within the outfall assessment process.

9.3. Methodology

9.3.1. Flood levels have been established at each watercourse crossing, or where a watercourse is in close proximity to the Proposed Scheme by the best available technique (see Section 9.4 for a description of how flood levels have been derived).

9.3.2. Each watercourse with the potential to be affected by the Proposed Scheme has been assessed in terms of the likelihood for the proposed changes to affect the existing floodplain by applying the flood levels to the DF3 design. The results of this are presented in Table 9-1.

9.3.3. The flood levels applied to the assessment either have a direct climate change component in the way they have been derived or have been derived using methods with an in built contingency to allow for climate change. This is described in more detail in Section 9.4.

9.3.4. Encroachment of the scheme into areas of existing flood storage have been identified. This encroachment will lead to displacement of flood waters, which in turn will lead to a change in peak water levels in areas adjacent to the Proposed Scheme. Potential peak water levels changes have been estimated and an impact predicted based on Table A4.4 of Design Manual for Road and Bridges Volume 11, Section 3, Part 10 HD45/09. This has then been translated into an effect by cross referencing the impact with the receptor sensitivities in terms of flood risk, as described in Section 9.4.2 of this report, using Table A4.5 in HD45/09. Receptor sensitivities have been based on Table A4.3 in HD45/09. Receptor sensitivities have been assumed to be reflective of receptor importance as described in Table A4.3 in HD45/09.

9.3.5. The assessment of floodplain encroachment has been done on a location by location basis but also considers cumulative impacts of floodplain encroachment on the floodplain by multiple design features.

9.3.6. An iterative design process has been undertaken with the design team to introduce mitigation measures into the flood sensitive locations. This has been undertaken in order to remove floodplain impingement resulting in potential significant effects. However, where the design or baseline data details have not been sufficient at DF3 to remove all significant effects a strategy is presented, to be applied to all future design stages to ensure the floodplain impingement is removed or mitigated to remove all significant effects, as required.

9.3.7. Through the DF3 design period consultation with the Environment Agency and Lead Local Flood Authority has involved data collection only. The design has not been sufficiently progressed to inform detailed discussions during this design period.

Road Drainage

9.3.8. An assessment has also been undertaken at each existing outfall location along the route of the Proposed Scheme. This determines:

- The existing condition of the road drainage outfalls, this will include taking account of the Priority Status classification and the characteristics of the receiving surface or groundwater feature;

- The potential for the scheme to elevate the risk of highway related contaminants affecting the water quality within the receiving waterbody (surface or ground). This will occur if the predicted change in traffic movements is sufficient to cross a threshold within the Highways England Water Resources Assessment Tool (HAWRAT); and
- If the receiving catchment affected by the outfall location is within close proximity to a water dependent vulnerable receptor such as SSSI, SAC or Ramsar wetland site. Investigation into incorporating additional pollution prevention measures will be undertaken with the design team to safeguard these vulnerable receptors.

9.3.9. The predicted impact to the receiving waterbody has been estimated using Table A4.4, the importance of the waterbody has been based on the sensitivity information provided in Section 9.4, which has been based on Table A4.3 of HD45/09. Receptor sensitivities have been assumed to be reflective of receptor importance as described in Table A4.3 in HD45/09. The effect has then been determined by applying Table A4.5 of HD45/09.

9.3.10. Cumulative assessments have been undertaken where multiple outfalls discharge to the same receptor.

Assumptions and Limitations

9.3.11. This assessment has considered the potential impact of the design as at Design Freeze 3 (DF3) but acknowledges that changes may follow in line with the engineering design programme.

9.3.12. It is assumed that the measures proposed within the Operational Environment Management Plan (OEMP HE551530-AMAR-EAC-ZZ-TE-LX-000001) will be followed to avoid significant detrimental impact to the water environment during the construction stage.

9.3.13. Calculations have been undertaken to quantify the volume of floodplain encroachment. These calculations provide a sensitivity-based assessment of where mitigation is required. At this stage of the design process the volumes of encroachment are approximate and indicative.

9.3.14. The possibility of unmarked cross drainage features should be considered.

9.3.15. Land will not be available to accommodate replacement floodplain storage outside the highway boundary. Potential significant effects have been identified at DF3 due to floodplain impingement. However, experience from other SMP schemes have determined that it is possible to adapt the design to either remove the impingement into floodplain by steepening the gradient of embankment slopes and applying retaining walls, or extending retaining walls to remove existing sections of slope to provide extra volumetric capacity. Detailed analysis may be required to inform this. Therefore, it is assumed that all residual floodplain impingement significant effects will be removed from the scheme as the design is taken forward.

9.3.16. Changes to outfalls required to mitigate effects by the scheme or enhancements will also be limited by the requirement to undertake all works within the highway boundary.

9.3.17. Works proposed and currently ongoing at Junction 3 of the M42 have been reviewed and understood to address an area of existing surface water flooding. This location was identified as a location of potential flood risk concern for the DF3 design. However these changes are assumed to alleviate the problem and ensure that the SMP scheme is not affected by or increase flood risk in this location.

9.4. Baseline Conditions

9.4.1. The baseline conditions examine the water features in the study area that are crossed or are located in close proximity to the existing motorway and have the potential to be affected by the Proposed Scheme.

Watercourses

9.4.2. Watercourses affected by both western and northern sections of the M42 sit within the 'Tame Anker and Mease' Management Catchment, which contains the Rivers Cole and Blythe. This is situated within the Humber River Basin District. The watercourses of the River Alne catchment affected by the M40 sit within the Avon Warwickshire Management Catchment, situated within the Severn River Basin District. A detailed account of the watercourses considered in the assessment is given below:

- Surface water accumulation: there are surface water drains to the east of Junction 3, a culvert is present passing beneath the M42, but the location is not certain at this stage and it appears not to connect to a surface watercourse;
- Tributary of the River Blythe 1: small watercourse. This passes through a culvert beneath the M42 at Ch 01+785;
- Spring Brook: (tributary of the River Blythe 2) is culverted beneath the M42 at Ch 03+353;
- tributary of Preston Bagot Brook 1, is culverted beneath the M40 at the intersection (Junction 3a) Ch 06+686 near Jonathan's Coppice, this same watercourse is then culverted beneath the slip roads to and from the M40, connecting to the M42 North section at Chalcot Wood;
- a field drainage culvert passes under the M40 at Ch 06+430 with no defined surface watercourse shown;
- tributary of Preston Bagot Brook 1, flowing south east, passes beneath the M40 at Ch 07+224. It then continues to run along in close proximity to the M40 in a south easterly direction crossing under the M40 again at Ch 07+636 and Ch 08+072, just west of Junction 16;
- at Ch 00+245, north of the Intersection of Junction 3a, tributary of the River Blythe 3 passes beneath the M42;
- the Stratford upon Avon Canal is crossed at Ch00+800;
- tributary of the River Blythe 3 runs parallel in close proximity to the M42 (southbound side) from just north of Kineton Lane (01+700) until it crosses beneath the M42 at 02+124, heading north west; and
- the River Blythe passes beneath the M42 north of Junction 4.

9.4.3. All surface water features within the study area are identified in Table 9-1 and are detailed on the plans that make up Figure 9.1.

Table 9-1 Surface water features crossed by the Proposed Scheme

Watercourse	Main river or Ordinary watercourse	WFD waterbody and status	Receptor Sensitivity	Receptor details	Crossing point(s), chainage and location
Bissell Wood Drain	Ordinary watercourse	GB104028042400. Blythe from Source to Cuttle Brook. POOR	HIGH	A432 and agricultural buildings potentially affected by the surface water. Please see Table 9-7	M42 West section Ch. 0+586. Pipe drain / culvert beneath M42 indicated but not detailed.

Watercourse	Main river or Ordinary watercourse	WFD waterbody and status	Receptor Sensitivity	Receptor details	Crossing point(s), chainage and location
Forshaw drain 1	Drain		Low	No receptors.	M42 West section Ch. 1+040. Small pipe possibly connects the Forshaw drains beneath the M42.
Forshaw drain 2	Ordinary watercourse		Low	No receptors.	M42 West section Ch. 1+178. Small pipe possibly connects the Forshaw drains beneath the M42.
Tributary of River Blythe 1	Ordinary watercourse		HIGH	Industrial buildings. Please see Table 9-7.	M42 West section Ch. 1+785.
Biddles Hill drain 1	Drain		Low	No receptors	M42 West section Ch. 2+166.
Biddles Hill drain 2	Drain		Low	No receptors	M42 West section Ch. 2+242.
Spring Brook (Tributary of the River Blythe)	Ordinary watercourse		HIGH	Sewage treatment works. Please see Table 9-7	M42 West section Ch. 3+353.
Spring Brook ponds	Ponds		Low	No receptors.	M42 West section Ch. 3+400. Four small ponds in close proximity to the M42, eastbound side.
Tributary of River Blythe 2	Ordinary watercourse		Low	No receptors	M42 West section Ch. 4+316
Woods Coppice pond	Pond	GB109054043850. Preston Bagot Bk - source to conf R Alne. POOR	Low	No receptors.	M42 West section Ch. 4+340
Bissell's coppice pond 1	Pond		Low	No receptors.	M42 West section Ch. 4+848
Bissell's coppice pond 2	Pond		Low	No receptors.	M42 West section Ch. 5+135
Tributary of Preston Bagot Brook 1	Ordinary watercourse		HIGH	Flood risk to road deck indicated. Please see Table 9-7	M42 West section Ch. 5+686
				Flood risk to road deck indicated.	M42 West section Ch. 5+839

Watercourse	Main river or Ordinary watercourse	WFD waterbody and status	Receptor Sensitivity	Receptor details	Crossing point(s), chainage and location
				Please see Table 9-7	
Chalcot Wood pond 1	Pond		Low	No receptors.	M42 West section Ch. 6+000
Chalcot Wood pond 2	Pond		Low	No receptors.	M42 West section Ch. 6+150
Drain	Drain		Low	No receptors	M42 West section Ch. 6+430. Field drain culvert
Bramhope ponds	Pond		Low	No receptors.	M42 West section Ch. 7+000
Tributary of Preston Bagot Brook 1	Ordinary watercourse		HIGH	Flood risk to road deck indicated. Please see Table 9-7	M40 section Ch. 7+224. Culvert
Tributary of Preston Bagot Brook 2	Ordinary watercourse		Low	No receptors	Confluence. M40 section Ch. 7+632. Northbound side.
Tributary of Preston Bagot Brook 1	Ordinary watercourse		HIGH	Flood risk to road deck indicated. Please see Table 9-7	Culvert. M40 section Ch. 7+634.
Tributary of Preston Bagot Brook 3	Ordinary watercourse		Low	No receptors	M40 section Ch. 7+691. Confluence
Tributary of Preston Bagot Brook 1	Ordinary watercourse		HIGH	Flood risk to road deck indicated. Please see Table 9-7	Nuthurst Road culvert. M40 section Ch. 7+745.
Fish pond	Pond		Low	No receptors.	M40 section Ch. 7+800.
Tributary of Preston Bagot Brook 4	Ordinary watercourse		Low	No receptors. Fish pond upstream.	Confluence on southbound side. M40 section Ch. 7+943.
Tributary of Preston Bagot Brook 1	Ordinary watercourse		HIGH	Flood risk to road deck indicated. Please see Table 9-7	Culvert under M40, followed by 200m parallel flow along northbound side. M40 section Ch. 8+074.

