HS2 London to West Midlands EIA Scope and Methodology Report

A report to HS2 Ltd by Arup/URS

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ARUPURS

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PART A

Part A

Executive summary

1. This report outlines the proposed approach to the development of the Environmental Impact Assessment (EIA), and subsequent Environmental Statement (ES), for Phase 1 (London to West Midlands) of the proposed high speed rail network (HS2). The ES will be submitted to Parliament along with the hybrid bill and considered alongside the draft legislation in order to authorise Phase 1 of HS2.

2. The EIA responds to the European Community Directive[1] and Parliament's Standing Order 27A[2] which requires the consideration of Part II and as much of Part I of Schedule 4 of the Town and Country Planning (Environmental Impact Assessment) Regulations 2011[3] as required to enable the preparation of an Environmental Statement to inform decision makers of the likely significant environmental effects of the Proposed Scheme.

3. This document sets out the draft scope and methodology that is proposed for the EIA of Phase 1 of HS2 and which is considered appropriate to determine the likely significant environmental effects that decision makers will need to consider. It also sets out the approach to the reporting of alternatives in the Environmental Statement.

4. The purpose of the draft Scope and Methodology report is to inform consultation with relevant authorities. The aim of the consultation is to establish a commonly accepted approach to the EIA for Phase 1 of HS2. Further consultation on the outcome of the EIA will be held with these and other authorities and the public when the draft Environmental Statement (ES) is published in spring 2013.

[1] Council Directive of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment; 85/337/EEC, as amended (2011/92/EU)
[2] Standing Order 27A of the Standing Orders of the House of Commons relating to private business (environmental assessment)
[3] Department for Communities and Local Government, 2011 No. 1824, *Town and Country Planning (Environmental Impact Assessment) Regulations 2011,* The Stationery Office

1 Introduction

1.1.1 This report outlines the proposed scope and methodology for the Environmental Impact Assessment for Phase 1 (London to West Midlands) of the proposed high speed rail network (HS2). Phase 1 of HS2 is referred to in this report as the Proposed Scheme.

1.2 Structure of this report

1.2.1 This report is divided into three main parts:

- Part A – an introduction to the HS2 Scheme, the background from the Appraisal of Sustainability (AoS)[4], an outline of the applicable legislation and the hybrid bill process, a general description of the EIA assessment process, including the overall scope of the assessment and a description of the main alternatives considered;
- Part B – the environmental topic sections, describing the proposed scope and methodology for each topic; and
- Part C – an outline of the proposed structure of the Environmental Statement (ES).

1.2.2 The annexes to the report include a list of consultees and a series of maps showing the HS2 route.

1.3 Introduction to HS2

1.3.1 HS2 is planned to be a Y-shaped rail network with stations in London, Birmingham, Leeds, Manchester, Sheffield and the East Midlands linked by high speed trains with a capacity to convey up to 26,000 people each hour at peak times at speeds of up to 360 kph (250mph). High speed trains would also connect seamlessly with the existing West Coast and East Coast Main Lines to serve passengers beyond the HS2 network in Edinburgh, Glasgow, Newcastle, Durham, York, Darlington, Liverpool, Preston, Wigan and Lancaster.

1.3.2 HS2 would be built in two phases. The first phase would involve construction of a new railway line of approximately 230 kilometres (km) between London and Birmingham by 2026. The second phase would involve lines built from Birmingham to Leeds and Manchester, and a direct link at high speed to Heathrow Airport, by 2033. A formal consultation on second phase routes is planned to begin in early 2014 with a final route expected to be chosen by the end of 2014.

1.3.3 The first phase of HS2 would include a connection to Europe via the Channel Tunnel. HS2 trains would be up to 400 metres (m) long with 1,100 seats

[4] Booz & Co. (UK) Ltd and Temple Group Ltd (February 2011), *HS2 London to the West Midlands Appraisal of Sustainability*

during peak hours. Double decker trains (e.g. TGV Duplex) could be introduced to run on the HS2 network and would be compatible with services to Europe through the Channel Tunnel. Services using both HS2 and existing rail lines will use standard-size non-double decker high speed trains.

1.3.4 In January 2012 the Government announced the intention to proceed with HS2, and announced the preferred line of route for London to the West Midlands (i.e. Phase 1). Phase 1 would connect London and the West Midlands with stations at Euston, Old Oak Common, Birmingham Interchange and Birmingham Curzon Street. Some of the services would continue at conventional speeds, to serve directly the North West and Scotland, through a connection with the West Coast Main Line (WCML) near Lichfield.

1.3.5 HS2 Ltd is a company wholly owned by the Department for Transport (DfT) and is charged with the development and promotion of the high speed rail project on behalf of Government. HS2 Ltd is now starting to take forward the first phase of the project and to begin the next stage of engineering, design and environmental work. Government aims to deposit a hybrid bill in Parliament by the end of 2013 to seek the powers to construct and operate Phase 1 of HS2. The powers sought are described in Section 1.9 below. HS2 Ltd is also continuing to work on proposals for Phase 2 (the line of route to Leeds and Manchester), and will deliver recommendations on the routes for Phase 2 to the Government in 2012.

1.4 Purpose of this report

1.4.1 As the Proposed Scheme will be authorised by a hybrid bill, the objectives of Environmental Impact Assessment (EIA) will be pursued through the Parliamentary process. Parliament's Standing Order 27A requires the promoter to prepare and deposit an ES, the contents of which are specified in Standing Order 27A[5] by reference to the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999, since revoked and replaced by the Town and Country Planning (Environmental Impact Assessment) Regulations 2011[6].

1.4.2 HS2 Ltd will prepare the ES for the Proposed Scheme, in accordance with the requirements of Standing Order 27A and by reference to the 2011 Regulations. HS2 Ltd will also take account of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009[7].

1.4.3 The scoping process allows for early presentation of the intended approach to undertaking an EIA so that it can be discussed with and informed by

[5] Standing Order 27A of the Standing Orders of the House of Commons relating to private business (environmental assessment)
[6] Department for Communities and Local Government, 2011 No. 1824, *Town and Country Planning (Environmental Impact Assessment) Regulations 2011,* The Stationery Office
[7] Department for Communities and Local Government, 2009 No. 2263, *Infrastructure Planning (Environmental Impact Assessment) Regulations 2009,* The Stationery Office

consultees. It defines the focus of the subsequent environmental assessments to be undertaken as part of the EIA process, the primary aim being to identify the key issues to be addressed and to focus the ES on the most likely significant effects associated with the Proposed Scheme.

1.4.4 This draft EIA Scope and Methodology Report forms the basis for consultation with key consultees on the scope and methodology for the EIA. It provides a brief description of the Proposed Scheme and sets out environmental issues to be considered in the EIA. It also outlines the approach to the consideration of significant effects and their mitigation to be employed in the EIA.

1.5 HS2 Phase 1 route description

Greater London

1.5.1 HS2's London terminus would be an expanded station at Euston. The station would be entirely rebuilt over a single level with 10 platforms for high speed trains alongside 14 classic platforms, two of which would be capable of being used by high speed classic-compatible services. The station would need to be extended to the south and the west and, to obtain the necessary clearance under Hampstead Road bridge, the platforms would need to be built below the current track level. This would allow new development over the platforms and open up east-west routes for local people across the site. This would require demolition of property, including around 200 dwellings largely in four mainly local authority-owned blocks of flats on the Regent's Park Estate. It would also be necessary to take part of St James's Gardens and some surrounding buildings.

1.5.2 Leaving Euston, the route would descend into tunnel for 7km curving round to the west, broadly in line with the West Coast Main Line, to a new interchange station at Old Oak Common. Here, passengers from the West Midlands and North would be able to change onto Crossrail, the Heathrow Express, the Great Western Main Line or other local public transport. There would be a link from Old Oak Common to High Speed 1 (HS1), partially in tunnel and in part along an upgraded section of the North London Line to an existing junction with HS1 just north of St Pancras.

1.5.3 The Proposed Scheme would leave Old Oak Common in a short tunnel, emerging at North Acton to run alongside the Central Line. The route would enter a further tunnel in the Northolt area for 4km to reduce impacts on people living near the railway, and to avoid major disruption to the Chiltern Railways line and the West London Waste Authority transfer station. It would emerge from tunnel at West Ruislip alongside the Chiltern Line and would curve northwards from the Chiltern Railways corridor to cross the Colne Valley on a viaduct, heading to a tunnel portal just inside the M25.

Country

1.5.4 The route would enter a 13km long tunnel just before crossing the M25 to pass underneath a section of the Chiltern Hills. It would pass under Chalfont St Giles and the edge of Amersham to surface within the Chilterns Area of Outstanding Natural Beauty (AONB) near Little Missenden. From there the alignment would be in cutting to pass between South Heath and Great Missenden within a 1.1km green tunnel (where earth is built up around and over a section of the route to screen the village from noise and visual impacts) as it passes South Heath. The route would then cross Wendover Dean on a 500m long viaduct before following the corridor of the A413 to pass Wendover in a 1.3km green tunnel.

1.5.5 Leaving the AONB beyond Wendover, the route would then pass to the south-west of Stoke Mandeville and Aylesbury, and then to the north-east of Waddesdon, largely at surface level. The route would follow the corridor of an existing freight line along the former Great Central Line railway. At Calvert it would cross the East-West Rail Line where an infrastructure maintenance depot would be located. It would continue broadly to follow the corridor of the former Great Central Line railway, largely at surface level or in shallow cutting. It would diverge away from that corridor as it approaches Brackley, passing Turweston in deep cutting with a short section of green tunnel.

1.5.6 It would then head north-west through open countryside, largely in cutting but with a 2.1km green tunnel past Greatworth. The route would then curve to avoid the site of Edgcote Roman villa, the likely location of the Battle of Edgcote Moor, and Edgcote House and its Park and Garden. It would enter a 2.5km green tunnel past Chipping Warden and Aston le Walls, before running largely on the surface towards Ladbroke and Southam. At Southam the route would enter a green tunnel merging into a bored tunnel to pass under the hill at Long Itchington Wood for nearly 1.5km. From the tunnel at Southam the route would head towards the gap between Kenilworth and Coventry, passing Offchurch and Cubbington, and through part of the National Agricultural Centre at Stoneleigh.

1.5.7 Through the gap between Kenilworth and Coventry, the route would then pass through Burton Green on the alignment of the disused Berkswell to Kenilworth railway cutting in a 520m green tunnel.

West Midlands

1.5.8 From Burton Green the line would head north-west to cross the Rugby to Birmingham branch of the West Coast Main Line (WCML) and the A452 near Balsall Common. The route would then curve to the north to head past Hampton-in-Arden towards a new interchange station close to Birmingham Airport and the National Exhibition Centre.

1.5.9 Leaving the new Birmingham interchange station the line would head north to a triangular junction located to the west of Coleshill. The junction would provide north and south facing spurs into Birmingham city centre.

1.5.10 Heading north the line would run to the east of the M6 and M42, before curving to the north-west to pass close to Middleton near Tamworth. From Middleton the route would curve past Tamworth and to the east of Lichfield connecting with the WCML to the south of Handsacre which will enable services to run onwards to the north-west.

1.5.11 The spur into Birmingham city centre would follow the Water Orton rail corridor in the east of the city, past a new rolling stock depot located at Washwood Heath, to a new dedicated high speed station at Curzon Street in the city centre. The station entrance would be adjacent to Moor Street station.