Watercourse	Main river or Ordinary watercourse	WFD waterbody and status	Receptor Sensitivity	Receptor details	Crossing point(s), chainage and location
Tributary of the River Blythe3	Ordinary watercourse	GB104028042400. Blythe from Source to Cuttle Brook. POOR	Low	No receptors.	Culvert. M42 North section Ch. 0+246.
Tinkers Lane Ponds	Ponds		Low	No receptors.	M42 North section 0+350
Stratford upon Avon Canal	Canal		HIGH	Canal and River Trust	Bridge. M42 North section 0+800.
Tributary of the River Blythe3	Ordinary watercourse		HIGH	Agricultural Fields. Please see Table 9-7	Culvert at Kineton Lane. M42 North section 1+600.
Tributary of the River Blythe3	Ordinary watercourse		HIGH	Flood risk to road deck indicated. Please see Table 9-7	Parallel channel. M42 North section 1+715.
Blythe Valley Park Ponds	Ponds		Low	No receptors.	M42 North section 2+000. Northbound side
Tributary of the River Blythe3	Ordinary watercourse		HIGH	Flood risk to road deck indicated. Please see Table 9-7	M42 North section 2+122. Culvert.
A34 drain	Drain		Low	No receptors.	M42 North section 3+120. Extending >400m north of the A34 along northbound side of the M42, parallel to the River Blythe.
River Blythe	Main River		HIGH	Flood risk to road deck indicated. Please see Table 9-7	M42 North section 3+546. Bridge

9.4.4. The sensitivity/importance of these watercourses has then been documented in Table 9 1 and is based on the descriptions given in table A4.3 of DMRB Vol. 11, Section 3, Part 10 45/09 (Ref 9.3). The key indicator used is the 2016 overall Water Framework Directive (WFD) quality classification of the relevant WFD waterbody. In addition, the proximity and hydraulic linkage to national and international sites, designated in terms of ecology, biodiversity and nature conservation sites, has been considered. These are identified in Table 9 2.

Table 9-2 Designated Sites close to the Proposed Scheme

Location	Designation Name	ID number	National Designation	Associated watercourses	Water vulnerability

M42 West 01+500 to 02+300	Windmill Naps Wood	1002065	SSSI	Tributary of the River Blythe 1. Upstream side of M42. Not affected (no hydraulic link).	Low
M42 West 02+000 to 03+000	Clowes Wood & New Fallings Coppice	1002152	SSSI	Tributary of the River Blythe 1. 0.95km downstream. Not in close proximity and so dilution will reduce the impact.	Low
M42 West 03+500 and M42 North from 03+000	River Blythe	1002269	SSSI	Spring Brook (River Blythe). Connectivity to the Proposed Scheme disrupted by culverts, and not in close proximity and so dilution will reduce the impact.	Low
M42 North 03+100	Monkspath Meadow	1002268	SSSI	Outside the Proposed Scheme area, no connectivity to watercourse affected by the Proposed Scheme.	Low
M42 North. >2.0km north of Junction 4.	Malvern & Brueton Park	1009716	LNR	River Blythe. Outside the Proposed Scheme area, >1km downstream and so dilution will reduce impact.	Low

Flood Risk

9.4.5. Existing peak flood levels for the 1% Annual Exceedance Probability (AEP) event, with an additional allowance for Climate Change (1%AEP+CC) or greater (Flood Zone 2), have been derived for each watercourse either crossing the existing motorway or located within close proximity to the motorway and at risk of being affected by the Proposed Scheme. These levels have been derived using three sources of data from the Environment Agency outlined in Table 9.3.

Table 9-3 Data sources

Available data source	Description
EA Modelled Flood Level data	The Environment Agency have been approached for flood level data of the watercourses that have been previously modelled for the main river locations and when received will supersede the Flood Zone derived values in Table 9 4 where applicable. The Environment Agency flood levels data for climate change scenarios are likely to be for the 20% increase.
EA Flood Zone 2 map	National data set: Mapped outlines of 0.1%AEP (1 In 1000 year) flood extents for planning purposes. The Environment Agency flood zone mapping data set is available on Figure 9.1
EA Surface water 0.1% AEP	National data set: Mapped outlines of potential surface water flood risk at 0.1%AEP. Environment Agency Risk of Surface Water Flooding (RoSWF) is available on Figure 9.2

9.4.6. As outlined in Table 9 3, Environment Agency modelled flood levels for the 1% AEP+CC event are available for some watercourses but not at locations that are affected by the Proposed Scheme. For the watercourses where this data is not available it has been necessary to use the Flood Zone 2 (0.1% AEP) mapping and Risk of Surface Water Flooding (RoSWF) mapping (0.1% AEP) in conjunction with topographical data (Ref 1) at the existing crossing locations to determine an appropriate design flood level. The derived flood levels and their source detail are outlined in Table 9 4 to Table 9 6.

9.4.7. Although climate change allowances are not explicitly allowed for when flood levels are derived from Flood Zone 2 or the RoSWF data set there is an in built climate change contingency. This is due to the fact that they are based on the 0.1% AEP event. Therefore this has an in built contingency. Furthermore, the method used to derive the flood level often overestimates the flood level.

9.4.8. Deriving flood levels in the manner described is potentially of lower accuracy. However, it is a time and cost effective method of providing flood level information within an in built contingency which is very useful when considering climate change and other external factors that can affect the design process. Therefore, it may be beneficial to refine these levels using fluvial hydraulic analysis at detailed design stage and take climate change into account in this analysis. Fluvial hydraulic modelling will only be required if the design process outlined in Sections 9.5 and 9.6.4 requires more accurate flood level information.

Table 9-4 Localised flood level date for M42 West watercourse crossing: Eastbound and Westbound

M42 WEST				
Watercourse Crossing (Names tbc)	Flood Water Level (mAOD)	Chainage START	Chainage END	Detail
M42 WEST - EASTBOUND CARRIAGEWAY				

Tributary of the River Blythe 1	151.5	01+755	01+840	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
Spring Brook	140.6	03+321	03+394	Flood levels estimated from the Flood zone 2 outline
M42 WEST - WESTBOUND CARRIAGEWAY				
Bissell Wood Drain	162.8	00+465	00+683	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
Tributary of the River Blythe 1	151.5	01+728	01+800	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
Spring Brook	141.6	03+330	03+418	Flood levels estimated from the Flood zone 2 outline

Table 9-5 Localised flood level date for M40 watercourse crossing: Southbound and Northbound

M40				
Watercourse Crossing (Names tbc)	Flood Water Level (mAOD)	Chainage START	Chainage END	Detail
M40 SOUTHBOUND CARRIAGEWAY				
Tributary of Preston Bagot Brook (River Alne)	140	05+746	05+871	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
	123.2	07+163	07+205	Flood levels estimated from the Flood zone 2 outline
	118.48	07+581	07+646	Flood levels estimated from the Flood zone 2 outline
	118.48	07+655	07+747	Flood levels estimated from the Flood zone 2 outline
	117.8	07+755	07+880	Flood levels estimated from the Flood zone 2 outline
	116.5	07+973	08+071	Flood levels estimated from the Flood zone 2 outline
	116	08+076	08+190	Flood levels estimated from the Flood zone 2 outline
M40 NORTHBOUND CARRIAGEWAY				
Tributary of Preston Bagot Brook (River Alne)	140	05+655	05+885	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
	121.5	07+184	07+223	Flood levels estimated from the Flood zone 2 outline
	118.74	07+517	07+600	Flood levels estimated from the Flood zone 2 outline
	118.32	07+603	07+677	Flood levels estimated from the Flood zone 2 outline

	116.1	08+000	08+070	Flood levels estimated from the Flood zone 2 outline
	114.7	08+073	08+240	Flood levels estimated from the Flood zone 2 outline
	113.74	08+246	08+327	Flood levels estimated from the Flood zone 2 outline
	108	09+071	09+163	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
	106.8	09+232	09+395	Flood levels estimated from the Flood zone 2 outline

M40				
Watercourse Crossing (Names tbc)	Flood Water Level (mAOD)	Chainage START	Chainage END	Detail
M40 SOUTHBOUND CARRIAGEWAY				
Tributary of Preston Bagot Brook (River Alne)	140	05+746	05+871	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
	123.2	07+163	07+205	Flood levels estimated from the Flood zone 2 outline
	118.48	07+581	07+646	Flood levels estimated from the Flood zone 2 outline
	118.48	07+655	07+747	Flood levels estimated from the Flood zone 2 outline
	117.8	07+755	07+880	Flood levels estimated from the Flood zone 2 outline
	116.5	07+973	08+071	Flood levels estimated from the Flood zone 2 outline
	116	08+076	08+190	Flood levels estimated from the Flood zone 2 outline
M40 NORTHBOUND CARRIAGEWAY				
Tributary of Preston Bagot Brook (River Alne)	140	05+655	05+885	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
	121.5	07+184	07+223	Flood levels estimated from the Flood zone 2 outline
	118.74	07+517	07+600	Flood levels estimated from the Flood zone 2 outline
	118.32	07+603	07+677	Flood levels estimated from the Flood zone 2 outline
	116.1	08+000	08+070	Flood levels estimated from the Flood zone 2 outline
	114.7	08+073	08+240	Flood levels estimated from the Flood zone 2 outline

	113.74	08+246	08+327	Flood levels estimated from the Flood zone 2 outline
	108	09+071	09+163	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
	106.8	09+232	09+395	Flood levels estimated from the Flood zone 2 outline

Table 9-6 Localised flood level data for M42/M40 Interchange watercourse crossings: Slip roads

M42 NORTH SLIP ROADS				
Watercourse Crossing (Names tbc)	Flood Water Level (mAOD)	Chainage START	Chainage END	Detail
M42 NORTH SLIP TO M40 SLIP (Southern side)				
Tributary of Preston Bagot Brook 1 (River Alne)	136.57	00+536	00+588	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
	136.57	00+600	00+732	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
M40 NORTHBOUND SLIP TO M42 NORTH (Southern side)				
Tributary of Preston Bagot Brook 1 (River Alne)	140	00+619	00+682	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.

Table 9-7 Localised flood level data for M42 North watercourse crossings: Northbound and Southbound

M42 NORTH				
Watercourse Crossing (Names tbc)	Flood Water Level (mAOD)	Chainage START	Chainage END	Detail
M42 NORTH - SOUTHBOUND CARRIAGEWAY				
Tributary of the River Blythe 3	138	00+228	00+270	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
	130.61	01+547	01+583	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. No channel present.
	127.38	01+709	01+866	Flood levels estimated from the Flood zone 2 outline
	126.765	01+867	02+196	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.

River Blythe	121.77	03+303	03+544	Flood levels estimated from the Flood zone 2 outline
	121.77	03+548	03+772	Flood levels estimated from the Flood zone 2 outline
M42 NORTH - NORTHBOUND CARRIAGEWAY				
Tributary of the River Blythe 3	139	00+169	00+243	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
	126.765	02+075	02+176	Flood levels estimated from the RoSWF 0.1AEP outline. No Flood Zone outline. Channel present.
River Blythe (EA may provide water levels)	124.7	03+100	03+280	Flood levels estimated from the Flood zone 2 outline
	122.34	03+290	03+544	Flood levels estimated from the Flood zone 2 outline

9.4.9. The flood levels provided in Table 9 4 to Table 9 7 have then been used in the assessment of impacts caused by the Proposed Scheme.

9.4.10. The key areas of flood risk uncertainty based on the baseline data available are described below:

- Characteristics of the modified channel of tributary of Preston Bagot Brook 1 passing beneath the M40 at the intersection (Junction 3a) 06+686 near Jonathan's Coppice are unknown and are not represented by the RoSWF outline. This same watercourse then passes beneath the slip roads to and from the M40, connecting to the M42 North section. No information is available on the condition or capacity of the culverts or the flood risk that they represent;
- Tributary of Preston Bagot Brook 1 is not accurately represented by the Flood Zone 2 outline or the RoSWF map at the crossing locations at 07+224, 07+636 and 08+072 and no representation of the culverts under Pound House Lane and Nuthurst Road (both on the southbound side of the M40) is evident in either of the flood maps, suggesting that the flow dynamics are not accurately represented;

- From 07+500 to 08+300 Flood Zone 3 shows flood risk along the route of the Proposed Scheme;
- Flood Zone 2 and 3, originating from the tributary of the River Blythe 3 channel, is shown to follow the route of the M42 up to Junction 4. It does not pick up the shape of the watercourse channel, suggesting low confidence in the Flood Zone map at this location; and
- The culvert at 02+124 is shown to have the potential to increase local flood levels on the southbound side of the M42, but flood water levels are likely to be over represented.

9.4.11. Further detail on the drainage characteristics throughout the route of the Proposed Scheme can be found in the Drainage Strategy Report (Ref 9.10).

9.4.12. The surrounding area of the Proposed Scheme is largely agricultural or open grassland which are categorised as receptors of low sensitivity value with a low probability of affecting residential and industrial properties. However, there are more vulnerable receptors located within the study area. These are accounted for in Table 9.8 (Ref 9.3) in terms of receptor, location and importance.

Table 9-8 Flood risk receptors and importance

Watercourse and chainage	Receptor	Importance
Tributary of River Blythe 1. Eastbound side. 01+785	Industrial estate on the right bank and Biddles Hill road downstream of the Proposed Scheme.	Medium
Spring Brook. Eastbound side	Sewage Treatment Works downstream on the left bank. The North Warwickshire Line railway runs parallel in close proximity. (NPPF category: essential infrastructure)	HIGH
Tributary of Preston Bagot Brook 1. 5+700. Both sides.	M40 road level indicated as at risk from flooding. (NPPF category: essential infrastructure)	HIGH
Tributary of Preston Bagot Brook 1. 7+224. Southbound side.	M40 and Pound Hurst Lane within Flood Zone 3. (NPPF category: essential infrastructure)	HIGH
Tributary of Preston Bagot Brook 1. 7+760. Southbound side.	Nuthurst Road and M40 within Flood Zone 3. (NPPF category: essential infrastructure)	HIGH
Tributary of Preston Bagot Brook 1. 8+074. Southbound side.	M42 road deck within Flood Zone 3. (NPPF category: essential infrastructure)	VERY HIGH
Tributary of the River Blythe 3. M42 North 1+600. Southbound side.	Agricultural fields and Kineton Road (NPPF category: less vulnerable)	Medium
Tributary of the River Blythe 3. 1+800 to 2+200	Road Deck of the M42 is below Flood water level. (NPPF category: essential infrastructure)	HIGH
River Blythe. 3+600	M42 indicated as at risk to the Flood Zone 3 outline. Road deck level indicated as vulnerable to the flood water levels. (NPPF category: essential infrastructure)	HIGH

Embankment flood risk sensitivity

9.4.13. The flood risk sensitivity of the existing embankment has also been assessed. This has been undertaken by examining the existing topography along the route of the Proposed Scheme by cross section at 10m intervals. The locations where the toe (bottom edge) of the existing embankment earthworks is at the same level as, or below the estimated flood water level for the locations are shown in Table 9 6 to Table 9 8.

9.4.14. These locations show the chainages either side of the carriageway that would have a high likelihood of displacing some volume of flood water should a buildout of the existing embankment earthworks be required under the Proposed Scheme. This does not mean that development should be avoided at these locations. For each of the locations identified below, the design should ensure that the flood water levels are considered when extending verges, emergency areas or placing features that will require build-out beyond the existing embankment profile. These locations are marked on Figure 9.3.

Table 9-9 Locations with flood risk sensitivity identified by chainage extent on the M42/40 East – West line

M40 M42 E-W Line - flood level sensitive locations					
Eastbound carriageway			Westbound carriageway		
Ch. Start	Ch. End	Dist. (+/- 10m)	Ch. Start	Ch. End	Dist. (+/- 10m)
			0+460	0+480	20
			0+500		10
			0+540	0+630	90
			0+670	0+680	10
1+800	1+830	30			
3+350	3+390	40			
			3+370	3+390	20
			3+420		10
			5+660	5+850	190
5+830	5+870	40			
7+200	7+210	10			
			7+550	7+710	160
7+660	7+730	70			
7+990	8+000	10			
8+030	8+060	30	8+030	8+060	30
8+070	8+190	120	8+100	8+110	10
J3a to J4 M42 North section - flood level sensitive locations					
Southbound carriageway			Northbound carriageway		
Ch. Start	Ch. End	Dist. (+/- 10m)	Ch. Start	Ch. End	Dist. (+/- 10m)
			2+130		10
2+170		10	2+160	2+170	10
			3+450	3+540	90
3+550	3+600	50			

3+620	3+700	80			
3+720	3+760	40			

Road drainage

9.4.15. The road drainage network including the Priority outfalls has been identified using the Highways England HAGDMS data set. HAGDMS comprises a map viewer of the highway network owned and managed by Highways England (HE). A wide range of information regarding the motorway and the associated assets are presented through the map viewer. This includes the location of existing outfalls. The system contains details regarding the motorway network and associated assets. These are accessed by employing the systems search facility.

9.4.16. In terms of outfalls one of the key pieces of information provided is the outfall 'status'. The HE assesses outfalls to determine the risk of polluted surface water from being discharged into the receiving watercourses and their structural condition. The outfalls are then designated a Priority Status. The priority status system used is listed below:

- Priority A (Very High) – very high risk of releasing polluting matter to the wider environment and /or poor structural condition;
- Priority B (High) – high risk of releasing polluting matter to the wider environment and/or low structural condition;
- Priority C (Moderate) - moderate risk of releasing polluting matter to the wider environment and/or moderate structural condition;
- Priority D (Low) - moderate risk of releasing polluting matter to the wider environment and/or good structural condition;
- Priority X (Risk Addressed) – Issues identified have been rectified
- Not Determined - No assessment undertaken.

9.4.17. Table 9 10 provides a summary of the drainage outfalls within 1km of the Proposed Scheme (HAGDMS 2019) and provides details of the number of outfalls classified for each priority status. This varies from the number quoted in the scoping report due to regular data reviews in HAGDMS.

Table 9-10 number of outfalls following initial review of the scheme

HE Priority Status	Priority A	Priority B	Priority C	Priority D	X (Risk Assessed)	Not Determined
Number of outfalls	3	9	8	12	6	2

9.4.18. Following a detailed assessment of the connectivity of the road surface to the outfalls and receiving environment, only 18 contributing road surface area catchments were identified. Connectivity of the registered outfalls to the drainage network identified on the HAGDMS viewer is not always clear and has had to be derived by a comprehensive review process reviewing topography, continuous network characteristics, reports authored by the maintenance contractor responsible for the area and available on the HAGDMS database and, in some cases, CCTV survey from within the network. The road drainage catchments have then been split between permeable and impermeable surface area, with road surface assumed to be impermeable.

9.4.19. Only nine of the outfalls identified on the HAGDMS database with an existing Priority Status could be associated with the road catchments' drainage network. The remaining nine road drainage outfall

locations had no HAGDMS 'Outfall' reference. However, they are identified as the end of a pipe location on the HAGDMS data base within in the asset inventory. The results of the assessment of these outfalls can be found in Section 9.5.

9.4.20. The 2016 Flooding Hotspot report produced for Kier Highways (Ref 9.4) identifies significant road flooding hotspots along the M40 within the Interchange. It states that since November 2010 there are ten recorded flood events within the scheme extents, half of which have occurred since March 2015. The report suggests that the flooding issue at this location is becoming more pronounced and frequent. It recommends activities to improve collection and dispersal of surface water from the carriageway, reducing the risk of a flood event. Further information on road surface flooding hotspots can be found in the Drainage Strategy Report (Ref 9.10). Further information on mitigation and enhancement can be found in section 9.6.7 to 9.6.10 in this report.

Groundwater features

9.4.21. The groundwater and hydrogeological regime of the study area has been based on information available from the British Geological website (Ref 9.5) and the Environment Agency (Ref 9.6). For the M42 west section of the Proposed Scheme bedrock secondary 'B' aquifer underlies the route between Junctions 3 and 3a and most of the M40. Secondary A aquifer underlies most of the M42 north section from 00+250 to 02+150 and is classified as 'Minor aquifer' of 'Low' vulnerability. The whole study area is mostly underlain by undifferentiated superficial drift aquifer with small sections of Secondary A superficial drift along the watercourses.

9.4.22. The following groundwater bodies along the existing route are managed under the Water Framework Directive:

- GB40402G990800 – Tame Anker Mease - Secondary Combined. Approximate chainage (M42 West) -0+605 – 04+316 & (M42 North) 00+000 – 03+475. Overall Classification for 2016 GOOD;
- GB40902G990900 – Warwickshire Avon - Secondary Mudrocks. Approximate chainage (M42 WEST to M40) 04+316 – 09+770. Overall Classification for 2016 GOOD;

9.4.23. The closest groundwater Source Protection Zone is >5km away from the Proposed Scheme at the M40 Junction 16 and none of the Proposed Scheme falls within a groundwater drinking water safeguard zone.

9.4.24. Using the criteria set out in Table A4.3 in HD45/09, the sensitivity of the groundwater features described above are of low vulnerability. Groundwater is therefore, considered as being of low sensitivity for the whole route of the Proposed Scheme.

Abstractions and discharges

Surface and groundwater abstractions

9.4.25. There are no abstraction licence locations within 1km of the Proposed Scheme or along the route.

Surface and groundwater discharges

9.4.26. There are 34 unrevoked licensed discharges (Ref 9.7) within 1km of the Proposed Scheme. Eight of these are within 100m of the M40/M42 Interchange Proposed Scheme centreline. Table 9 11 shows the number of discharges by Local Authority.