1.6 Previous environmental assessment work on this project

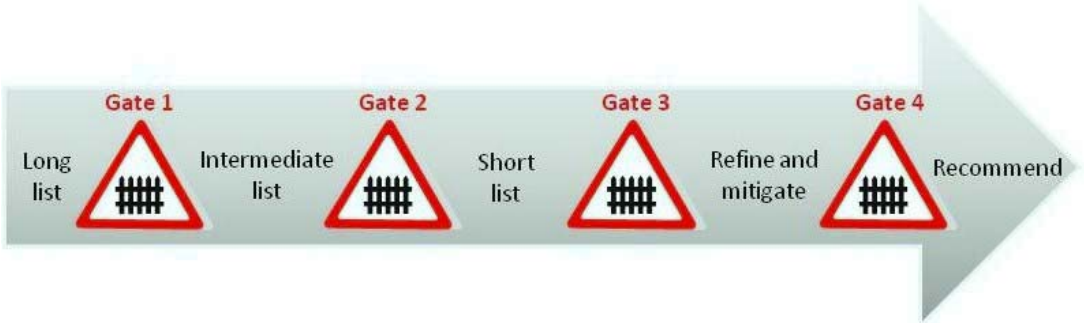
1.6.1 An Appraisal of Sustainability (AoS) for Phase 1 of HS2 was published in February 2011 as part of a public consultation on the strategy for high speed rail and to inform the Government's decision on the preferred route for HS2.

1.6.2 The AoS report provided a strategic appraisal of the key impacts of the proposals for high speed rail between London and the West Midlands. The AoS approach was devised to meet relevant planning requirements and to determine the extent to which Phase 1 of HS2 would support objectives for sustainable development. Four sustainable development priorities were used for the assessment:

- Reducing greenhouse gas emissions and combating climate change;
- Protecting natural and cultural resources and providing environmental enhancement;
- Creating sustainable communities; and
- Enabling sustainable consumption and production.

1.6.3 The AoS considered and compared various route options for Phase1 of HS2 and looked at these alongside wider transport and economic objectives, operational requirements, cost and practicality. This was incorporated into decision making, regarding the development of the route, which helped refine the number of options down to a preferred route. This is shown in Figure 1. The process is described in full in the AoS.

Figure 1 - The staged review of options



1.6.4 Almost 55,000 responses to the 2011 public consultation were received, with 36,918 responses including comments addressing matters related to the AoS. A summary of the responses received is available in High Speed Rail: Investing in Britain's Future Consultation Summary Report available from the DfT website[8].

1.6.5 In response to the consultation feedback HS2 Ltd published:

- Review of possible refinements to the proposed HS2 London to West Midlands Route [9];
- Review of HS2 London to West Midlands Appraisal of Sustainability in January 2012[10]; and
- Review of HS2 London to West Midlands route selection and speed.

1.6.6 The AoS process has been taken into account in developing the Scope and Methodology report for the EIA of the Proposed Scheme.

1.7 Consultation on the Environmental Impact Assessment

1.7.1 Future engagement with the community and interested organisations will be undertaken throughout the EIA process as it will enable the project to adequately take account of people's concerns and understand local issues. This will include engagement with three forums as described below.

Environmental Forum

1.7.2 The Environmental Forum will involve national representatives of environmental statutory authorities and government departments. This group would further advise HS2 Ltd and ensure that HS2 is developed in accordance with current and emerging Government policy and legislation.

[8] Department for Transport, January 2012, *High Speed Rail: Investing in Britain's Future Consultation Summary Report*
[9] HS2 Ltd, January 2012, *Review of possible refinements to the proposed HS2 London to West Midlands Route*
[10] HS2 Ltd, January 2012, *Review of HS2 London to West Midlands Appraisal of Sustainability*

Planning Forums

1.7.3 The Planning Forums are intended to facilitate discussion of design and planning issues, environmental impacts and mitigation principles and will include planning officers from local authorities and other transport and environmental health practitioners with local responsibilities.

Community Forums

1.7.4 The Community Forums will enable local participation, facilitate on-going discussions and build relationships, which will assist HS2 Ltd to identify local priorities and explore opportunities for local community benefits.

1.7.5 This three-part consultation structure provides the formal mechanism for HS2 Ltd's engagement moving towards the deposit of the hybrid bill. It would be supplemented by meetings and engagement with organisations and individuals as necessary (including those represented on the Forums), particularly in relation to specially affected groups.

1.7.6 In addition to the forums detailed above, there will be two specific periods of consultation as part of the EIA. Firstly, there will be consultation on this Draft Scope and Methodology report (see Annex A for List of Consultees) and secondly, consultation on the draft ES. The consultation on the draft ES is planned for spring 2013 and will give the public the opportunity to comment on the predicted effects and the mitigation proposed.

1.8 Monitoring of performance against sustainability and environmental goals

1.8.1 As described in Section 1.6 above the AoS reported on the extent to which the Proposed Scheme would satisfy sustainable development objectives and identified some potential significant effects. During the EIA process the potential significant effects identified in the AoS will be monitored and the ES will report on how the predicted effects may have changed as a result of scheme development. To facilitate the reduction of such effects HS2 Ltd is preparing Environmental Design Aims (EDAs) to guide the project development teams. These EDAs will draw upon the knowledge gained through the AoS. They will be applied and monitored during the EIA process. Practicable measures will be considered further to avoid or reduce the potential environmental effects of the Proposed Scheme as part of a continuing effort to improve the sustainability performance of the new railway during construction and operation.

1.8.2 The EIA will identify the likely environmental effects of the Proposed Scheme and determine options for further mitigation, including monitoring provisions. Environmental plans will be formulated to manage environmental issues during the design, construction and operation of HS2. These will include a Code of Construction Practice (CoCP) which would set out the

principles for the management and monitoring of the environmental aspects arising out of construction and ensure that such effects would be managed effectively on site. This could include measures such as sound and water quality monitoring as necessary.

1.8.3 After construction, guidance would be set to ensure the effectiveness of mitigation determined through the legislation authorising the Proposed Scheme and appropriate management plans, monitoring and remedial response plans would be established as required for the new railway. As part of this process, HS2 Ltd will work with the relevant responsible authorities as required by the authorising legislation to develop the necessary monitoring and management plans.

1.9 Hybrid bill powers

1.9.1 Government will deposit a hybrid bill for consideration by Parliament. If passed it becomes an Act of Parliament conferring powers, including development consent to build the railway line and thereafter to operate and maintain it. The powers would include:

- Authority to nominate an undertaker to build the railway line, and any other ancillary powers needed to operate and maintain it;
- A planning regime necessary for the nominated undertaker to make applications for approval of details for certain matters defined by the Act, to local planning authorities;
- Giving the nominated undertaker the rights to construct, operate and maintain the railway and associated major works as described in the Act (and its accompanying plans and sections) and other, ancillary works;
- Powers of compulsory acquisition or temporary possession of land and properties required for the scheme;
- Powers to protect gas, water, telecommunications and electricity infrastructure which might be affected by the scheme; and
- Powers over rights of way.

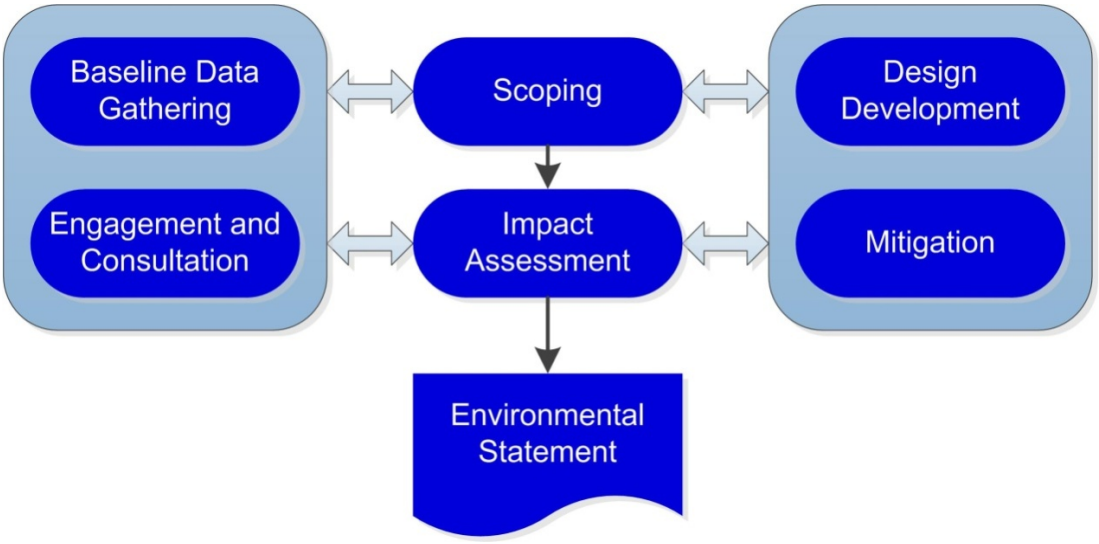
2 EIA methodology

2.1 Introduction

2.1.1 The Environmental Impact Assessment will be carried out in accordance with applicable legal requirements and current best practice. It will take account of the 2009 and 2011 EIA Regulations and associated guidance.

2.1.2 The EIA will comprise a number of related activities, as illustrated in Figure 2 below:

Figure 2 – EIA process diagram



2.1.3 As Figure 2 shows, the main stages in the EIA process comprise:

- EIA scoping, to identify the potentially significant environmental effects and establish the scope and methodology of environmental studies to be carried out, engaging and consulting with stakeholders to take account of their views;
- Establishing current baseline conditions, i.e. the environmental conditions that currently exist in the vicinity of the Proposed Scheme. These will be determined from desk-top studies, previous environmental studies, publicly available information, focussed environmental surveys and consultation with groups that have specialist local knowledge. HS2 Ltd will use best endeavours to access land to undertake environmental surveys;
- Projecting future baseline conditions (i.e. the future conditions without the Proposed Scheme in place). The current baseline will be extrapolated to take account of predicted or anticipated change factors including, but not limited to, changes caused by changing climatic conditions, policy, legislation, urban development, advances in technology and by other planned infrastructure projects;

- Consideration of policies, guidelines and legislation relevant to EIA;
- Review of the design of the Proposed Scheme to identify potential adverse environmental effects and practicable design measures to avoid, reduce or otherwise mitigate adverse effects;
- Assessment of environmental effects, with reference to recognised criteria and using professional judgement;
- Engagement and consultation with formal and informal stakeholders throughout the assessment and EIA design process;
- Preparation of the draft Environmental Statement (ES);
- Public consultation on the draft ES (planned for Spring 2013); and
- Preparation of the final ES

2.1.4 The ES is then submitted to Parliament alongside the hybrid bill for the Proposed Scheme and allows Parliament to make an informed decision in pursuance of the objectives of EIA about whether the Proposed Scheme should go ahead. The provision of further information to Parliament and further consultation may be required during this legislative process.

2.1.5 The EIA will consider the following two scenarios:

- The effects of the construction, existence and operation of the Proposed Scheme at various times (see temporal scope below); and
- The effects of the Proposed Scheme in addition to other schemes, either consented or under construction at that time (but not included in the projected baseline, see section 2.1.3) and identified as having the potential to result in significant cumulative impacts.

2.1.6 The EIA will consider both the beneficial and adverse environmental effects of the Proposed Scheme in the short, medium and long term. It will consider both temporary and permanent effects caused directly and indirectly by the Proposed Scheme. It will also address cumulative effects.

2.1.7 A description of the mitigation measures envisaged in order to prevent, reduce and where possible remedy any significant adverse effects will be provided.

2.1.8 The methodologies for the assessments provided in this report vary from topic to topic. In general however, all of the assessments will involve a process of interaction between engineering design, planning and environmental considerations with a view to avoiding or reducing adverse effects on the environment during construction and operation. Mitigation measures would be considered and incorporated in the Proposed Scheme wherever appropriate and practicable; the extent and scale of mitigation will be designed to control and minimise adverse environmental effects. It will also identify opportunities to promote positive environmental effects.

2.1.9 There will inevitably be some uncertainties in predicting future impacts and effects, especially given that operations would not be due to commence until 2026. In such situations the ES would report the range of magnitude of the

impact under consideration. In this way there would be upper and lower boundaries projected.

2.2 Scope of the assessment

2.2.1 The following section defines the temporal, geographic and technical scope of the assessment for Phase 1 of HS2.

Temporal scope

2.2.2 The main construction works for the Proposed Scheme are anticipated to take place between 2017 and 2026 (including a period of commissioning), and the intensity and scale of construction along the route will vary over this period. The ES will set out the anticipated construction programme in order to establish the likely duration of works in each location. The assessment of construction effects will then relate to the programme described.