Table 9-11 Private and public Licensed discharge consents within 1km of the Proposed Scheme centreline (All licences are private, except where indicated)

Local Authority	Licensed discharges within 1.0km of the Proposed Scheme Centreline	Licensed discharges within 0.1km of the Proposed Scheme Centreline
Solihull Local Authority	2 Licensed discharges	-
Stratford on Avon Local Authority	20 Licensed discharges (2 Public)	1 Licensed discharge
Warwick Local Authority	7 Licensed discharges	1 Licensed discharge
Bromsgrove Local Authority	5 Licensed discharges	-

9.4.27. All abstractions are considered receptors of high sensitivity, but there are none identified within 1km of the Proposed Scheme. The eastern section of the M42 and the north section of the Interchange and M42 sit within the Humber_SWSGZ2204_Bourne Blythe & Shustoke Res. Drinking Water Safeguard Zone. This is considered to be low sensitivity.

9.4.28. Discharges, of which there are 34 within 1km of the Proposed Scheme are considered receptors of low sensitivity.

9.5 Assessment of Effects

Construction Effects

9.5.1. Excavation, land stripping and other construction activities that have the potential of releasing polluting matter to the water environment and or changing local hydraulic conditions will be controlled by the Outline Environmental Management Plan (OEMP). It is assumed that there will be no impacts when these measures are implemented. All works undertaken in association with the construction activities in close proximity to watercourses (8m is the standard threshold, although this will be confirmed with the Lead Local Flood Authority, Internal Drainage Board and Environment Agency) will require the contractors to pursue bespoke environmental permits from the responsible authorities pertaining to prescribed activities such as storage of material on flood plain. Therefore, it is assumed that there will be no significant effects at the construction stage.

Operational Effects

Flood Risk

9.5.2. The potential impact of the Proposed Scheme on the existing floodplain storage provided at each watercourse crossing location or where a watercourse runs in close proximity to the Proposed Scheme has been based on an assessment of the structures proposed to be located within the Environment Agency Flood Zone 2 and/or the RoSWF outlines and the associated water levels (as described in Table 9 4 to Table 9 7).

9.5.3. Table 9 12 shows the following information:

- where infrastructure associated with the Proposed Scheme has required earthworks extension;
- where this results in impingement into floodplain;

- where the implementation of retaining walls has removed floodplain impingement; and
- where impingement remains.

Table 9-12 DF3 Retaining walls and remaining volumetric impacts (Ref 9.8)

Watercourse	Chainage START	Chainage END	Impacts	Retaining walls applied Y/N	Remaining impacts m^3
M42/M40 - WESTBOUND					
Surface water accumulation and drainage.	0+460	0+680	Retaining wall design shows potential impingement of the flood water levels. Works being under taken as part of junction improvements has been reviewed and it is determined that the works will remove the impact caused by SMP scheme	N/A	N/A
Tributary of the River Blythe 1	1+800	1+830	Build-out retained above the potential flood water level. No residual impact. Not identified in DF2 as requiring consideration.	Y	0.0
Spring Brook (River Blythe)	3+350	3+390	Overpass for the M42 over the railway and Spring Brook. No impacts at this location.	N	0.0
Tributary of Preston Bagot Brook 1	5+660	5+773	No earthworks shown at these locations	N	0.0
	5+775	5+800	Unretained widening within floodplain.	Y	44.6
	7+600	7+635	Retain earthworks along left bank of channel up to the culvert in the vicinity of Nuthurst Lane. Estimated water level is above the toe of the retained section.	Y	1.45
	7+665	7+675	Retaining wall	Y	4.87
	8+030	8+060	Toe of embankment earthworks widening remains above the estimated flood water level.	N	0.0
M42/M40 - EASTBOUND					

Watercourse	Chainage START	Chainage END	Impacts	Retaining walls applied Y/N	Remaining impacts m^3
Tributary of the River Blythe 1	1+800	1+830	Culvert entrance at this location. Minor difference to the existing land profile. The watercourse channel must not be affected by the toe of the embankment.	N	3.98
Spring Brook (River Blythe)	3+350	3+390	Overpass for the M42 over the railway and Spring Brook. No impacts at this location.	N	0.0
Tributary of Preston Bagot Brook 1	5+820	5+860	Water levels at low confidence at this location. Modelled levels needed.	N	53.3
	7+640	7+655	Retaining wall with toe lower than Flood level	Y	16.7
	7+680	7+725	Toe of 70m retaining wall above the estimated flood water level.	Y	0.52
	7+990	8+000	Embankment earthworks result in negligible impact at DF3.	N	0.8
	8030	8060	Embankment earthworks. Water levels and connectivity at low confidence at this location.	N	13.2
	8+070	8+190	No significant embankment earthworks widening shown in DF3. Road indicated as at risk from flooding from the Brook. Reports of standing water on HAGDMS, but not severe and not fluvial.	N	0.0
M42 J3a to J4 SOUTHBOUND					
Tributary of the River Blythe 3	1+875	1+882	Proposed structural buildout on left bank of watercourse channel. Toe of retaining wall above the estimated flood water level.	Y	0.0
	2+030	2+040	Proposed structural buildout on left bank of watercourse channel. Toe of retaining wall above the estimated flood water level.	Y	0.0

9.5.4. Table 9 12 demonstrates that the design has avoided or mitigated floodplain impingement at all but three locations. These are described below:

- the M40 on the stretch of road that passes through the Junction 3a Interchange and crosses the tributary of Preston Bagot Brook 1. It is estimated that up to 44m^3 (on the westbound (upstream of the M40) side) and 53.3m^3 (on the eastbound (between the carriageways within the intersection) side) volume of flood water will be displaced by the Proposed Scheme embankment widening earthworks;

- two retaining walls on the north/west bound side of the M40, 90m west of Nuthurst Lane (ch. 7+591 to 7+739). The design of these retaining walls serves to reduce the impact of the build-out required for a gantry base and electrical box on the tributary of Preston Bagot Brook 1 but does not eliminate the impingement of floodplain with up to 17m^3 floodplain capacity loss remaining; and
- Unretained earthworks between chainages 8+030 – 8+060, on the east bound carriageway.

9.5.5. In accordance with DMRB assessment criteria any change of flood level in excess of 10mm is considered a minor adverse impact. It is likely that the potential impingement at these three locations could result in an increase of flood level of this magnitude. All these floodplain locations have been identified as high importance in Table 9 8 as they have the potential to impact essential infrastructure. Therefore, the effect of the floodplain impingement at these three locations will result in a moderate significant effect.

9.5.6. However, measures will be implemented within the following stages of the design to remove or mitigate the impacts and effects identified at DF3. The strategy to be followed is outlined in Section 9.6.

Road Drainage

9.5.7. A road drainage outfall assessment has been undertaken to identify the potential impacts caused by the scheme to receiving waterbodies (surface and ground) as a result of changes to the traffic flow. This was done to identify the locations that may require mitigation to ensure that there are no impacts leading to significant effects. Changes to the traffic flow (Annual Average Daily Traffic – AADT) can either be caused as a direct result of the proposed smart motorway programme (SMP) improvements (referred to as the “Do Something (DS)” scenario) or due to a change in traffic flow over time (The “Do Nothing (DN)” scenario).

9.5.8. The assessment concluded that:

- no individual outfalls show a decline in Priority Outfall status as a result of the ‘Do Minimum’ scenario for the year 2037 (DM 2037) AADT scenario compared to the 2015 baseline; and
- no individual outfalls show a change in Priority Outfall status as a result of the ‘Do Something’ scenario for the year 2037 (DS 2037) AADT scenario (i.e. with SMP) compared to the ‘Do Minimum 2037’ (i.e. No SMP).

9.5.9. Outfalls SP0972_2269a, show high levels of dissolved Zinc and Copper, although the assessment has determined it as a Priority C outfall . It discharges into tributary of the River Blythe 1, which is less than 1km upstream of the Clowes Wood & New Fallings Coppice SSSI and therefore if the water quality from this outfall could be improved there would be an overall benefit to the wider water environment.

9.5.10. Similarly, Outfalls ‘NOT REFERENCED A’ and SP1474_2588e that show a toxicity failure due to Copper and feed into watercourses within 0.5km (not at the same location) of the River Blythe which is a designated SSSI. Therefore, an improvement in the local water quality would also have an overall benefit to the wider water environment.

9.5.11. Further details on the outfall assessment and the conclusions on potential improvements on four of the outfall locations can be found in the M42/M40 Interchange Outfall Assessment document HE551530-AMAR-EWE-RP-YE-000002, Appendix F.

9.5.12. This assessment concluded that the changes to traffic flow would not lead to a deterioration of the receiving watercourses accepting highway related runoff from any of the outfalls within the study area. However, outfalls have been identified that would benefit from enhancement to provide an overall improvement to the local water quality environment, specifically due to the connectivity or proximity of SSSIs.

9.5.13. The drainage design principles, including the implementation of attenuation to manage additional surface water generated by additional hardstanding and the allowance of climate change (20% increase in peak rainfall) within the design (See Drainage Strategy Report) ensures that the road drainage system will not have any impacts, in terms of increasing surface water runoff from the motorway during operation

9.6. Design, mitigation and enhancement measures

Road Drainage

9.6.1. The Proposed Scheme design includes the requirement to include a new surface water management system to collect and manage surface water falling onto the increased impermeable surface of the highway. The design of this system ensures that discharges of surface water to receiving watercourses will not increase. This allows for a 20% increase in peak rainfall intensity across any additional hardstanding. The road drainage design is prescribed in IAN161/15 (Ref 9.9).

9.6.2. Implementation of this will improve the efficiency of the existing drainage reducing incidences of carriageway flooding. This will likely reduce existing flooding hot spot issues. It will also ensure that the proposed road drainage design will have a negligible impact on the quantity of surface water discharged to receiving watercourses. Therefore, the flood risk to land or buildings adjacent to these will remain unchanged.

9.6.3. The outfall assessment provided in Appendix F has determined that none of the outfalls from the highway directly affected by the scheme, require any mitigation to reduce pollutant loading. However, outfalls have been identified where works would present an opportunity to enhance the local environment, these measures have not been included as part of the DF3 design.

Flood risk

9.6.4. Work is being undertaken in close liaison with the design team to ensure that any encroachment into the floodplain caused by the Proposed Scheme is reduced or compensated using the most appropriate solution. Communication with the Environment Agency is already in progress and has informed the baseline of this assessment and proposed mitigation measures. In accordance with NPPF all potential flood risk impacts will have to be mitigated utilising the measures outlined below, where reasonably practicable. This is a commitment upon the Design Agent to implement at all stages of design up to construction, in all locations where there is the potential for flood risk impacts, not just the potential for significant effects, and forms a commitment within the OEMP which must be undertaken. To ensure an adverse effect is avoided as a result of encroachment the following activities will be undertaken, at all locations where the potential for floodplain encroachment has been identified, throughout detailed design:

- Detailed calculation of flood plain losses at the locations identified in section 9.5;
- The same calculation will also be necessary at new locations, if design changes cause additional areas of floodplain to be affected;
- Design workshops to investigate the potential for all encroachment to be removed by steepening embankment slopes or through the use of retaining structures. As part of discussions already held with the design team there are no engineering constraints to the use of retaining structures should these be required as a solution. A decision will need to be made on the cost effectiveness of this against the following measure; and
- 'If encroachment is unavoidable, then the losses will be compensated on a level for level, volume for volume basis through the delivery of compensation. This can be achieved through steepening slopes, and/or introducing retaining structures elsewhere within the Proposed Scheme.