2.2.3 Trains are currently expected to start operating on the London to the West Midlands section in 2026. The ES will describe the predicted frequency, speed and length of trains and how that is estimated to change after 2026. It is expected that in Phase 2 the use of the London to the West Midlands railway will intensify. Therefore, effects arising from the operational rail traffic on the London to West Midlands section will be assessed taking account of the anticipated services that would be expected when HS2 reaches maximum capacity (anticipated to be up to 18 trains per hour at peak times in each direction in Phase 2). The ES will also describe the effects of services operating prior to the opening of Phase 2.

2.2.4 Effects arising from passenger usage of the Phase 1 railway, such as those that would arise at Euston, Birmingham City Centre, Birmingham Interchange and Old Oak Common stations, and on journeys to and from these stations, would be assessed at both the maximum anticipated use of Phase 1 and of Phase 2.

2.2.5 Other effects would also be dependent on longer term considerations after opening of Phase 1, such as the progressive growth in background road traffic or the maturing of mitigation (e.g. growth of planting or habitat creation). Where this applies, the topic sections in Part B of this report identify the appropriate temporal scope that would be adopted, taking account of these factors.

2.2.6 The EIA will establish the baseline environment as it exists at present and then take account of likely changes to the baseline for the future scenarios defined above.

Geographic scope

2.2.7 The term geographic scope (also called spatial scope) means the area over which the EIA will consider effects. In general this will take into account the distance from the Proposed Scheme over which changes to the environment

are likely to occur as a result of the construction or operation of the Proposed Scheme (taking account of the temporary and permanent land take requirements). In addition to the physical extent of the works, this is influenced by two principal factors:

- The nature of the baseline environment; and
- The manner in which the effects are likely to be propagated.

2.2.8 In addition the EIA will consider the geographic scope of indirect or secondary effects such as:

- HS2 services on the 'classic network ' north of Birmingham;
- Consequential changes to rail traffic on other lines, especially on the West Coast Main Line between London and Birmingham;
- Passenger access to and from stations and interchanges; and
- Consequential development around stations and interchanges.

2.2.9 Transboundary effects are significant environmental effects caused in other countries (i.e. other than the United Kingdom). The most likely transboundary effects caused by HS2 concern additional services to mainland Europe via the existing HS1 line. However, the existing railway lines across mainland Europe are designed for interoperability and will readily accommodate these additional services. Therefore, it is considered unlikely that the Proposed Scheme will result in any significant effects on the environment of another country and thus transboundary effects are not proposed to be considered further.

Technical scope

2.2.10 The environmental topic areas to be considered and the extent of the assessment work proposed for each is referred to as the technical scope. Schedule 4 to the 2011 EIA Regulations requires the ES to describe the likely significant effects of the project on aspects of the environment including:

- Human beings;
- Fauna;
- Flora;
- Soil;
- Water;
- Air;
- Climatic factors;
- Material assets (including architectural and archaeological heritage);
- Landscape; and
- The inter-relationships between the above factors.

2.2.11 These aspects have been refined and adapted with reference to good EIA practice for rail and other linear transport infrastructure projects. As a result, the environmental topic areas proposed for inclusion in the EIA are as follows:

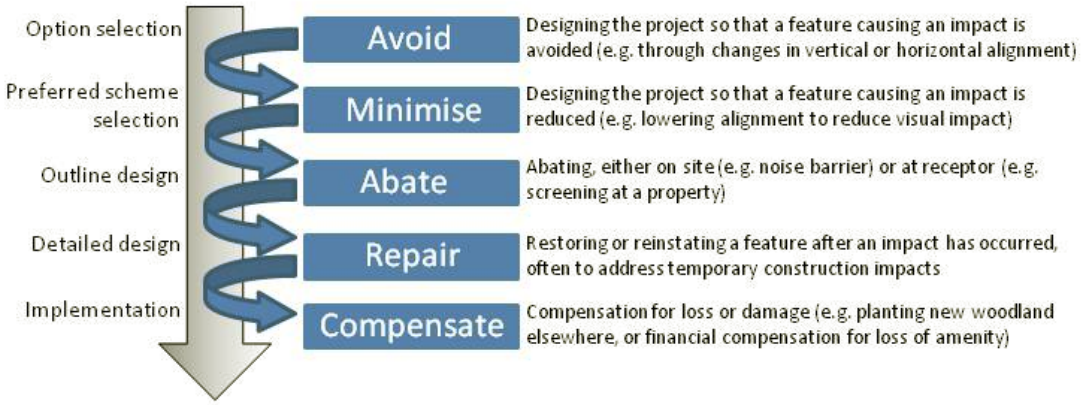
- Air quality;
- Agriculture and soils;
- Climate;
- Community;
- Cultural heritage;
- Ecology;
- Electromagnetic interference;
- Land quality;
- Landscape, townscape and visual assessment;
- Socio-economics;
- Sound and vibration;
- Traffic and transport;
- Waste and material resources; and
- Water resources and flood risk assessment.

2.2.12 These environmental topics have been evaluated as part of this scoping exercise in order to determine the extent to which they should be included in the EIA, having regard to whether there are likely to be significant effects that relate to them. Part B of this report provides further details for each topic of the assessment approach to be applied during the EIA.

2.3 Approach to mitigation

2.3.1 The EIA will identify mitigation measures that would help to avoid, reduce or, where appropriate, offset significant effects.

2.3.2 The following hierarchy will be used to consider mitigation measures:



2.3.3 Mitigation opportunities will continue to be identified during development of the project. The EIA process is an iterative process, which is likely to enable further refinement of the Proposed Scheme, with the objective of avoiding or reducing adverse environmental effects. Mitigation measures will be identified by regularly reviewing the likely significant adverse environmental effects identified during the ongoing assessment process and considering these at design workshops. Where practicable, design modifications will be considered to avoid or reduce significant adverse effects.

2.3.4 During the EIA process, HS2 Ltd intends to develop the mitigation incorporated into the Proposed Scheme through:

- Environmental Design Aims - To structure and guide the design;
- Collaborative design work - To achieve improved design outcomes;
- Community engagement - To allow local people, environmental organisations and responsible authorities to explain their issues and put forward their ideas to influence the design and guide HS2 Ltd on what they would like to be incorporated into the Proposed Scheme. This will be described in a report of public participation;
- Mitigation report - To demonstrate the mitigation HS2 Ltd has committed to through the development of the design of the Proposed Scheme; and
- Code of Construction Practice - To detail the approach to be taken during construction to reduce adverse effects, including the use of Environmental Management Plans for construction.

2.3.5 The proposed mitigation measures will be described in the ES, together with the significant effects remaining after mitigation (termed the residual effects). Where the Proposed Scheme is likely to improve environmental conditions (over and above the baseline), these effects will be identified as enhancements.

2.3.6 After the conclusion of the hybrid bill, mitigation would be implemented through the Code of Construction Practice, the operation of detailed planning and environmental controls and through appropriate compensatory measures.

2.4 Cumulative effects

2.4.1 Cumulative effects are broadly defined as incremental effects that result from the accumulation of a number of individual effects, either caused by the Proposed Scheme (intra-project effects) or by other developments which would be under construction at the same time as HS2 or built later(inter-project effects). Where it is identified that other schemes are expected to be complete and in operation before construction of HS2 their effects will be considered through the extrapolation of the future baseline.

2.4.2 The assessment of cumulative effects will therefore consider the following;

- The combined effects on a single receptor of a number of individual environmental impacts, for example noise, airborne dust and traffic;

- The effects of other developments in the vicinity of the Proposed Scheme which are under construction or have been consented, which when combined with the effects of the Proposed Scheme may have an incremental significant effect; and

- The cumulation of individual effects on a receptor which when summed in a regional context or over the scheme result in an effect of greater significance than the sum of the individual effects (i.e. synergistic effects).

2.4.3 The list of other proposed schemes that should be considered as having a cumulative effect in combination with HS2 will be discussed during consultation on the scope and further researched during the EIA. As an example, however, it is expected that the EIA should consider carefully the effects of construction of HS2 Phase 2 in the vicinity of receptors of impacts from Phase 1.

2.4.4 The geographical scope of schemes to be included in the cumulative assessment depends on the context (e.g. rural or urban) and on the characteristics of the topic concerned. This will be defined in relation to the individual topic sections in the course of the EIA process in consultation with appropriate stakeholders.

2.4.5 Where relevant, potential cumulative effects arising will be identified in each topic assessment, which will include details of the cumulative assessment methodology and results. The ES will include a summary of the route-wide cumulative effects.

2.5 Defining significant effects

2.5.1 This report refers to both environmental impacts and environmental effects. The general approach taken is that the project has the potential to cause an *impact* on the receiving environment or its neighbours either through physical change (such as the land used for the project, or change in land form) or through changes in sound levels, air quality, or socio economic factors. The extent to which an impact causes a significant environmental or socio economic *effect* to occur will depend on a number of factors. In the main it is significant *effects* that are reported in the Environmental Statement, but in the EIA process much of the attention is on assessing the level of impacts that give rise to the effects and determining how to avoid or reduce them.

2.5.2 The predicted effects will be classified according to whether they are considered to be major, moderate or minor; and beneficial, negligible, adverse or no impact. This will provide a consistent approach to expressing the results of the assessments undertaken as part of the EIA. The terms used are defined as follows:

- Beneficial - Advantageous or positive impact to an environmental resource or receptor;
- Negligible - Imperceptible impact to an environmental resource or receptor;
- Adverse - Detrimental or negative impact to an environmental resource or receptor;

- Minor - Slight, very short or highly localised impact without a significant consequence;
- Moderate - Limited impact (by extent, duration or magnitude) which may be considered to be significant; and
- Major - Considerable impact (by extent, duration or magnitude) of more than local importance or in breach of recognised standards, policy or legislation.

2.5.3 Potential variants to this approach are described as appropriate in the environmental topic sections in part B of this report.

2.5.4 Where it is not possible to quantify impacts, qualitative assessments will be carried out, based on professional experience and judgement. Where uncertainty exists this, together with any assumptions relied on, will be noted in the relevant assessment and any limitations to the EIA work will be reported in the ES.

2.5.5 The significance of effects will be evaluated with reference to recognised standards and accepted criteria for each assessment topic, where these are available. Where no recognised standards or criteria exist, professional judgement will be used to develop an appropriate approach to undertake a robust and appropriate assessment, as explained below. Each topic section in this report describes the approach to be taken. In determining whether a resulting effect is significant and then applying a level (i.e. minor, moderate, major) of significance, due consideration will be given to:

- Spatial extent (e.g. local, district, regional, national or international);
- Magnitude of the impact;
- Impact duration (whether short, medium or long term);
- Frequency of occurrence;
- Impact nature (whether direct or indirect, permanent or reversible);
- Whether the impact occurs in isolation, is cumulative or interactive;
- Sensitivity and number of receptors affected;
- Value of a resource affected;
- Performance against environmental quality standards; and
- Compatibility with environmental policies.

2.6 Assumptions and limitations

2.6.1 Each topic chapter of the ES will include a section to explain any assumptions made in undertaking the assessments.

2.6.2 During the preparation of the EIA there could be some probable and unforeseen circumstances that could result in factors that may limit the information available to inform the assessment process. Any limitations will be described in the relevant topic chapter within the ES.

3 Reporting of alternatives in the ES

3.1.1 The Government considers that a continuing increase in demand will create a need over the next twenty to thirty years for additional capacity to cater for inter-city journeys between London and the major conurbations in the Midlands and the North. It does not, however, believe transferring rail demand to road or domestic aviation to be an appropriate solution. If the increases in demand for inter-urban travel that would be expected as the UK economy returns to a pattern of long-term and sustainable growth are to be accommodated, then Government considers that it is the rail network which needs to be in a position to play the lead role in delivering new capacity and that a clear case exists for this new capacity to be a new high speed rail network.