9.6.5. The above approach is one that has been previously agreed within Highways England on the SMP, and the Environment Agency as the consenting authority. Following and documenting the process described above will support any environmental permit required for works within floodplain storage areas that will be required in advance of construction being commenced. The implementation of these measures will be required to ensure the permit is granted, and therefore ensures that all impacts will be appropriately mitigated.

9.6.6. This approach has been applied to the DF3 design and ensured that impingement into floodplain has been removed or mitigated at all but three locations. Therefore, the further measures (see above) are required at the following locations:

- The M40 on the stretch of road that passes through the Junction 3a Interchange and crosses the tributary of Preston Bagot Brook 1;
- two retaining walls on the north/west bound side of the M40, 90m west of Nuthurst Lane (ch. 7+591 to 7+739); and
- unretained earthworks between chainages 8+030 – 8+060, on the east bound carriageway.

Further mitigation and enhancement

9.6.7. At DF3, the locations described above impinge into existing areas of floodplain. Therefore, at the later stages of the design the process outlined in Paragraph 9.6.4 will have to be followed to ensure that impingement is either removed or mitigated through flood storage compensation. It is recommended that fluvial hydraulic modelling is undertaken to improve the accuracy of the flood levels and inform the design process. Following this process will ensure that all significant effects are removed.

9.6.8. Opportunities to enhance the conditions at the existing outfalls identified in Paragraphs 9. 5.9 and 9.5.10 should be explored and implemented into the drainage design. This will be undertaken in the following stages of design if funding is available. This has not been implemented at DF3.

9.7. Residual effects

9.7.1. Implementation of further mitigation identified in section 9.6 should ensure the residual effects of the Proposed Scheme will all be reduced to neutral, and therefore not significant.

9.7.2. Floodplain impingement will be avoided in all cases by incorporating mitigation (retained structures, compensatory floodplain storage as described in section 9.3.15) within the design. This will ensure that there is no net increase in flood risk and in line with the requirements of the NPPF. This may

have to be informed by fluvial hydraulic analysis of the tributary of Preston Baggot Brook 1. This will remove all significant effects from the scheme.

Table 9-13 Residual effects

Watercourse	From	To	Direction	Sensitivity of receptor	Significance of effect pre-mitigation (adverse)	Expected magnitude of impact post-mitigation	Significance of effect post-mitigation (adverse)
Tributary of the River Blythe 1	1+800	1+830	M40 EB	HIGH	Minor Adverse	Negligible	Neutral
Tributary of Preston Bagot Brook 1	5+660	5+773	M40 WB	HIGH	Negligible	Negligible	Neutral
Tributary of Preston Bagot Brook 1	5+775	5+800	M40 WB	HIGH	Major Adverse	Negligible	Neutral
Tributary of Preston Bagot Brook 1	5+820	5+860	M40 EB	HIGH	Major Adverse	Negligible	Neutral
Tributary of Preston Bagot Brook 1	7+600	7+635	M40 WB	HIGH	Minor Adverse	Negligible	Neutral
Tributary of Preston Bagot Brook 1	7+640	7+655	M40 EB	HIGH	Major Adverse	Negligible	Neutral
Tributary of Preston Bagot Brook 1	7+665	7+675	M40 WB	HIGH	Moderate Adverse	Negligible	Neutral
Tributary of Preston Bagot Brook 1	8+030	8+060	M40 EB	HIGH	Major Adverse	Negligible	Neutral
A number of locations have been identified above where the data suggests an impact. The receptors for all locations are essential infrastructure – M42 and M40 as shown on Table 9.8. However, there is a lack of sufficient quality of information to be able to have confidence in these impacts and the design has some potential to accommodate some volumes through design. *This location (Junction 3 westbound off slip) has no definable impact at this stage due to ongoing conflicting HE construction work.							

9.7.3. No impacts in outfall performance as a consequence of traffic flow increases have been detected in the initial assessment. However, outfalls have been identified where works would present an opportunity to enhance the local environment, these measures have not been included as part of the DF3 design.

9.8. Summary

9.8.1. Table 9-14 summarises the potential impacts and residual effects on water receptors as a result of the Proposed Scheme and mitigation measures to be implemented. In summary, with mitigation

measures implemented, as detailed in Section 9.6, the Proposed Scheme will not have any significant effects on the water environment.

Table 9-14 Residual effects

Feature/receptor	Potential environmental impacts	Proposed mitigation, enhancement or monitoring measures	Residual effects
Watercourses crossed by the Proposed Scheme (as detailed within Table 9.1)	Floodplain encroachment:	Design workshops to investigate the potential for all encroachment to be removed by steepening embankment slopes or through the use of retaining structures. There are no engineering constraints to the use of retaining structures should these be required as a solution to avoid impact or provide appropriate level for level, volume for volume compensation elsewhere within the Proposed Scheme.	Neutral in all cases

10. Cumulative Effects

- A review was undertaken to update the committed developments in the study area from the Environmental Scoping Report.
- No significant intra-project cumulative effects were identified.
- The key developments under consideration for inter-project cumulative effects are Blythe Valley Park hybrid application for housing and employment; and office development at Huskisson Way.
- The assessment has determined that there are no significant cumulative effects on any receptors from any of the committed developments in combination with the Proposed Scheme.

10.1 Introduction

10.1.1. There are two types of cumulative effects covered in this chapter

- Those caused by the Proposed Scheme and that arise when individual receptors 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 classed as intra-project cumulative effects.
- Those caused by a combination of the Proposed Scheme with other relevant schemes. These are classed as inter-project effects.

10.1.1. In both cases, cumulative effects may be of greater significance than the individual significance of any of the identified non-cumulative effects reported in chapters 5 to 9. The intra-project effects assessment focuses on key sensitive receptors, including properties and communities.

10.1.2. In accordance with IAN 125/15, the assessment covers the main likely significant cumulative effects, rather than reporting every interaction.

10.2. Methodology

Intra-project cumulative effects

10.2.1. The potential cumulative effects of different aspects of the Proposed Scheme have been determined by identifying any individual receptors, or categories of receptors, affected by multiple impacts under more than one specialist topic.

10.2.2. The intra-project cumulative study area has been defined by the study areas adopted for the specialist topics with the potential for interactions. These are as detailed in the respective assessment chapters. For all potential interactions, the smaller study area has been adopted as potential interactions will not exist outside the scope of the one interacting aspect.

10.2.3. There is also the potential for an individual receptor, or groups of receptors, to be affected by adverse impacts under one topic and beneficial impacts 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. The intra-project effects assessment focusses on key sensitive receptors, including properties and communities.

Inter-project cumulative effects

10.2.4. In order to identify inter-project effects, a review was undertaken to identify other relevant projects using a selection criteria methodology. This criteria focussed on identifying major developments within 1km of the scheme.

10.2.5. The identification of relevant projects was limited to the period August 2013 to January 2019, 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).

10.2.6. Following the above criteria those projects which have sufficient environmental data and assessments would need to be readily available for any cumulative assessment to be conducted. If sufficient environmental data and assessments is not available, no consideration of cumulative effects will be possible with that particular development. In addition, only those developments with valid planning permissions and for which environmental impact assessment has been undertaken have been included in the assessment of cumulative effects. Due to the uncertainty over the construction timings for the identified developments and the timescale for the SMP scheme, cumulative effects from construction have been based on the assumption that should they overlap, effects will be mainly on receptors in close proximity to both schemes. At time of writing the location of diversion routes for the SMP scheme was not confirmed, but it is assumed that the emergency diversion routes already in place for motorway maintenance will be utilised.

10.2.7. Information on committed developments between August 2013 and November 2017 were described in the Environmental Scoping Report for this scheme. For the purposes of this EAR, this information was updated to identify consented development between November 2017 and January 2019. This was done through a review of the information available on the local planning authorities planning websites for developments that fall within the requirements as listed in 10.2.5.

10.2.8. The criteria above cover the two types of development projects recommended for assessment by Highways England guidance (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 and noise are inherently cumulative.
- Development projects with valid planning permissions, for which a formal EIA is a requirement or for which non-statutory environmental impact assessment has been undertaken.
- Relevant projects were identified by searching Local Planning Authority Planning Registers and gathering information on the following:
- Planning permissions yet to be implemented.
- Planning permission under construction.
- Nationally Significant Infrastructure Project applications at the pre-application stage onwards. This is due to the Planning Act process making these developments reasonably foreseeable. It is likely due to construction timescales that cumulative effects will be limited to the operational phase.
- Submitted planning applications not yet determined.

10.2.9. Whilst information has been gathered from local authority websites, no consultation with local authorities has taken place to confirm this development schedule at this time.

10.2.10. Projects fitting the above definitions represent projects about which there can be a high degree of certainty that they will be implemented. However, site allocations identified by local councils (for example in their local development plans) have been scoped out of the cumulative effects assessment on the basis that there is uncertainty around the nature and timeframes for development and that they are therefore not reasonably foreseeable. This assessment also excludes

developments that are conditional on another development that does not have consent, conjectural or conceptual projects and policy aspirations.

10.2.11. Using this approach, the following developments were identified for inclusion in this assessment. Further information is given in Appendix A.

Table 10.2: Developments considered within cumulative effects

Location	Description	Distance from Proposed Scheme
Blythe Valley Development, Blythe Valley Park Planning application: PL/2016/00863/MAOOT	Hybrid planning application for a mixed use development of land at Blythe Valley Park to comprise: in outline with all matters reserved (save for the new access, internal spine road and elements of landscaping - as described below), up to 750 residential dwellings, up to 98,850sqm of Use Class B1, B2 and B8 floor space, up to 250 unit housing with care facility (Use Class C2/C3) up to 2,500sqm of ancillary town centre uses (Use Class A1-A5), up to 1000sqm of ancillary leisure and community uses (Use Class D2), up to 200 bed hotel (Use Class C1) associated car parking (including shared car parking which could be decked) public open space, public realm and highways works; in full, new vehicular access, internal spine road, soft and hard landscaping (in part) SUDS and balancing ponds.	524m
Land Adjacent to J4 M42, Box Tree Farm, Stratford Road, Hockley Heath, Solihull Planning application: PL/2016/02754/MAJFOT	Development of new motorway service area, associated highway improvement works and other associated infrastructure. Land Adjacent to J4 M42 Box Tree Farm Stratford Road Hockley Heath Solihull	44m
Land at Fore Business Park, Huskisson Way, Shirley, Solihull Planning application: PL/2017/01594/MAJFOT	Hybrid planning application for employment development at Fore Business Park to comprise a) in full: Erection of two office buildings (Use Class B1) with ancillary automotive training and testing facility, security gatehouse, access road, car parking, landscaping and associated work; and b) in outline, with all matters reserved: up to 10,930 square metres (GIA) of office floor space.	237m
Land at Fore Business Park, Huskisson Way, Shirley, Solihull Planning application: PL/2018/01988/PPRM	Reserved matters application pursuant to outline planning permission PL/2018/01336/VAR for the erection of an office building incorporating research and	244m

Location	Description	Distance from Proposed Scheme
	development labs (Use Class B1) with associated internal access road, service yard, car parking (including a decked car park), landscaping and all other details required by condition 35 relating to the reserved matters of access, appearance, landscaping, layout and scale.	