3.1.2 The Government does not consider that yet more rounds of incremental enhancements to existing lines will be sufficient to meet long-term capacity needs for passengers or freight. It is Government's view that analysis by Network Rail has indicated that even very major enhancement packages simply cannot resolve the pressures on capacity anticipated on the West Coast Main Line (WCML) over the coming decades. The strong likelihood is that even pushing the WCML to the absolute limit, as the alternatives that have been looked at do, would only delay rather than eliminate the need for new lines in the future. In the meantime, substantial disruption would have been imposed on passengers over a number of years as works were carried out and the additional strategic, economic and connectivity benefits that high speed rail is particularly capable of delivering would have been foregone.

3.1.3 Given the opinion that upgrading the existing north-south lines is not a viable long-term solution, HS2 Ltd considers that the real choice, therefore, is not between high speed rail and further incremental upgrades and that only a new line is capable of providing the capacity that is required. But building new conventional rail lines would not be significantly cheaper, nor would their impacts on the environment and communities be significantly less than those of new high speed rail lines. However, new conventional rail lines would deliver far fewer benefits in terms of enhanced connectivity and support for long-term economic growth. The additional benefits generated by designing a new line to accommodate high speed services, compared to a new conventional speed line, would outweigh the additional costs by a factor of more than four to one. These matters are described in more detail within the report, *High Speed Rail Strategic Alternatives Study: Strategic Alternatives to the proposed Y Network*[11].

3.1.4 The Proposed Scheme is the product of some two years of work by HS2 Ltd to examine a substantial number of possible alternative routes and stations.

[11] Atkins, 2011, *High Speed Rail Strategic Alternatives Study, Strategic Alternatives to the Proposed 'Y' Network*, Department for Transport

The main alternatives that have been considered are reported in the consultation document, *High Speed Rail: Investing in Britain's Future Consultation Summary Report*[12].

3.1.5 The Environmental Statement (ES) will provide an outline of the main alternatives studied by HS2 Ltd and Department for Transport (DfT) and the reasons for their rejection.

3.1.6 The main alternatives to be described in the ES will include the following:

Strategic alternatives

3.1.7 In outline, other alternatives are described in *High Speed Rail Strategic Alternatives Study: Strategic Alternatives to the proposed Y Network.*

3.1.8 Alternatives to constructing HS2 (including those addressed by DfT) e.g. consideration of enhancement / capacity improvements on the existing classic lines such as the West Coast Main Line (WCML) and Chiltern Railway.

Route alignment alternatives

3.1.9 These would include alternatives such as route corridor alternatives between London and West Midlands, location of the stations, and means of connecting to other rail networks including High Speed 1 (HS1) and the WCML that were considered to determine the Government's preferred route for consultation.

3.1.10 It will also include an outline of route corridors and design speed alternatives that were considered following the consultation held in spring 2011. These included refinements to alternative routes following existing transport corridors, together with reduced design speeds and associated line curvature. (These also included the Government's preferred route that had been consulted upon.)

[12] Department for Transport (DfT), February 2011, *High Speed Rail: Investing in Britain's Future Consultation Summary Report*

Design alternatives on the proposed route

3.1.11 In outline, the appraisal of route refinements that were considered for the Government's preferred route following the consultation held in spring 2011.

3.1.12 These included options for station and infrastructure maintenance depot options and locations, alternative alignments considered on the preferred route post-consultation (e.g. capturing changes to the scheme such as extended and new bored tunnels; extended and new green tunnels, and surface alignment changes to accommodate community and environmental concerns expressed at consultation).

Other alternatives

3.1.13 There will continue to be design refinements in response to the EIA and the local engagement planned by HS2 Ltd, to respond to local environmental sensitivities and local issues raised through consultations. These would include for example the location of construction site compounds, the access routes to and from construction sites and vent shafts. Localised alternatives for these types of features will be considered in order to determine their most suitable location.

3.1.14 The alternatives described in the ES will include those that are considered during the EIA process and prior to submission of the ES to support the hybrid bill.

Part B

4 Air quality

4.1 Introduction

4.1.1 This section of the report sets out the scope and methodology for assessing the effects of the Proposed Scheme on air quality during its construction and operation. These activities could result in changes in air quality and therefore need to be assessed in the Environmental Statement (ES). Air quality changes would occur during construction as a result of the construction activities and the associated traffic. In operation, the main changes in air quality would arise as a result of changes to road layouts and traffic flows near the stations/interchanges and where road diversions are required. Also, changes to air quality during operation are likely to arise from any atmospheric emissions from new buildings (e.g. stations/ interchanges and infrastructure maintenance depots) built as part of the Proposed Scheme and also potentially from modal shift. The air quality assessment would focus on air pollutants that are likely to arise from the construction and operation of the Proposed Scheme. These pollutants are nitrogen dioxide (NO_2), particulate matter (PM_{10} and $PM_{2.5}$) and dust.

4.2 Establishment of baseline and definition of survey requirements

4.2.1 The stations/interchanges and small sections of the route (in London and Birmingham) are located within or in proximity to Air Quality Management Areas (AQMA). However, the rest of the Proposed Scheme runs through a predominantly rural setting where air quality is generally good and in these sections the route alignment does not pass through any AQMAs. Annex D shows the Proposed Scheme route map in relation to AQMAs.

4.2.2 The vast majority of AQMAs in the United Kingdom (UK) are designated where nitrogen dioxide (NO_2) and particulate matter (PM_{10}) concentrations are elevated. This is mostly related to vehicle emissions from heavily trafficked roads. The London Borough of Camden has declared the whole borough as an AQMA for NO_2 and PM_{10} and Birmingham City Council has declared its entire local authority area as an AQMA for NO_2. Local authorities review the need for AQMAs on a regular basis and therefore during the assessment it is possible that AQMAs are no longer required and are revoked. It is also possible new AQMAs will be declared; therefore this will be reviewed throughout the air quality assessment.

4.2.3 Under Part 4, Section 82 of the Environment Act 1995 (Local Air Quality Management)[13], local authorities in the UK are required to review and assess

[13] Department for Environment, Food and Rural Affairs, 1995, The Environment Act 1995, The Stationery Office

local air quality in their areas of jurisdiction and accordingly they are required to produce annual reports detailing the outcomes of these reviews and assessments. Information relating to existing ambient air quality at the Proposed Scheme stations/interchanges and along the route alignment is available from a series of air quality review and assessment reports prepared by local authorities under the Local Air Quality Management regime. The baseline assessment would include collation of local air quality monitoring and modelling data from these reports with a focus on NO_2, PM_{10} and $PM_{2.5}$.

4.2.4 The assessment will review air quality monitoring data available from the national Automatic Urban and Rural Network (AURN) available on Defra's website (http://uk-air.defra.gov.uk/networks/). The AURN is the UK's largest automatic monitoring network and is the main network used for compliance reporting against the EU's Ambient Air Quality Directives. These sites provide high resolution hourly information which can be downloaded from the website. Some of the AURN sites are located in Greater London; however, the main air quality monitoring network in London is the London Air Quality Network (LAQN) which is managed by the Environmental Research Group, King's College London. Hourly air quality data can be downloaded from the website (www.londonair.org.uk). The West Midlands Air Quality Group website (http://www.wmair.org) also contains information relevant to the West Midlands area.

4.2.5 Further background air pollutant concentration data is available on Defra's Air Information Resource (AIR) website (http://uk-air.defra.gov.uk). These data comprise estimated background air pollution data for 2008 and projections for future years for a $1km^2$ grid for every local authority in the UK.

4.2.6 With respect to potential air quality effects on vegetation and ecosystems, critical loads for pollutant deposition and critical levels of gaseous pollutant concentrations for the whole of UK network of protected sites are available from the UK Air Pollution Information System (APIS) (http://www.apis.ac.uk).

4.2.7 Data will be gathered from the above listed sources covering pollutants that are likely to arise from the construction and operation of the Proposed Scheme. These pollutants are NO_2, PM_{10} and $PM_{2.5}$. With regard to the effect on vegetation and ecosystems, baseline data for nitrogen oxides (NOx) and nitrogen deposition would be collated.

4.2.8 Additional air quality monitoring data might be required for model verification although it is expected that sufficient data will already be available (see section 4.7.1 of this report).

4.3 Consultation

Consultation on the AoS

4.3.1 The consultation undertaken during the preparation of the Appraisal of Sustainability (AoS) indicated that some consultees provided responses related to the air quality effects of the Proposed Scheme. The main points highlighted during this consultation were the direct potential effects of the Proposed Scheme during construction and the direct/indirect effects during operation. Comments regarding air quality were received from two of the local authorities consulted; (No other comments directly related to the air quality assessment were received.)

- London Borough of Camden responded that the Proposed Scheme would result in a number of negative environmental effects including air quality. The Council indicated that the air quality effects during construction were the main concern and it required a detailed quantitative assessment of local air quality and traffic effects of the scheme during construction. These effects would be specifically related to dust and PM_{10} emissions associated with the demolition and construction works as well as NOx and PM_{10} vehicle emissions during that phase.
- London Borough of Hillingdon's main concern was with regard to potential air quality effects during the operation phase and whether the scheme would improve air quality as a result of modal shift. The Council highlighted that the AoS recognised that local air quality improvements from a mode shift from car to rail is not expected to be significant. The Council stated that the AoS did not assess the alternative options to ensure that this modal shift was significant and led to improvement in air quality. The Council also raised concerns regarding local air quality around Heathrow which would suffer from increased passengers accessing the airport by road vehicles, as freed up slots (currently used by short-haul flights) are used by larger planes with larger passenger numbers. Finally, the Council stated that it was unacceptable to propose a high traffic generating scheme in a location where air quality is poor.

Consultation as part of the EIA process

4.3.2 The key consultees to be consulted in relation to air quality assessment methodology are environmental health departments at local authorities where:

- The Proposed Scheme stations, interchanges and infrastructure maintenance depots would be located;
- The Proposed Scheme would pass through;
- Significant changes in operational or construction traffic would occur; and
- There are construction activities in general.

4.3.3 In addition, the Greater London Authority (GLA) will be consulted in relation to the air quality assessment methodology.

4.4 Key aspects of the scheme for the topic

4.4.1 The main air quality effects from the Proposed Scheme during its construction would arise from:

- Emissions associated with site plant and vehicles;
- Emissions from construction traffic;
- Changes in emissions arising from local diversions; and
- Dust arising from activities such as use of haul roads, wind erosion of temporary stockpiles, earth moving operations, and demolition activities.

4.4.2 The above aspects would have the potential to cause changes in NO_2, PM_{10} and $PM_{2.5}$ concentrations and may cause dust deposition at sensitive human receptor locations. Also, some have the potential to cause changes in NOx concentrations at ecologically sensitive habitats.

4.4.3 Air quality effects from the operation of the Proposed Scheme will be categorised into direct and indirect effects. Direct effects would arise from the changes in traffic flows at the Proposed Scheme stations and along the route. In addition, there would be potential air quality effects from emissions from buildings.

4.4.4 Indirect effects would arise from changes in emissions brought about by a modal shift from car to rail services. This may have a beneficial effect on air quality.

4.5 Scope of assessment

Spatial scope

4.5.1 Assessment of the effects of emissions arising from local traffic diversions and construction traffic around worksites would be limited to receptors located along roads that meet any of the criteria specified in the Design Manual for Roads and Bridges (DMRB)[14]. These criteria are as follows:

- Road alignment change by 5 metres (m) or more;
- Daily traffic flows change by 1,000 annual average daily traffic (AADT) or more;
- Heavy Duty Vehicle (HDV) flows change by 200 AADT or more;
- Daily average traffic speed would change by 10 kph or more; or
- Peak hour traffic speed would change by 20 kph or more.

4.5.2 The assessment of dust emissions arising from construction sites associated with the Proposed Scheme will be carried out in accordance with the Institute of Air Quality Management (IAQM) Guidance[15]. These include areas around worksites where there are sensitive receptors within 350m from the

[14] Highways Agency, 2007, *Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 1 Air Quality, HA207/07*, The Stationery Office

[15] Institute of Air Quality Management (IAQM), 2012, *Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance*, IAQM

site boundary and/or within 100m of the routes used by construction vehicles on the public highway and up to 500m from site entrances.