10.2.12. The application for the development at Blythe Valley Park has a number of reserved matters applications relating to the individual components of the hybrid application. Supporting information submitted to the Local Authority (Solihull Borough Council) includes transport assessment, ecology assessments, drainage and geo-environmental assessments. For the purposes of the cumulative assessment within this report, the application is considered in it's entirety.

10.2.13. Some of the developments identified in the review, such as the applications for office buildings at plot F2 and F3, north of the Oracle Building (Appendix A), have been constructed and are now complete. Therefore, they have not been considered further for potential cumulative effects.

10.2.14. The applications in Table 10.1 have been cross checked against those included in the traffic model. All the above developments have been included within the traffic model.

10.2.15. Those projects already in the traffic model are not assessed again for air quality and noise as their traffic consequences are already accounted for in the future year Do-Minimum scenario of each assessment.

10.2.16. Having identified relevant projects, the next step was to identify potential significant effects. These were determined on the following basis:

- Does the development project/application present the potential for a source of impact that could affect an environmental receptor also affected by the Proposed Scheme? Examples of sources would be a structure that is particularly visible or a process that creates significant emissions or noise.
- Is there a potential pathway by which that impact could travel from the source to the receptor? For example, a line of sight to a viewpoint, a distance across which noise could be heard, or a flow path for a contaminated discharge.

10.2.17. For a cumulative effect to be identified, there would need to be an identified pathway between the impact source (or one of the development projects) and a receptor (one of the receptors or groups of receptors identified in this report as affected by the Proposed Scheme). This is referred to as the 'source-pathway-receptor' model.

10.2.18. Any identified cumulative impacts are further defined as construction or operation phase effects or short or long term effects (based on whether they would remain 15 or more years after construction) and beneficial or adverse. Highways England guidance (DMRB, Volume 11, Section 2, Part 5 (HA205/08)) sets out a specific methodology for the assessment of the significance of cumulative effects. Following this, the significance of cumulative effects is categorised as set out in Table 10.2.

Table 10.2 Determining significance of effect for cumulative effects

Significance	Effect
Not significant	Effects that are beyond current forecasting ability or within the ability of the affected resource to adapt to the change
Minor	Effects that are locally significant
Moderate	Effects that are unlikely to become issues upon which project design should be selected, but where future work may be necessary to improve current performance
Major	Effects that may become key decision making issues
Severe	Effects that the decision maker must take into account as the receptor/resource is irretrievably compromised

10.3 Potential Effects

Intra-project cumulative effects

10.3.1. In assessing the potential for intra-project cumulative effects, each topic has been reviewed in terms of the sensitive receptors it identifies and the likely effects. Effects reviewed are residual effects from each topic assessment, following the implementation of mitigation.

Construction cumulative effects

10.3.2. Effects from construction noise and changes in air quality from dust production have largely considered the same residential receptors. Combined effects on local residents can arise from increased nuisance from these localised construction effects. With adherence to the mitigation measures as outlined in the OEMP, these effects are not considered to be significant.

10.3.3. For those receptors that currently receive noise mitigation from existing noise barriers, the temporary removal of these barriers during the verge widening and resurfacing works, will result in slight noise increases and potentially increased visibility of the motorway and existing traffic. With the measures as set out in the OEMP and the minimum amount of time required to replace the noise barriers, these effects are considered to be short term and not significant.

10.3.4. There is potential for cumulative effects on Windmill Naps SSSI and its associated wildlife from construction noise and disturbance during site clearance. However, with adherence to the measures set out in the OEMP, and works done under appropriate wildlife licences where necessary, these are not considered to be significant.

Operational cumulative effects

10.3.5. There is potential for operational cumulative effects on Windmill Naps Wood SSSI and its associated fauna and flora, from habitat degradation, nitrogen deposition and noise disturbance. The conversion of the hard shoulder to a permanent running lane will reduce the distance between the SSSI boundary and the traffic, as well as resulting in an increase in traffic volumes. This has potential to increase the exposure to traffic on the woodland, increasing nitrogen deposition and resulting in increased noise at the woodland boundary. All of these factors have potential to result in reduced habitat potential for fauna at the SSSI boundary. The air quality assessment undertaken for this scheme modelled changes in nitrogen oxides at Windmill Naps Wood as a result of the scheme. The magnitude of change was predicted to be imperceptible with the change modelled as being less than 0.4$\mu g/m^3$. As this change is imperceptible, any cumulative effects with other schemes are considered unlikely to significantly affect baseline conditions at the SSSI, these cumulative effects are not considered to be significant.

10.3.6. No other operational cumulative effects are anticipated.

Inter-project cumulative effects

10.3.7. The traffic data provided has included other Road Investment Strategy (RIS1) schemes and non-RIS schemes (as detailed in Appendix B.1 Section 2.1.4). The cumulative impact during operation of the Proposed Scheme has therefore been assessed with these schemes. No significant adverse effects are expected to occur as a consequence of the Proposed Scheme after opening.

10.3.8. The cumulative impact from HS2 construction traffic has been considered and it is unlikely to materially affect the results of this assessment. No significant effects are anticipated with HS2 construction traffic.

10.3.9. An assessment of other relevant development has been made against each environmental topic in Table 10.3 below. The location of each development relative to the Proposed Scheme is shown in Appendix A.

Table 10.3: Cumulative Effects Assessment

Proposed Development	Figure Ref	Potential Cumulative Effect						Comments
		Air Quality	Noise and Vibration	Landscape and Visual	Cultural heritage	Biodiversity	Water	
Blythe Valley Park – hybrid application for housing, employment land	(SMBC6)	N	N	Y	N	N	N	Air Quality – the operational effects of the Blythe Valley application are included in the traffic model, the AQ assessment for the Proposed Scheme identified there would be no significant effects. Construction of the housing is likely to occur after the construction works on the M42, there will be no cumulative effects on residents on Kineton Lane from the schemes. Noise – operational effects are included in the traffic model, the noise assessment for the Proposed Scheme indicates there will be no significant change in existing noise levels. Do-something absolute noise levels are expected to be between the LOAEL and SOAEL at their highest, with reduction shown across the development site. No cumulative impacts are foreseen as a result of construction phase activities due to distance and screening. There will be no cumulative effect on the residents at Kineton Lane. Landscape and Visual – Kineton Lane residents will experience no significant change in their views of the motorway, given existing screening vegetation between the houses and motorway. The Blythe valley park is located to the north of the houses, while the M42 is located to the south. The LVIA undertaken for the Blythe valley application concluded that the residual effect of the development on the residents of Kineton Lane, would be minor to moderate adverse. However, given that the M42 works are confined to the highway boundary, and the lack of visibility between Kineton Lane and the motorway, it is considered that there will be no significant cumulative effects.

Proposed Development	Figure Ref	Potential Cumulative Effect						Comments
		Air Quality	Noise and Vibration	Landscape and Visual	Cultural heritage	Biodiversity	Water	
								Construction effects are not likely to be concurrent, there will be no significant cumulative effects. Cultural heritage – no common receptors for the 2 schemes, there will be no cumulative effects, either during construction or operation. Biodiversity – at time of writing this EAR, the ecology surveys for the M40/42 interchange were incomplete. Based on the precautionary principle, there is potential that the 2 schemes may have common ecological receptors. Operational effects on ecological receptors affected by the Proposed Scheme, will be managed through project specific environmental management plans to ensure ecological effects are minimised. One of the planning conditions on the outline planning permission for the Blythe Valley application is that '*no phase of the development hereby approved shall be commenced unless and until a Biodiversity Monitoring Scheme to ensure that there is no net biodiversity loss as a result of the development … has been submitted and agreed in writing by the Local Planning Authority'*. Overall, it is considered unlikely that the 2 schemes will result in cumulative effects on biodiversity receptors. Construction effects will be managed through the OEMP for the motorway scheme and for the housing scheme through a CEMP, overall it is considered that there will be no significant cumulative effects. Water – The drainage for both schemes ultimately discharges into the River Blythe SSSI. The existing drainage on the M42 will be retained, resulting in a neutral effect. Water management on the Blythe Valley

Proposed Development	Figure Ref	Potential Cumulative Effect						Comments
		Air Quality	Noise and Vibration	Landscape and Visual	Cultural heritage	Biodiversity	Water	
								Park scheme will incorporate SuDS and good design principles to ensure no net adverse effects on the water quality of the River Blythe. Construction effects will be managed through the OEMP and for the housing scheme through a CEMP. It is considered that there will be no significant cumulative effects. Overall, it is considered that there will be no cumulative effects arising from these 2 schemes on any potential receptors, either from construction or operation.
Land adjacent to M42 J4 – new service station	N/A	N	N	N	N	N	N	AQ – there are no receptors located in the vicinity of the scheme that would be affected by changes in air quality. Noise – the ES for the service station concluded that the receptors adjacent to the road links included in the operational traffic assessment would not experience any significant effects. Noise levels from the M42 scheme will also not result in significant effects. The timescale for the construction of the service station is unknown, but should construction coincide, the effects will be managed and minimised through application of the OEMP and best practice measures. Landscape and Visual – there are no receptors in common that would experience visual effects from the M42 works and the service station, therefore there will be no cumulative effects. Although the provision of the service station will have some impact on the local landscape character, in association with the existing motorway infrastructure, this is not significant.

Proposed Development	Figure Ref	Potential Cumulative Effect						Comments
		Air Quality	Noise and Vibration	Landscape and Visual	Cultural heritage	Biodiversity	Water	
								Cultural heritage – there are no common receptors for the 2 schemes. Biodiversity – At time of writing the ecology surveys for the Proposed Scheme were incomplete, therefore there is potential that the 2 schemes will have biodiversity receptors in common. Potential effects on ecological receptors from the Proposed Scheme will be managed through the OEMP. From information available on the Solihull Planning Portal, it is likely that should the service station application be approved, then planning conditions will be attached requiring ecological effects to be minimised and managed through a Construction and Environmental Management Plan and Biodiversity Enhancement Plan. On the basis of this, it is considered that there will be no significant effects on ecological receptors. Water – The drainage for both schemes ultimately discharges into the River Blythe SSSI. The existing drainage on the M42 will be retained, resulting in a neutral effect. The service station proposals will result in a slight adverse effect on the SSSI through a culvert extension causing the loss of some river bank, however the effect is not significant. Should construction periods overlap, construction effects will be managed and minimised through best practice measures and adherence to the OEMP. Overall, it is considered that there will be no cumulative effects arising from these 2 schemes on any potential receptors.

Proposed Development	Figure Ref	Potential Cumulative Effect						Comments
		Air Quality	Noise and Vibration	Landscape and Visual	Cultural heritage	Biodiversity	Water	
Land at Fore Business Park – hybrid application for office buildings	(SMBC1)	N	N	N	N	N	Y	AQ – this scheme is included in the traffic model and there are no significant cumulative effects. Noise – this scheme is included in the traffic model and there are no significant cumulative effects. Landscape and visual – There are no common receptors between these two schemes. Cultural Heritage – There are no common receptors between these two schemes Biodiversity – At time of writing the ecology surveys for the Proposed Scheme were incomplete, therefore there is potential that the two schemes will have biodiversity receptors in common. Potential effects on ecological receptors from the Proposed Scheme will be managed through the OEMP. From information available on the Solihull Planning Portal, planning conditions attached to the approval of the office development requires ecological effects to be minimised and managed through a Construction and Environmental Management Plan. On the basis of this, it is considered that there will be no significant cumulative effects on ecological receptors. Water – The common receptor for these two schemes is the River Blythe. As the existing motorway drainage will be retained where possible, and any new drainage will be designed to current standards, there will be a neutral effect on the river from the Proposed Scheme. Drainage installed as part of the office development, will incorporate SuDS and be designed to ensure no adverse effects on water quality.

Proposed Development	Figure Ref	Potential Cumulative Effect						Comments
		Air Quality	Noise and Vibration	Landscape and Visual	Cultural heritage	Biodiversity	Water	
								Construction impacts will be managed through adherence to the OEMP and best practice measures by the developer of the buildings. There will be no significant cumulative effects. Overall, there will be no significant cumulative effects on any receptors from these two schemes.
Land at Fore Business Park – reserve matters application for office building incorporating labs	(SMBC 2)	N	N	N	N	N	Y	AQ – this scheme is included in the traffic model and there are no significant cumulative effects. Noise – this scheme is included in the traffic model and there are no significant cumulative effects. Landscape and visual – There are no common receptors between these two schemes. Cultural Heritage – There are no common receptors between these two schemes Biodiversity – At time of writing the ecology surveys for the Proposed Scheme were incomplete, therefore there is potential that the two schemes will have biodiversity receptors in common. Potential effects on ecological receptors from the Proposed Scheme will be managed through the OEMP. From information available on the Solihull Planning Portal, planning conditions attached to the approval of the office development requires environmental effects to be minimised. On the basis of this, it is considered that there will be no significant cumulative effects on ecological receptors.

Proposed Development	Figure Ref	Potential Cumulative Effect						Comments
		Air Quality	Noise and Vibration	Landscape and Visual	Cultural heritage	Biodiversity	Water	
								Water – The common receptor for these two schemes is the River Blythe. As the existing motorway drainage will be retained where possible, and any new drainage will be designed to current standards, there will be a neutral effect on the river from the Proposed Scheme. Drainage installed as part of the office development, will incorporate SuDS and be designed to ensure no adverse effects on water quality. Should construction periods overlap, construction effects will be managed through best practice measures and the OEMP. There will be no significant cumulative effects. Overall, there will be no significant cumulative effects on any receptors from these two schemes.

10.4 Summary

10.4.1. The assessment on cumulative effects indicates there is potential for intra-project effects on local residential receptors from construction noise and dust resulting in nuisance. The application of the measures as set out in the OEMP will however, ensure that these effects are not significant.

10.4.2. No operational intra-project effects were identified on any receptors.

10.4.3. A review of committed developments was undertaken to identify if any inter-project effects could arise. The key developments in the area with potential for cumulative effects with the Proposed Scheme are office developments at Huskisson Way, and a hybrid development within Blythe Valley Park for housing and employment space.

10.4.4. These schemes are included within the traffic data received for the Proposed Scheme and so air quality and noise are considered within the assessments for these topics in Chapter 5 and 8. At this stage, the location of diversion routes is not confirmed for the M40/42 interchange project, so it has not been possible to consider the cumulative effects on receptors along these routes from other projects. It is considered however that each project will have manage construction traffic to minimise effects on local residents.

10.4.5. Receptors with potential to be affected by cumulative effects are residents on Kineton Lane, Windmill Naps Wood SSSI and River Blythe. The assessment has concluded that there are no likely cumulative significant effects arising from the Proposed Scheme and the committed developments.

11. Environmental Management

11.1 Overview

11.1.1. This section sets out arrangements for environmental assessment and management going forwards.

11.1.2. Environmental management will be implemented in line with DMRB and IAN 183/14 Environmental Management Plans (June 2014).

11.1.3. As part of this EAR, an Outline Environmental Management Plan (OEMP) has been produced as a separate document. The OEMP sets out environmental commitments and actions to be taken forwards as part of the detailed design and construction of the Proposed Scheme.

11.1.4. The OEMP will be developed into a Construction Environmental Management Plan (CEMP) prepared in collaboration with the Delivery Partner as more information becomes available and there is more certainty in terms of the Proposed Scheme layout, construction methods and programme. Towards the end of the construction period the CEMP will be refined into a Handover Environmental Management Plan (HEMP), which will contain essential environmental information needed by the body responsible for the future maintenance and operation of the asset.

11.1.5. The purpose of an OEMP is to manage the environmental effects of the Proposed Scheme. Over the lifetime of the Proposed Scheme the OEMP will be built upon to manage the environmental effects during the construction and maintenance and operation phases of the Proposed Scheme. The OEMP will be a live document, and will be updated as required over the life of the project should the Proposed Scheme, predicted effects or legislation change. Throughout the construction, maintenance and operation phases the OEMP will be used to:

- Act as a continuous link and main reference document for environmental issues between the design, construction and the maintenance and operation stages of a project.
- Demonstrate how construction activities and supporting design will properly integrate the requirements of environmental legislation, policy, good practice and those of the environmental regulatory authorities and third parties.
- Record the objectives, commitments and mitigation measures to be implemented together with programme and date of achievement.
- Identify the key staff structures and responsibilities associated with the delivery of the Proposed Scheme and environmental control and communication and training requirements as necessary.
- Describe the contractor's proposals for ensuring that the requirements of the environmental design are achieved, or are in the process of being achieved, during the Contract Period.
- Act as a vehicle for transferring key environmental information at handover to the body responsible for operational management. This will include details of the asset, short and long term management requirements and any monitoring or other environmental commitments.
- Provide a review, monitoring and audit mechanism to determine effectiveness of and compliance with environmental control measures and how any necessary corrective action will take place.

11.1.6. The identification of environmental actions and population of an OEMP is critical to the environmental performance of a project.

11.1.7. In relation to the Proposed Scheme the sources of information from which environmental actions have been identified include the M40/42 Interchange Environmental Scoping Report and additional surveys undertaken for this EAR.

11.1.8. At this stage it is only possible to indicate in outline the persons responsible and the timings associated with these. When the CEMP is prepared further commitments and actions will be added and more specific responsibilities attributed and timings identified.

11.1.9. The OEMP does not cover any further surveys that may be required as part of the Proposed Scheme. Nevertheless, the OEMP identifies areas of risk where surveys or other precautionary measures may be required at a later date. The OEMP does not cover embedded mitigation measures that are part of the design; for example, gantry and Emergency Refuge Area relocations. The OEMP largely consists of tertiary mitigation during construction and operation, however, secondary mitigation is included as appropriate.

11.2 OEMP Conclusions

11.2.1. The OEMP includes a Register of Environmental Actions and Commitments to be implemented by the Delivery Partner in order to minimise construction effects on sensitive receptors. With these mitigation measures applied, the Proposed Scheme will not result in any significant effects during construction.

12. Recommendations

12.1 EIA Screening

12.1.1. The Environmental Impact Assessment Directive was updated in 2014, by Directive 2014/52/EU, with the aim of making environmental impact assessments more proportionate and effective. The updated Directive places more importance on the scoping and screening processes, to ensure that EIAs consider only those effects that are likely to be significant to the environmental receptors.

12.1.2. In light of this update, Highways England published Interim Advice Note 125/15 Environmental Assessment Update in 2015 and IAN 126/15 Environmental Assessment Screening and Determination. IAN 125/15 provides guidance on how the updated Directive should be applied to highways schemes, to ensure a more proportionate approach. It states that the objective of a scheme should be to avoid or minimise significant effects, either through effective design or through incorporation of design mitigation. Projects should be screened early in their inception to determine if significant effects are likely to occur – the screening process. As part of this guidance, the IAN includes a Screening Checklist as Annex B. The Screening Checklist for the Proposed Scheme is included as Appendix H in this EAR.

12.1.3. Further advice on screening projects is provided in IAN 126/15 and includes the thresholds which projects should be screened against. It provides advice on how to report the determination as to whether a project should be subject to an Environmental Impact Assessment or not. The IAN also provides a template for the Record of Determination.

12.1.4. A Screening Determination has been prepared for the Proposed Scheme, document reference HE551530-AMAR-EGN-SWI-RP-YE-000001.

12.1.5. The screening determination has concluded that the Proposed Scheme will not have significant effects on the environment. Construction impacts will be managed through the OEMP and through the application of any wildlife licencing as required.

12.2. Recommendations

12.2.1. At time of writing the ecology surveys were incomplete. Post SGAR3 it is recommended that the following surveys are completed/undertaken:

- GCN presence/absence
- dormouse
- emergence/re-entry surveys on mature trees to confirm presence/absence of bat roosts
- otter/water vole (once detailed design confirms if any drainage outfalls will be affected by the scheme).

12.3. Conclusions

12.3.1. This EAR sets out the environmental assessment of the Proposed Scheme as described in chapter 2. Chapters 5 to 10 consider the potential environmental effects of the Proposed Scheme, taking into account the measures within the OEMP. A summary of the potential effects are summarised in Table 12.1.

Table 12-1 EAR conclusions

Topic	Conclusion	Significance of effect
Air Quality	Construction impacts from dust will be managed through the measures as	No significant effects.