4.5.3 Assessment of nitrogen deposition will be required if there are significant changes in traffic flows within 200m of ecologically sensitive sites. Ecological resources and other ecological issues are contained in Section 9 of this report.

Temporal scope

4.5.4 The assessment of air quality effects of construction traffic will be undertaken for the following scenarios:

- Future baseline traffic emissions during each year of construction without the Proposed Scheme construction traffic emissions; and
- Future baseline traffic emissions during each year of construction with the Proposed Scheme construction traffic emissions.

4.5.5 The assessment of air quality effects due to change in traffic during operation will be undertaken for the following scenarios:

- Future baseline traffic emissions during the year of operation without the Proposed Scheme; and
- Future baseline traffic emissions during the year of operation with the Proposed Scheme.

Technical scope

4.5.6 The assessment will not include the transboundary effects of the Proposed Scheme on air quality, as the likely changes in atmospheric emissions would be negligible in this context. Also, the air quality effects arising from the modal shift will only be assessed in terms of change in regional emissions.

4.6 Assessment methodology

Legislation

4.6.1 The assessment will take into account the following legislation:

- Part 4 of the *Environment Act 1995*;
- *The Air Quality (England) (Amendment) Regulations 2002*[16]; and
- *Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe*[17].

Guidance

4.6.2 The assessment will take into account the following guidance:

- *Local Air Quality Management Technical Guidance LAQM.TG*(09)[18];

[16] Official Journal of the European Union, 2008, *Directive 2008/50/EC of the European Parliament and of the Council*, EU
[17] Defra, 2009, *Local Air Quality Management Technical Guidance LAQM.TG(09)*, Defra
[18] Environmental Protection UK, 2010, *Development Control: Planning for Air Quality*, Environmental Protection UK

- *Design Manual for Roads and Bridges*. Volume 11, Section 3, Part 1 Air Quality, HA207/07;
- Environmental Protection UK Guidance – *Development Control: Planning for Air Quality*[19];
- IAQM Guidance on the *Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance*; and
- Greater London Authority's *Best Practice Guidance: The Control of Dust and Emissions from Construction and Demolition* published in 2006 (due to be revised in 2012)[20].

Significance criteria

4.6.3 Air quality limit values and objectives are quality standards for clean air. These limit values and objectives will be used as assessment criteria for determining the significance of any potential changes in local air quality resulting from the Proposed Scheme. Some pollutants have standards expressed as annual average concentrations and others have standards expressed as 24-hour, 1-hour or 15-minute average concentrations. Some pollutants have standards expressed in terms of both long-term and short-term concentrations. Table 1 sets out these EU air quality limit values and UK national air quality objectives for the pollutants relevant to this study (NO_2, PM_{10} and $PM_{2.5}$).

4.6.4 The significance of effects resulting from the Proposed Scheme on local air quality for individual sensitive receptors will be determined using the approach described by the Environmental Protection UK *Guidance Development Control: Planning for Air Quality*. The Guidance incorporates the latest position of the IAQM on impact significance. Significance criteria methodology is detailed in Annex D of this report.

4.6.5 The impacts of dust emissions on sensitive receptors would be determined using the IAQM Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance. Details of these significance criteria are detailed in Annex D.

[19] Environmental Protection UK, 2010, *Development Control: Planning for Air Quality*, Environmental Protection UK

[20] Greater London Authority (GLA) and London Councils, 2006, *The Control of Dust and Emissions from Construction and* Demolition - Best Practice Guidance, GLA

Table 1 – UK and EU Air Quality Standards and Guidelines

Pollutant	Averaging Period	Limit Value/Objective	Date for Compliance	Basis
Nitrogen dioxide (NO_2)	1 hour mean	200 µg/m^3, not to be exceeded more than 18 times a year (99.8th percentile)	31st Dec 2005	UK
			1st Jan 2015*	EU
	Annual mean	40 µg/m^3	31st Dec 2005	UK
			1st Jan 2015*	EU
Particulates (PM_{10}) Measurement technique: Gravimetric	Daily mean	50 µg/m^3, not to be exceeded more than 35 times a year (90.4th percentile)	31st Dec 2004	UK
			31st Dec 2009*	EU
	Annual mean	40 µg/m^3	31st Dec 2004	UK
			None Specified	EU
Particulates ($PM_{2.5}$) Measurement technique: Gravimetric	Annual mean	25 µg/m^3	2020	UK
			2010	*EU Target Value
			2015	*EU Limit Value
		Target of 15% reduction in concentrations in urban areas	Between 2010 and 2020	UK
		Target of 20% reduction in concentrations in urban areas		*EU Limit Value

* Not yet ratified.

Construction effects

4.6.6 The construction effects will be assessed through an investigation of potential sources of air pollutant emissions from construction activities and through the formulation of appropriate mitigation and control measures. An environmental risk assessment of construction effects will be carried out using the risk-based approach and the significance criteria described in the IAQM Guidance on the assessment of construction impacts on air quality. This Guidance considers the potential for dust emissions from demolition,

earthworks, construction and trackout[21] activities that are likely to take place. Also it considers three separate dust effects:

- Annoyance due to dust soiling;
- Harm to ecological receptors; and
- The risk of health effects due to a significant increase in exposure to PM_{10}.

4.6.7 The methodology will take into account the distance from the scheme to the receptors that may experience these effects.

4.6.8 With regard to assessment of the effects of emissions arising from changes in traffic flows during construction, traffic data will be screened using the DMRB criteria described in section 4.5.1. Following this screening exercise, roads meeting any of these criteria would be subject to further assessment using the air quality screening tool specified in DMRB. This tool will be used to forecast concentrations of traffic-related pollutants (NO_2 and PM_{10}) at receptors located within 10m from the kerbside of each of those roads. If this predicts significant change in pollutant concentrations, an appropriate atmospheric dispersion model (e.g. ADMS-Roads or ADMS-Urban) would be used to further investigate the effects of changes in traffic flows at those receptors. Dispersion modelling would use the latest available vehicle emission data from Defra and take into account information in the National Atmospheric Emission Inventory and the London Atmospheric Emissions Inventory as appropriate. Comparison of results with and without the construction traffic and local diversions in the future years would allow the effect to be determined.

4.6.9 This assessment would comply with the requirements of LAQM.TG(09) and would address the issues related to model verification and sensitivity analysis. This will only be considered in relation to areas where detailed air dispersion modelling is required and it will not be necessary elsewhere on the route of the Proposed Scheme.

Operational effects

4.6.10 Operational effects due to the diversion of traffic flows at stations/interchanges and along the route of the Proposed Scheme would be assessed using the methodology described in 4.6.8. The assessment of emissions from other sources such as emissions from buildings, will be assessed using a detailed dispersion model such as ADMS if a significant impact is expected. An initial appraisal will be undertaken that will examine the magnitude and location of the emissions to determine whether dispersion modelling is required.

[21] The unintentional transfer of dust and dirt from construction/demolition sites onto public roads, where it may be deposited and then re-suspended by other vehicles.

4.6.11 Where there is a need to carry out assessment of nitrogen deposition near to sensitive sites, this will follow the methodology detailed in Volume 11 of DMRB.

4.6.12 The assessment of indirect effects brought about by modal shift from car to rail will be undertaken by calculating the change in total emissions based on the change in vehicle kilometres travelled by vehicles.

Cumulative effects

4.6.13 Cumulative effects will be largely taken into account in the traffic data used for the assessment which will incorporate likely change brought about by other proposed developments both during and following construction. Where there is planned development that includes significant emissions to the atmosphere then these emissions would be included within the air quality modelling undertaken for the Proposed Scheme if these are likely to result in cumulative effects.

4.7 Assumptions

4.7.1 The air quality assessment assumes the following:

- There is available baseline data from the sources mentioned in section 4.2; and
- There is an adequate level of detail of construction activities at construction sites.

5 Agriculture and soils

5.1 Introduction

5.1.1 This section of the report covers 'Agriculture and Soils' which includes the environmental topic areas of soil, agricultural land, and farm and farm-based enterprises. In particular, it considers the potential impacts of the loss of agricultural land in terms of agricultural land quality, soil resources, local farm businesses and on-farm enterprises, and agri-environment schemes.

5.1.2 The approach that will be adopted to assess agricultural impacts is derived from national planning policy. This approach accords with the advice given in various good practice guides for the preparation of Environmental Impact Assessments (EIAs).

5.1.3 The principal feature of national policies regarding agricultural land use is the emphasis on safeguarding scarce natural resources in the long-term national interest. Consequently, policies for development in the countryside give a measure of protection to the "best and most versatile" agricultural land (defined as Grades 1, 2 and 3a in the Agricultural Land Classification (ALC) system).

5.1.4 Policy advises that the presence of the best and most versatile agricultural land should be taken into account alongside other environmental considerations in development decisions. Where significant development of agricultural land is unavoidable, poorer quality land in Grades 3b, 4 and 5 should be used in preference to higher quality land, except where this would be inconsistent with other sustainability considerations. Policy is less concerned in agricultural terms with the loss of lower quality land, except where this contributes in some special way to the environment or local economy.

5.1.5 ALC is not the sole consideration in assessing how development proposals affect agriculture. Other factors to be considered include the impact on farm size and structure, the use of buildings and other fixed equipment (including irrigation and drainage), or any stimulus the development might give to rural economic activity, for example in demand for renewable energy.

5.2 Establishment of baseline and definition of survey requirements

5.2.1 A description of the baseline environment for the Proposed Scheme for consultation in 2011 is contained within the Appraisal of Sustainability (AoS). Section 8.17 of the AoS describes the baseline environment in relation to soil and land resources.

5.2.2 There is a well-established methodology for classifying the quality of agricultural land, contained within guidance issued by the then Ministry of Agriculture, Fisheries and Food (MAFF) in 1988.[22]

5.2.3 Agricultural land in England and Wales is graded between 1 and 5, depending on the extent to which physical or chemical characteristics impose long-term limitations on agricultural use. Grade 1 land is excellent quality agricultural land with very minor or no limitations to agricultural use, and Grade 5 is very poor quality land, with severe limitations due to adverse soil, relief, climate or a combination of these. Grade 3 land is subdivided into Subgrade 3a (good quality land) and Subgrade 3b (moderate quality land).

5.2.4 MAFF produced a Provisional ALC of England and Wales in the late 1960s/early 1970s at a scale of 1:63,360 (1 inch to 1 mile). This information is now shown on magic.gov.uk (at a scale of 1:250,000) and was used to inform the AoS. However, this ALC information was based on reconnaissance field surveys and was intended to provide general strategic guidance on agricultural land quality; it is not sufficiently accurate for use in the assessment of individual developments and should not be used other than as general guidance. In addition to limitations of scale, this classification was undertaken using a system that has since undergone two fundamental revisions and does not distinguish between the subgrades of Grade 3, which has important policy implications.

5.2.5 Since the publication of the Provisional ALC, certain areas of the country (usually those proposed for non-agricultural development) have been surveyed in greater detail. Those surveys carried out by MAFF and its successors are available from Natural England, and copies of all detailed ALC surveys along or within 1 kilometre (km) of the route alignment will be obtained for use in the EIA.

5.2.6 Where detailed ALC information is not available from Natural England, an ALC survey will be undertaken for all land to be acquired or used. This will require an examination of published geological, topographical, soil and climatic information, and a site survey involving the examination of soil profiles using hand-held augers and spades. Samples may be taken for laboratory analysis. The soil characteristics will then be described and analysed in terms of the

[22] Ministry of Agriculture, Fisheries and Food (MAFF), 1988, *Agricultural Land Classification of England and Wales: Revised guidelines and criteria for grading the quality of agricultural land*, MAFF

MAFF guidelines to classify and map all agricultural land in a grade between 1 and 5.

5.2.7 Where access to land is unavailable, a predictive ALC will be undertaken based on an interpretation of published soil and agro-climatic data in the light of the MAFF ALC guidelines.

5.2.8 A risk assessment will be prepared to ensure that health and safety hazards relating to the ALC and soil surveys are taken into account.

5.2.9 Information on the existing agricultural use and circumstances of all land to be acquired or used will be obtained directly from the owners and occupiers of the land. Where land is within a formal tenancy, this information will be obtained from the tenant. This will involve face-to-face interviews based on a standard set of questions which will be agreed first with relevant consultees but will be likely to cover:

- A description of the existing size, location and use of farm holdings;
- A description of the existing scale and nature of agricultural and non-agricultural enterprises based on farm holdings and their associated capital and labour inputs;
- A discussion of the physical impacts on the structure and operation of the farm holding; and
- A discussion about potential options to mitigate such impacts.

5.2.10 The term 'farm holding' is used in a wide sense and is taken to include land associated with arable cropping, livestock rearing, field-scale and glasshouse horticulture (of edible and non-edible crops), farm woodland enterprises such as charcoal-making, and commercial equestrian enterprises. Non-agricultural, farm-based enterprises will be those within the control of the main occupier of the farm holding.

5.2.11 Where practicable, a representative of the HS2 project design team will attend these interviews with the agricultural surveyor, which will also address the issue of lone working. The opportunity will also be taken to ask specific questions of land owners and occupiers from other environmental disciplines, in order to minimise the number of visits to individual farm holdings.

5.2.12 Information on the presence of any agri-environment schemes (such as Environmental Stewardship) will be obtained from magic.gov.uk and from individual land owners and occupiers, who will also be asked for details of the nature, requirements and duration of such schemes within the land to be acquired or used for the construction and operation of the Proposed Scheme.

5.3 Consultation

Consultation on the AoS

5.3.1 The principal issues for the assessment of the effects on agricultural interests arising from consultation on the AoS were:

- The EIA should include a detailed ALC and soil resources field survey;
- The AoS did not consider farmland other than that shown as Grades 1 and 2, nor the implications of the loss of this land for food production; and
- The EIA should consider the impact of severance on farming communities.

5.3.2 These issues were raised by farmers' and landowners' representative groups, and by individual members of the public.

Consultation as part of the EIA process

5.3.3 It is intended to continue this engagement with representative groups of farmers, landowners and other rural enterprises, and particularly (but not exclusively) with the following:

- The National Farmers' Union (NFU) at regional and national levels;
- The Country Land and Business Association (CLA) at regional and national levels;
- The Central Association of Agricultural Valuers (CAAV);
- Campaign for the Protection of Rural England (CPRE);
- The British Horse Society (BHS); and
- Hunting Groups (those responding to the consultation were the Bicester Hunt with Whaddon Chase, Cotswold Vale Farmers Hunt, Fitzwilliam (Milton) Hunt, Warwickshire Hunt, West Street Tickham Hunt).

5.3.4 At the strategic level, it will be necessary to continue consultation with the Department for Environment, Food and Rural Affairs (Defra) and Natural England, particularly in formulating appropriate assessment methodologies and significance criteria. Natural England will also be consulted in respect of the availability of existing detailed ALC information and existing agri-environment schemes along and close to the route alignment.

5.3.5 The key consultation in the EIA, however, will be with the owners and occupiers of the land to be acquired or used for the construction and operation of the Proposed Scheme, as detailed above in the discussion of the baseline survey.

5.4 Key aspects of the scheme for the topic

5.4.1 The key aspects of the Proposed Scheme that will affect agricultural interests will involve:

- Permanent and temporary land-take of all grades of agricultural land;

    - permanent land-take will affect the nation's stock of agricultural land, which may include areas of high quality used for food and fibre production; and
    - temporary land-take that is not restored to its pre-existing condition will similarly involve a loss of a finite resource;
- Permanent and temporary loss of soils in other land uses (e.g. woodland); permanent loss of such soils will reduce the ability to support particular habitats; (the biodiversity effects of such loss will be assessed within the Ecology Chapter of the ES.);
- The sustainable re-use of soils displaced by the Proposed Scheme; soil is a finite resource which fulfils a number of functions and services including food and fibre production, environmental interaction with air and water, support of ecological habitats and biodiversity; support for the landscape; protection of cultural heritage and provision of raw materials;
- Permanent and temporary severance of agricultural land and loss of agricultural access; (the severance of land may affect the continued ability to farm or otherwise use the land to its potential.);
- Loss of farm dwellings, farm buildings and other on-farm infrastructure; farm capital may support significant areas of land and the loss of this capital may affect the continued ability to farm or otherwise use this land to its potential;
- Permanent and temporary disruption to drainage, irrigation and water supplies; (such disruption will affect land quality (if permanent) and hence land use; or lead to short-term land use change.); and
- Construction effects (e.g. dust and pollution) on adjacent agricultural land which may affect the ability of that land to continue in its present land use; the likelihood of such effects will be assessed, in the first instance, under the relevant topics (e.g. the Air Quality Chapter of the ES).

5.5 Scope of assessment

Spatial scope

5.5.1 The study area will need to be defined for the agricultural assessment. For most of the key issues identified, the study area is likely to be restricted to the limits of the land to be acquired or used for the construction and operation of the Proposed Scheme, although there may be the potential for effects on neighbouring farmland during the construction and operational phases.

5.5.2 The scope of the assessment will be guided by relevant legislation, planning policy and best practice guidelines.

Temporal scope

5.5.3 The temporal scope for this topic is outlined in section 2 of this report. Agriculture and soil effects will be assessed for the construction period (2017 – 2026) and the year of opening in 2026.

Technical scope

5.5.4 National policy will form the basis of the assessment of effects of the Proposed Scheme on agriculture and soils, and will define the scope of the assessment, namely:

- The quantity and quality of agricultural land that would be affected, both temporarily and permanently;
- The nature and use of the soil resource that would be affected (and displaced) by the Proposed Scheme;
- The physical impact of land loss and severance and other impacts on agricultural enterprises and farm-based non-agricultural enterprises; and
- The loss or degradation of features within agri-environment schemes.

5.6 Assessment methodology

Legislation

5.6.1 In 2006 the European Commission (EC) adopted a comprehensive '*Thematic Strategy*'[23] specifically dedicated to soil protection which included a proposal for a '*Soil Framework Directive*'[24] to promote the sustainable use of soil and protect soil as a natural resource. However, to date, an EU Soil Framework Directive has not been implemented.

5.6.2 Although there remains no specific legislation for the protection of soil and agricultural land, Defra issued the '*Soil Strategy for England – Safeguarding our Soils*'[25] in 2009. The Strategy sets out Defra's vision that by 2030 all England's soils will be managed sustainably and degradation threats tackled successfully in order to improve the quality of England's soils and safeguard their ability to provide essential services for future generations.

5.6.3 The Strategy sets out priorities for action in respect of:

- Better protection of agricultural soils;
- Protecting and enhancing stores of soil carbon;
- Building the resilience of soils to a changing climate;
- Preventing soil pollution;
- Effective soil protection during construction and development; and
- Dealing with the legacy of contaminated land.

Planning Policy

5.6.4 Policy advises that, when determining planning applications, the presence of the best and most versatile agricultural land should be taken into account alongside other sustainability considerations. Where significant development of agricultural land is unavoidable, poorer quality land in Grades 3b, 4 and 5

[23] European Commission (EC), 2006, *Soil Thematic Strategy* (COM (2006) 231), EC
[24] European Commission (EC), 2006, *Proposal for a Soil Framework Directive* (COM (2006) 232), EC
[25] Department for Environment, Food and Rural Affairs (Defra), 2009, *Safeguarding our Soils: A Strategy for England*, Defra

should be used in preference to higher quality land, except where this would be inconsistent with other sustainability considerations.

5.6.5 Lesser weight in agricultural terms should be given to the loss of agricultural land in Grades 3b, 4 and 5, except in areas such as uplands where particular agricultural practices contribute in some special way to the environment or economy.

5.6.6 There is no guidance in Policy with regard to the effects of development on farm holdings, although Natural England's Technical Information Note (TIN) 049[26] indicates that land quality is not the sole consideration in how development proposals affect agriculture in the planning system, with other factors, such as the impact on farm size and structure, the use of buildings and other fixed equipment, or any stimulus a development might give to rural economic activity, also being relevant.

Guidance

5.6.7 Guidance on classifying agricultural land is contained in 'Agricultural Land Classification of England and Wales, Revised guidelines and criteria for grading the quality of agricultural land', prepared by MAFF in 1988 and summarised in Natural England's TIN 049.

5.6.8 Best practice guidance on soil handling and management during the construction phase, to minimise potential adverse impacts on the soil resource, is found in MAFF's '*Good Practice Guide for Handling Soils*'[27] and Defra's '*Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*'[28].

Significance criteria

5.6.9 In order to assess the effects of the project on agricultural resources, significance criteria will need to be adopted relating to the effects on agricultural land and soils, on farming and other farm-based enterprises, and on agri-environment schemes.

5.6.10 The significance level attributed to each effect will be assessed based on the magnitude of change due to the project, the sensitivity of the affected receptor/receiving environment to change, and the relative scarcity or abundance of the resource/receptor in the locality.

5.6.11 The significance criteria will be based on interpretation of National policy advice and best practice guidance, and will be developed in consultation with Defra and Natural England.

[26] Natural England, 2009, *Technical Information Note (TIN) 049, Agricultural Land Classification: protecting the best and most versatile agricultural land*, Natural England
[27] MAFF, 2000, *Good Practice Guide for Handling Soils*, MAFF
[28] Defra, 2009, *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites,* Defra

5.6.12 The ALC survey will provide a statement of the actual amount and quality of agricultural land within the land to be acquired or used for the construction and operation of the Proposed Scheme. The magnitude of change will be reflected in the land required permanently and temporarily for the project and the sensitivity of the agricultural land resource will be reflected in its grading. The sustainable reuse of displaced soil resources will also be considered and is discussed further in Section 16 of this report.

5.6.13 It is common practice for EIA significance criteria to set an absolute threshold for the loss of a certain area of best and most versatile land (typically 20 or 50 hectare (ha)). However, such an approach will be inappropriate for a project of this scale; instead the significance of loss of best and most versatile land will be related to the abundance of such land in the locality. The methodology will set out a reasoned definition of "locality" that reflects the geographical scale at which effects will be reported.

5.6.14 The assessment will set out the predicted physical impacts on individual farm holdings, including the land lost by each holding during the construction phase, the area of land severed, the area to be restored to agriculture and the resulting residual permanent land loss to each holding. The effects identified will be assessed in accordance with the established significance criteria, which will be expressed primarily in physical terms and will reflect the degree of operational change required following construction of the project.

5.6.15 The potential longer-term implications for food production and security arising from the loss of agricultural land will also be assessed.

Construction effects

5.6.16 Construction effects on agricultural land and farm and farm-based enterprises may include temporary land-take and the use of the soil resource displaced by the construction of the Proposed Scheme.

5.6.17 Other construction effects may include the deposition of dust on sensitive crops, land uses or buildings; disruption to drainage, irrigation and water supply systems; and unintentional pollution of soil and water courses or bodies (used for crop irrigation or livestock drinking water supplies).

Operational effects

5.6.18 Operational effects on agricultural land and farm and farm-based enterprises will include permanent land-take, the loss and severance of land to farm and farm-based businesses, and the loss of agricultural capital.

5.6.19 Other potential operational effects may include noise on farm and farm-based enterprises, such as on housed livestock and on farm-based tourist or visitor attractions.

Cumulative effects

5.6.20 The construction of the Proposed Scheme will generate economic stimulus for development within its corridor. This, combined with developments that are already taking place or anticipated within the route of the Proposed Scheme, may result in increased pressure on agricultural land and farm businesses. Cumulative effects will be assessed in relation to other nationally significant projects that have received consent at the time of the assessment.

5.7 Assumptions

5.7.1 The assessment within this topic area considers soils as a medium for food and fibre production, and excludes an assessment of soil quality from the perspective of land contamination, which is detailed in Section 11 of this report. Soil also fulfils a number of functions, such as environmental interaction with air and water; support for ecological habitats and biodiversity; support for the landscape; and protection of cultural heritage. These aspects will be assessed under the relevant topics.