Topic	Conclusion	Significance of effect
	set out in the OEMP to avoid significant effects. Changes in nitrogen dioxide concentrations in the AQMAs close to the Proposed Scheme are imperceptible and would not result in an exceedance to existing air quality objectives. Nine receptors are predicted to experience a deterioration in air quality, while three receptors are predicted to experience an improvement. Change in NO2 levels are not predicted to exceed air quality objectives. Coleshill and Bannerly Pools SSSI and Windmill Naps Wood SSSI are not predicted to breach acceptable nitrogen deposition rates.	
Noise and Vibration	Construction noise effects for receptors at Tinkers Lane and Juggins Lane will be managed through the measures set out in the OEMP. Use of low noise surfacing on lanes 1 and 4 will have a beneficial effect on the receptors closest to the motorway with perceptible reductions in noise. During the operational phase, 736 out of a total of 1613 sensitive receptors in the calculation area are predicted to experience short-term major noise decreases in the opening year, 102 moderate decreases and 128 minor decreases. Additionally, 158 receptors are predicted to experience a minor increase in noise. The noise changes at the remaining sensitive receptors are shown to be negligible or no change.	No significant effects
Landscape, Visual and Cultural Heritage	There would be minor adverse impacts on landscape character areas as a result of site clearance and changes to the motorway infrastructure. There will be negligible impact on the setting of the listed buildings due to intervening screening vegetation beyond the highway boundary.	No significant effects

Topic	Conclusion	Significance of effect
Biodiversity	There will be no direct or indirect significant effects on Windmill Naps SSSI or River Blythe SSSI or on areas of ancient woodland and priority habitats adjacent to the proposed scheme. Construction impacts will be managed through the OEMP and derogation licences where considered necessary.	No significant effects
Road Drainage and the Water Environment	The proposed scheme crosses areas of floodplain associated with the River Blythe and its tributaries. There are three locations where potential retaining walls and embankments may result in floodplain impingement. An assessment of the outfalls along the Proposed Scheme was undertaken and concluded that no individual outfalls show a decline in Priority Outfall status as a result of the Do-Something scenario.	No significant effects
Cumulative effects	With the application of measures as set out in the OEMP, there will be no significant intra-project effects on any of the identified environmental receptors. Developments with potential for inter-project effects included in the assessment were Blythe Valley Park housing and employment development and office development at Huskisson Way. The assessment has determined that there are no significant cumulative effects on any receptors from any of the committed developments in combination with the Proposed Scheme.	No significant effects

13. Glossary and Abbreviations

Abbreviation	Full Term
AADT	Annual Average Daily Traffic
ALB	Abnormal Load Bay
ADMS	Atmospheric Dispersion Modelling System
ADS	Advanced Directional Signs
ALR	All Lane Running
AMIs	Advanced Motorway Indicators
AOD	Above Ordnance Datum
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
ARN	Affected Road Network
ATM	Active Traffic Management
CCD	Cross Carriageway Duct
CCTV	Closed-Circuit Television
CEMP	Construction Environmental Management Plan
CIEEM	Chartered Institute of Ecology and Environmental Management
CMS	Continuous Monitoring Stations
CO2	Carbon dioxide
CRTN	Calculation of Road Traffic Noise
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DF1	Design Fix 1
DF2	Design Fix 2
DF3	Design Fix 3
DF4	Design Fix 4
DF5	Design Fix 5
DM	Do Minimum
DMRB	Design Manual for Roads and Bridges
DS	Do Something
EAR	Environmental Assessment Report
EC	European Commission
eDNA	Environmental DNA

Abbreviation	Full Term
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
EnvIS	Environmental Information System
EPSML	European Protected Species Mitigation Licence
ERAs	Emergency Refuge Areas
ERTs	Emergency Roadside Telephones
EU	European Union
GLVIA	Guidelines for Landscapes and Visual Impact Assessment
HADDMS	Highways Agency Drainage Data Management System
HADECS	Highways Agency Digital Enforcement Camera System
HAWRAT	Highways Agency Water Risk Assessment Tool
HE	Highways England
HEMP	Handover Environmental Management Plan
HGV	Heavy Goods Vehicles
HDV	Heavy Duty Vehicle
HRA	Habitat Regulations Assessment
IAQM	Institute of Air Quality Management
IAN	Interim Advice Note
LAQM.TG	Defra's Local Air Quality Management Technical Guidance
LCA	Landscape Character Areas
LED	Light-emitting diode
LNR	Local Nature Reserve
LOAEL	Lowest Observed Adverse Effect Level
LWS	Local Wildlife Sites
MIDAS	Motorway Incident Detection and Automatic Signalling
NERC	The Natural Environment and Rural Communities Act
NIAs	Noise Important Areas
NIR	Noise Insulation Regulations
NOEL	No Observed Effect Level
NO2	Nitrogen Dioxide
NOx	Oxides of Nitrogen
NoD	Notice of Determination
NPPF	National Planning Policy Framework
NPSE	Noise Policy Statement for England
OEMP	Outline Environmental Management Plan
OS	Ordnance Survey
PCD	Pollution Control Devices
PCM	Pollution Climate Mapping
PM10	Particulate Matter smaller than 10µm
PPV	Peak Particle Velocity
PRoW	Public Right of Way

Abbreviation	Full Term
PTZ	Pan-Tilt-Zoom
RCB	Reinforced Concrete Barrier
REAC	Register of Environmental Actions and Commitments
RIS	Road Investment Strategy
RoD	Record of Determination
RCTTMS	Remotely Controlled Temporary Traffic Management Signs
SAC	Special Areas of Conservation
SBI	Sites of Biological Interest
SM	Smart Motorway
SM-ALR	Smart Motorway – All Lane Running
SMP	Smart Motorways Programme
SOAEL	Significant Observed Adverse Effect Level
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
TAG	Transport Analysis Guidance
TJR	Through Junction Running
TPG	Transport Planning Group
UK-AIR	Defra's UK Air Quality Information Resource
VMS	Variable Message Signs
VMSL	Variable Mandatory Speed Limits
VRS	Vehicle Restraint Systems
WFD	Water Framework Directive
ZoI	Zone of Influence
ZVL	Zone of Visual Influence

References

Chapter 1

Ref 1.1 Highways England. (2015). *Highways England Delivery Plan 2015-2020*.

Ref 1.2 The Town and Country Planning (Environmental Impact Assessment) Regulations 2017 http://www.legislation.gov.uk/uksi/2017/571/contents/made

Ref 1.3 The Design Manual for Roads and Bridges (DMRB) Volume 11: Environmental Assessment: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/index.htm

Ref 1.4 IAN 161/15 – Smart Motorways: http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/IAN161_15.pdf

Ref 1.5. IAN 183/14 - Environmental Management Plans: http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian183.pdf

Ref 1.6 Supplementary guidance for users of DMRB Volume 11 'Environmental Assessment Update': http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian125r2.pdf

Ref 1.7 IAN 126/15 - Environmental Assessment, Screening and Determination: http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian126r2.pdf

Ref 1.8 Highways England 2018: <M40/M42 Interchange Environmental Scoping Report, BC Reference MP0280-HEX-EGN-ZZ-AS-KK-0001>

Chapter 2

Ref 2.1 Safety in Design 2018: Making the Noise Right. http://www.safetyindesign.org.uk/wp-content/uploads/2018/01/SID-CON303.pdf

Chapter 4

Ref 4.1 IAN 125/15 - Environmental Assessment Update: http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian125r2.pdf

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Ref 4.3 Highways England, 2018: M40/42 Interchange Environmental Scoping Report, MP0280-HEX-EGN-ZZ-AS-KK-0001

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Ref 4.5 DMRB, Volume 11, Section 2 (Part 6): http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section2/hd4808.pdf

Chapter 5

Ref 5.1 Highways England (2018). Smart Motorways Programme. M40/M42 Interchange. Environmental Scoping Report. May 2018. Document reference MP0280-HEX-EGN-ZZ-AS-KK-0001

Ref 5.2 HE551530-AMAR-EGN-SWI-RP-YE-000002

Ref 5.3 Highways Agency, (2007) Design Manual For Roads and Bridges Volume 11, Section 3, Part 1 Air Quality

Ref 5.4 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.

Ref 5.5 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).
Ref 5.6 http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian170v3.pdf Highways Agency (2013) Interim Advice Note 170/12v3 Updated air quality advice on the assessment of future NOx and NO2 projections for users of DMRB Volume 11, Section 3 Part 1 'Air Quality'

Ref 5.7 http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian174.pdf Highways Agency (2013) Interim Advice Note 174/13 Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Pat 1 'Air Quality (H207,07)'

Ref 5.8 http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian175.pdf Highways Agency (2013) Interim Advice Note 175/13 Updated air quality 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 user of DMRB Volume 11, Section 3, Part 1 'Air Quality'

Ref 5.9 http://www.standardsforhighways.co.uk/ha/standards/ians/pdfs/ian185.pdf Highways England (2015) Interim Advice Note 185/15 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 Volume 11, Section 3 Part 7 Noise

Ref 5.10 Highways Agency (2013) Note on HA's Interim Alternative Long Term Annual Projection Factors (LTTE6) for Annual Mean NO2 and NOx Concentrations Between 2008 and 2030. Department for Transport.
Full list of LAQM reports reviewed is included in Appendix B4.

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Ref 5.12 Defra's UK Air Quality Information Resource (UK-AIR) website (http://uk-air.Defra.gov.uk)

Ref 5.13 Multi-Agency Geographic Information for the Countryside (MAGIC) website (www.magic.gov.uk)

Ref 5.14 UK Air Pollution Information System (APIS) website (www.apis.ac.uk)

Ref 5.15 Defra NOx to NO2 tool https://laqm.Defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc (version 6.1 17 October 2017)

Ref 5.16 Defra sector removal tool https://laqm.Defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxsector (version 6.0 November 2017)

Chapter 6

Ref 6.1 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)

Ref 6.2 Joint Nature Conservation Committee (2010) Handbook for Phase 1 habitat survey – a technique for environmental audit.

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Ref 6.4 Harris S., Cresswell, P. and Jefferies, D. (1989) Surveying Badgers. The Mammal Society.

Ref 6.5 Roper, T (2010) A Survey of British Natural History- Badger. New Naturalist Library, HarperCollins

Ref 6.6 Strachan R. Moorhouse T. and Gelling M. (2011) Water Vole Conservation Handbook, 3rd Edition

Ref 6.7 Bright, P., Morris, P., and Mitchell-Jones. (2006) The dormouse conservation handbook, 2nd Edition. English Nature, Peterborough

Ref 6.8 Collins, J. (ed.) (2016) Bat surveys for professional ecologists good practice guidelines 3rd Edition. Bat Conservation Trust, London

Ref 6.9 Wildlife and Countryside Act 1981. Available at https://www.legislation.gov.uk/ukpga/1981/69 (Accessed: 8 March Ref 6.10 The Conservation of Habitats and Species Regulations 2017. Available at https://www.legislation.gov.uk/uksi/2017/1012/contents/made (Accessed: 8 March 2019).

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Ref 6.15 Where a large meta population was anticipated with good habitat connectivity to the proposed scheme then the survey area was extended up to 500m.

Ref 6.16 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.

Ref 6.17 Significance of Ecology and Nature Conservation derived from IAN135/10 and HA 205/08

Ref 6.18 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.

Ref 6.19 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.

Ref 6.20 Dormouse Conservation Handbook 2006.

Ref 6.21 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

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Chapter 7

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Ref 7.3 https://www.historicengland.org.uk/listing/the-list/data-downloads

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Chapter 8

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Ref 8.12 World Health Organization, 1999. “Guidelines for Community Noise”.

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Ref 9.3 DMRB Table A4.3 of Volume 11, Section 3, Part 10 HD 45/09 and Technical Guidance to the National Planning Policy Framework, Table 2 - Flood risk vulnerability classification.

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Ref 9.6 www.environment-agency.gov.uk

Ref 9.7 https://environment.data.gov.uk/public-register/view/search-water-discharge-consents

Ref 9.8 Please refer to retaining wall schedules: HE551530-AMAR-HGT-SWI-SH-CE-000003 and HE551530-AMAR-HGT-SWI-SH-CE-000002

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Amey Arup Joint Venture

Amey
International Design Hub
5th Floor
Colmore Plaza
20 Colmore Circus
Birmingham
B4 6AT

Email: IDH.Reception@amey.co.uk
Telephone: 0121 212 5000
Fax: 0121 236 1160