5.7.2 This assessment also considers the effects on all farms (including horticulture), equestrian units, farm woodland and forestry enterprises, farm-based recreational and tourist uses and farm diversification projects that are either ancillary to the main agricultural use or within the control of the farm business. Other rural enterprises are assessed in Section 7 of this report.

6 Climate

6.1 Introduction

6.1.1 This section of the report addresses the effects of the Proposed Scheme on climate and climatic factors. It will set them in the context of the United Kingdom (UK) Climate Change Act[29] (2008); Carbon 2050[30] as well as the UK Climate Change Risk Assessment[31]. The assessment will determine the net greenhouse gas emissions (GHG) associated with the Proposed Scheme, i.e. any increases associated with the scheme less any reductions.

6.1.2 The Greenhouse Gas project protocol[32] will be used to help structure the assessment approach. This is an internationally accepted protocol based on project level emissions. It ensures that both direct and indirect emissions are measured and assessed.

6.1.3 Climate change adaptation will not be addressed in this chapter but instead will be incorporated into the definition of future baselines for key topic areas within the Environmental Impact Assessment (EIA). Significant effects will then be reported accordingly.

6.1.4 Assessments will be carried out for the following time periods:

- 2017 – start of construction;
- 2026 - Proposed Scheme opening;
- 2041 - 15 years after opening; and
- 2050 - in line with Government policy and national carbon reduction targets.

[29] HM Government, 2008, *Climate Change Act 2008*, The Stationery Office
[30] European Commission (EC), 2011, *Communication from the Commission to the European Parliament, the Council, The Economic and Social Committee and the Committee of the Regions, A Roadmap for Moving to a Competitive Low Carbon Economy in 2050*, EC
[31] Defra, 2012, *The UK Climate Change Risk Assessment 2012 Evidence Report*, Defra
[32] World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI), 2003, *The Greenhouse Protocol for Project Accounting,* WBCSD and WRI

6.2 Establishment of baseline and definition of survey requirements

6.2.1 A description of the baseline environment for the Proposed Scheme for consultation in 2011 is contained within the Appraisal of Sustainability (AoS) Main Report, Volume 1 (February 2011). Volume 1, Sections 8.2 and 8.3 of the AoS describes the baseline environment in relation to climatic factors and adaptability and GHGs and further details are provided in Appendix 2 of the AoS. This baseline covers current emissions in the UK and from UK transport sector and sub sectors. It also reviewed pertinent policies.

6.2.2 Scenarios of future baselines will build on the work of the AoS baseline scenarios for future power grid emission factors and the decarbonisation and modal split of travel (particularly rail, road and air travel). Reference to work by the Committee on Climate Change (CCC), the Department of Energy and Climate Change (DECC) and Department for Transport (DfT) will be made in determining these baselines. Baselines will cover:

- Construction;
- Proposed scheme opening; and
- Future travel patterns in terms of modal split and level of decarbonisation by mode and future grid fuel mix at Proposed Scheme opening, 15 years after opening and at 2050.

6.3 Consultation

Consultation on the AoS

6.3.1 Of the four principles of Sustainable Development outlined in the AoS, the highest number of comments related to reducing greenhouse gas emissions and combating climate change. Specifically, responses tended to focus on the following recurring themes:

- Energy consumption and power demand modelling;
- Carbon Intensity of fuel and decarbonisation of electricity;
- Modal shift;
- Comparative energy performance of high speed rail, aviation and road transport;
- Passenger demand modelling; and
- Construction emissions and embodied carbon.

6.3.2 Engagement undertaken as part of the EIA will seek to incorporate and investigate these themes.

Consultation as part of the EIA process

6.3.3 Key stakeholder groups are to be included during the engagement and consultation process. The consultees will be identified according to the

geographic scope and nature of the issues. The key stakeholder groups will include:

- Central Government Departments and Agencies;
- Local Government and Agencies;
- Non-Governmental Organisations;
- Road industry stakeholders;
- Aviation industry stakeholders; and
- Rail industry stakeholders.

6.4 Key aspects of the scheme for the topic

6.4.1 Key aspects of the Proposed Scheme for this topic include:

- Construction;
- Operation;
- Rolling stock;
- Energy Supply; and
- Modal shift.

6.4.2 Each of these aspects is examined below:

- Construction - Covers the embodied carbon of construction materials used in structures such as tunnels, bridges, stations, viaducts, rail lines and supporting infrastructure as well as GHGs released/captured due to land use clearance and planting. This will include the logistical impact of delivering materials to site and removal of waste. Depending on data availability fuel used by plant equipment during construction (such as Tunnel Boring Machines).
- Operation - This aspect looks at energy consumption of station/interchanges/immediately associated development and depots covering, for example, lighting, heating cooling, escalators, signalling, ventilation and lifts.
- Rolling stock - Energy use, and consequential GHG emissions, from the running of the trains will depend on, but not be limited to the following factors: train weight, acceleration, traction efficiency, breaking performance, regenerative breaking, train resistance, tunnel resistance factors and speed.
- Energy supply - The construction and operation assessment will take account of grid decarbonisation projections and will be based on evidence from sources such as the UK's Low Carbon Transition Plan[33], the Committee on Climate Change[34] [35], and DECC.

[33] Department of Energy and Climate Change (DECC), 2009, *The UK Low Carbon Transition Plan: national strategy for climate and energy*, DECC http://www.decc.gov.uk/en/content/cms/tackling/carbon_plan/lctp/lctp.aspx

[34] Committee on Climate Change (CCC), 2008, *Building a low-carbon economy – the UK's response to tackling climate change*, CCC

[35] Committee on Climate Change (CCC), 2009, *Meeting Carbon Budgets – the need for a step change*, CCC

- Modal shift - One of the main objectives of the Proposed Scheme is to encourage modal shift, primarily from road and air onto rail. This assessment will consider road, rail and air efficiency improvements likely to have occurred by the time the Proposed Scheme is in operation, as well as the likely impact on road, conventional rail and domestic air travel emissions.

6.5 Scope of assessment

GHG mitigation assessment

6.5.1 The assessment will cover both direct and indirect emissions associated with the key aspects listed above. Direct emissions are defined as emissions that occur on-site, such as emissions from a diesel generator during the construction of the railway. Indirect emissions are emissions that occur further up the supply chain or off-site, such as the manufacturing of rail sleepers.

6.5.2 The proposed approach for the GHG assessment is summarised in Table 2. For the purpose of this assessment the following aspects have been scoped out:

- Design stage – existing literature[36] shows that less than 1% of total emissions from high speed rail projects come from the design stage (paper and office energy consumption);
- Decommissioning – not considered to be appropriate for this project; and
- Commuting of construction workers – this information is unlikely to be available at this stage of the assessment.

Table 2 – Scope of GHG assessment

	Construction			**Operation & Maintenance**
	Materials embodied emissions	Logistics emissions	Construction site emissions	
Earthworks	✓	✓	✓	×
Rail tracks	✓	✓	✓	✓
Bridges	✓	✓	✓	✓
Tunnels	✓	✓	✓	✓
Viaducts	✓	✓	✓	✓
Stations/interchanges	✓	✓	✓	✓
Tunnel boring machines	✓	×	✓	n/a
Supporting Infrastructure (e.g. OHL and Signalling)	✓	✓	✓	n/a

[36] Systra, 2011, *Carbon Footprint of High Speed Rail*, a report of the International Union of Railways, Systra

Rolling stock	✓	✗	n/a	✓
Modal shift	n/a	n/a	n/a	✓

6.6 Assessment methodology

6.6.1 There is currently no officially recognised defined methodology for assessing the significance of GHG impact of a large infrastructure project in EIA. However, existing protocols and guidance, such as the GHG Protocol for Project Accounting or ISO14064[37], provide principles and requirements which are directly relevant to the Proposed Scheme. IEMA guidelines on climate change and EIA will also be referred to in determining levels of significance, as will The UK National Climate Change Risk assessment conducted by Defra.

6.6.2 The GHG assessment will use the guiding principles of existing protocols and specifications. This will be supported by a combination of carbon modelling tools, lifecycle software and publically available information including the University of Bath's Inventory of Carbon and Energy on construction materials.

6.6.3 The approach used will be to:

- Define emission sources;
- Gather information and appropriate GHG coefficients; and
- Calculate GHG emissions.

6.6.4 Construction related emissions will be based on construction strategies defined during the EIA stage which will provide information on construction materials and procurement, logistics and details of construction activities including plant and equipment to be used.

6.6.5 Operational and modal shift related emissions will be based on HS2's Demand Model outputs.

6.7 Assumptions

6.7.1 Predictions of future GHG emissions from the Proposed Scheme and for the baseline will need to make assumptions inter alia about the future carbon footprints of power generation and vehicle efficiencies. It will be appropriate for the assessment therefore to assess a range of predictions and these will be set out in the Environmental Statement.

[37] British Standard, 2006, *ISO14064 – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancement,* ISO

7 Community

7.1 Introduction

7.1.1 This section of the report sets out the scope and methodology to be adopted for the assessment of community effects.

7.1.2 Community effects are defined as those upon people and are considered against the four principal themes of residential property, community facilities, amenity and severance.

Residential property

7.1.3 This will include effects associated with loss of residential property; temporary re-housing of residents during construction of the Proposed Scheme; permanent and temporary residential land-take; and ground settlement on residential property.

7.1.4 Impacts on commercial and industrial property will be addressed as part of the Socio-Economic assessment. Impacts on farms and farm-based enterprises will be addressed as part of the Agriculture and Soils assessment.

Community facilities

7.1.5 This will include impacts on community facilities and infrastructure such as education, health, emergency services, places of worship, sports and recreational facilities and open spaces.

7.1.6 The assessment will consider both the permanent and temporary loss of facilities due to demolition or land-take and during construction. It will also consider the social (i.e. non-economic) effects of catalytic impacts and development around stations.

Amenity

7.1.7 This will include the community effect of impacts on aspects of amenity such as noise and visual intrusion, drawing from the conclusions of other assessment topics. It will cover construction of the Proposed Scheme, operation, and catalytic impacts and development around stations/interchanges, on near-by communities and community facilities.

Severance

7.1.8 Severance is defined as physical, psychological and social barriers resulting from the introduction of the Proposed Scheme and existing physical barriers. The community assessment will consider the physical, psychological and social (i.e. non-economic) impacts and effects on local communities. Severance of commercial and industrial buildings and land, and agricultural property and land, are addressed within the scope of assessments presented Section 14 and Section 5.

7.1.9 The community assessment recognises the inter-relationship of community and economic effects. As well as covering direct community effects it takes into account how economic and development impacts and effects identified by the Socio-economic Assessment will indirectly affect communities (the Socio-economic Assessment is focused on economic rather than social impacts and effects).

7.1.10 As well as the Environmental Impact Assessment (EIA) an Equalities Impact Assessment (EqIA) and a Health Impact Assessment (HIA), although not part of the EIA itself, are being prepared and will be submitted as separate reports at the hybrid bill stage. The EqIA will consider how impacts may differentially affect priority equality groups, with respect to the protected characteristics as defined in the Equality Act 2010. The HIA will examine the potential beneficial and adverse consequences upon public health, recognising that social and economic conditions and environmental factors have a bearing on the health of the population. The community impact assessment will take account of the findings of the HIA and EqIA and place them in the context of the overall community impact assessment.

7.2 Establishment of baseline and definition of survey

Characteristics of communities

7.2.1 The need to minimise adverse community effects has influenced the development of the Proposed Scheme, for example by realignment of the route to avoid the majority of communities between London and the West Midlands, further extension of tunnels, and the provision of green tunnels.

7.2.2 The route alignment nevertheless passes through - and potentially affects - a diverse range of communities and people. The main centres of population comprise the Greater London and Greater Birmingham areas, but the route will pass close to a variety of settlements, including villages, hamlets and isolated farmsteads in the countryside. Some of these are more dispersed rural/agricultural communities and potentially face issues such as ageing populations and social exclusion.

7.2.3 The key community characteristics of relevance include:

- Their physical layout and scale (e.g. in relation to land take, demolitions and severance);
- The location, type and importance of community facilities;
- Their social vulnerability (i.e. whether they contain or serve a high proportion of vulnerable individuals); and
- Their economic resilience (e.g. their degree of dependence on local employment or on access to employment elsewhere).

Baseline data and methods

7.2.4 The baseline will include collecting information on both resources and receptors.

7.2.5 Potential resources include:

- Community infrastructure, including education, health, emergency services, community halls and places of worship;
- Recreation infrastructure, including entertainment facilities, sports facilities, and other leisure activities;
- Open space;
- Residential properties (in terms of their occupation and amenity);
- Public rights of way (and other access routes of local importance); and
- Local communities as a whole.

7.2.6 Receptors include:

- Individuals using community resources;
- Residents;
- Local workers;
- Community groups; and
- Owners and organisations with interests in the community resources.

7.2.7 Information on resources and receptors will draw on a variety of sources that could include:

- Data collected during the Appraisal of Sustainability (AoS) supplemented and updated as appropriate;
- Relevant national datasets such as: Index of Multiple Deprivation (IMD) Access Domain; Ofsted reports and data; Census data; ONS Neighbourhood Statistics; Sports England's participation dataset; Land Registry information; Valuation Office Agency (VOA) information; and Yellow Pages and/or similar data sets on local facilities;
- Existing local studies and information such as: open space surveys; land-use surveys; housing needs surveys; user surveys; membership lists; registered users etc;
- Analysis and data from other relevant EIA topics such as: Sound and Vibration; Air Quality; Socio-Economics; Agriculture and Soil; and Traffic and Transport; and
- New studies and/or field surveys where appropriate.

7.3 Consultation

Consultation on the AoS

7.3.1 Key issues arising from the public consultation on the AoS related to: equity in terms of both the distribution of costs and benefits of HS2 and affordability of fares; concerns about amenity impacts and whether

environmental aspects were adequately valued; and impacts on property values and broader community impacts[38].

Consultation as part of the EIA process

7.3.2 In conjunction with the wider consultation process, including Community Forums, further engagement with relevant organisations and communities will be carried out as part of the assessment.

7.3.3 Stakeholders will be offered the opportunity to respond as part of a coordinated EIA approach and relevant organisations include:

- National government departments and statutory organisations;
- Local and regional government including the Greater London Authority, Birmingham City Council, Local Enterprise Partnerships (LEPs) and local authorities on the line of route;
- Other relevant local non-governmental organisations including for example tourism boards; and
- Relevant Voluntary and Community Sector (VCS) organisations and other special interest groups.

7.3.4 Engagement will be appropriate to each organisation. The HIA and EqIA consultation processes will require consultation with some of the above stakeholders and synergies with the Community assessment will be covered.

7.4 Key aspects of the scheme for the topic

7.4.1 The assessment of community effects will consider impacts during both construction and operation of the Proposed Scheme. This will include:

- Loss of and or/permanent land take from residential properties and community facilities;
- Permanent severance and/or diversion of public rights of way and other pedestrian routes that affect access to community facilities;
- Temporary displacement of residents;
- Temporary land take from residential properties and community facilities.
- Temporary closure of, or disruption to, the use of community facilities;
- Effects on communities served by the existing rail services as a consequence of changes to service, including frequency of service and modal shift; and
- Community implications of construction employment (e.g. relating to accommodation and welfare).

[38] Department for Transport (DfT), 2011, *High speed rail: Investing in Britain's future consultation summary report: A report to Government*, DfT

7.5 Scope of assessment

7.5.1 The scope for the community assessment draws on the AoS, experience and good practice from similar infrastructure projects elsewhere and professional judgment.

Spatial and technical scope

7.5.2 The proposed spatial scope for each of the four Community themes and relevant resources and receptors is summarised in Table 3. This scope will be refined as assessment proceeds, e.g. to ensure consistency with other environmental topics.

Table 3 - Resources, receptors and spatial scope

Resources	Receptors	Spatial scope
Residential Property		
Residential property.	Home owners/tenants.	Any properties needed as part of the direct impacts on land.
Community Facilities		
Community Infrastructure, including education, health, emergency services, community halls and places of worship.	Users, workers, and owners and organisations with interests in the facilities.	Any facilities needed as part of the direct impacts on land.
Recreation infrastructure including: entertainment facilities, sports facilities, and other leisure activities.	Users, workers, and owners and organisations with interests in the facilities.	Any facilities needed as part of the direct impacts on land.
Amenity		
Community Infrastructure, including education, health, emergency services, community halls and places of worship.	Users, workers, and owners and organisations with interests in the facilities.	To be determined based on relevant communities, settlements and infrastructure and their geographic boundaries.
Recreation infrastructure including: entertainment facilities; sports facilities; and other leisure activities.	Users, workers, and owners and organisations with interests in the facilities.	To be determined based on relevant communities, settlements and infrastructure and their geographic boundaries.

Resources	Receptors	Spatial scope
Open space provision.	Users, workers, and owners and organisations with interests in the facilities.	To be determined based on relevant communities, settlements and infrastructure and their geographic boundaries.
Play space provision.	Users, workers, and owners and organisations with interests in the facilities.	To be determined based on relevant communities, settlements and infrastructure and their geographic boundaries.
Severance		
Homes, businesses and Community Infrastructure.	Residents, users, workers, and owners and organisations with interests in the facilities.	To be determined based on relevant communities, settlements and infrastructure and their geographic boundaries.

Temporal scope

7.5.3 The temporal scope for this topic is outlined in section 2 of the report. Community effects will be assessed for the construction period (including a period of commissioning) (2017 – 2026) and for the year of opening in 2026. However, the assessment will also need to reflect the temporal scope of other topic assessments such as Socio-Economics and Traffic and Transport.

7.6 Assessment methodology

7.6.1 There are no industry-wide accepted methods for assessing community effects for projects of this nature. Methods have been developed for predicting and assessing effects which draw on guidance and analysis prepared for other project types such as the Design Manual for Roads and Bridges (DMRB), methods established for other railway and large infrastructure EIAs and professional judgment.

Legislation and guidance

7.6.2 Relevant guidance includes:

- Relevant Highways Agency Interim Advice Notes and other relevant guidance such as DfT's WebTAG;
- Good practice from other EIAs, for example including in relation to Crossrail and Thames Tunnel; and
- Relevant HIA and EqIA guidance.

Significance criteria

7.6.3 The significance of a community effect will be determined by assessing both the:

- Magnitude of the impact; and
- The sensitivity of community resources or receptors.

7.6.4 Each of these is examined in turn below.

Determining magnitude of impacts

7.6.5 To determine magnitude of impact, the nature of the impact (positive or negative) and characteristics (i.e. whether direct or indirect, secondary, cumulative, short or long-term, permanent or temporary, reversible or irreversible) will be assessed and classified as high, medium, low or negligible.

7.6.6 The magnitude of an impact is its severity or scale. The magnitude of an impact on a resource or receptor reflects consideration of information and analysis relating to the spatial extent (localised/isolated versus widespread with potential secondary effects); the extent (number of groups and/or people or households affected); and the duration (short, medium and long-term).

7.6.7 Guideline criteria have been established based on professional judgment and are presented in Table 4 below.

Table 4 – Community impact magnitude criteria

Impact magnitude	Definition
High	An impact that will be very severe/beneficial, and/or very likely to affect large numbers of groups and/or people (with number depending on the local context), and that will usually continue and effectively constitute a permanent, long-term impact on the baseline conditions.
Medium	An impact that is likely to affect a moderate number of groups and/or people (with number depending on the local context).
Low	An impact that is likely or may affect a small number of people (with number depending on the local context) and/or that usually does not extend beyond the life of the project so that the base case is not affected beyond a short or medium-term duration.
Negligible	An impact that is temporary in nature and/or is unlikely to measurably affect the well-being of people or a lower value resource so that the existing base case remains constant.

Determining receptor sensitivity

7.6.8 Sensitivity of resources will be defined by their importance, scarcity and size. Sensitivity of receptors will be determined by the extent to which individuals have the capacity to experience the effect without a significant loss or gain. Sensitivity will be classified as high, medium or low.

7.6.9 Guideline criteria have been established using professional judgment to determine the sensitivity of the receptors. These are presented in Table 5 below.

Table 5 – Community receptor value/sensitivity criteria

Receptor value and/or sensitivity	Definition
High	Individuals or groups who are at risk and that have little or no capacity to experience the impact without incurring a significant effect.
Medium	Individuals or groups that have a limited or average capacity to experience the impact without incurring a significant effect.
Low	Individuals or groups that generally have adequate capacity to experience impacts without incurring a significant effect.

7.6.10 The HIA and EqIA will help define the sensitivity of specific groups and this work will be incorporated in to the overall Community assessment.

Determining the significance of effects

7.6.11 The significance of a community effect is a product of the magnitude of the impact and the sensitivity of the receptor and will be determined based on professional judgement.

7.6.12 The approach to determining the significance of community effects is summarised in Table 6.

Table 6 – Community - significance of effect criteria

Significance		Impact magnitude			
		High impact	Medium impact	Low impact	Negligible impact
Sensitivity of receptor	High	Major adverse /beneficial – significant	Major adverse /beneficial – significant	Moderate adverse /beneficial –significant	Minor adverse /beneficial– not significant
	Medium	Major adverse	Moderate	Minor	Negligible

Significance		Impact magnitude			
		High impact	**Medium impact**	**Low impact**	**Negligible impact**
		/beneficial – significant	adverse /beneficial– significant	adverse /beneficial – not significant	– not significant
	Low	Moderate adverse/ beneficial - significant	Minor adverse/ beneficial – not significant	Negligible – not significant	Negligible – not significant

7.6.13 Effects are generally considered to be significant if both impact magnitude and receptor sensitivity is high or medium. Additionally, effects are generally considered to be significant if impact magnitude is high and receptor sensitivity is low, or alternatively if receptor sensitivity is high and impact magnitude is low. This equates to major and moderate adverse/beneficial effects.

7.6.14 Other effects, equating to minor adverse/beneficial and negligible effects, are generally not considered to be significant.

Construction effects

7.6.15 Construction effects will be assessed following the general EIA assessment process including:

- Establishment of the baseline with definition and collection of relevant data and information as outlined in section 7.2 above;
- Consultations including those outlined in section 7.3 above;
- Assessment of impacts and effects against key aspects of the scheme as outlined in section 7.4 above, covering the scope outlined in section 7.5 above and using the significance criteria outlined above;
- Consideration and integration of EqIA and HIA assessments where relevant; and
- Iterative further assessment of impacts identified through other EIA work, for example in relation to development covered in the Socio-economic Assessment.

Operational effects

7.6.16 The same process will be used for assessment of operational effects as outlined for construction effects above.

Cumulative effects

7.6.17 As outlined in section 2 of this report, the EIA will consider the interaction between HS2 and other consented or completed development which may give rise to significant cumulative effects.

7.6.18 In addition, community effects may result from the combination of impacts from other topics. Such impacts may occur both simultaneously (e.g. noise and severance during construction) and sequentially (e.g. where construction effects are followed by operational effects).

7.6.19 The key requirement is to identify whether combined effects on particular locations, resources or receptors (in this case, the local community) may give rise to any new or more significant effects. There is no established method for comparing impacts from a range of topics, so a judgment will be required, based on an overall understanding of the sensitivity of the community resource or receptor, the way in which it is likely to respond to the predicted change and the effectiveness of proposed mitigation.

7.7 Assumptions

7.7.1 For assessment purposes it will be necessary to assume that the baseline characteristics established during the EIA process will remain largely unchanged. However where it is possible to predict change, or to identify planned community facilities, these will be incorporated into the future baseline.

7.7.2 The assessment will take into account how uncertainty and variability of impacts could generate different effects. For example, variability in service frequency could have varying impacts on sound, vibration and air quality, which in turn could have different effects on community enjoyment of amenity.

8 Cultural heritage

8.1 Introduction

8.1.1 This section of the report describes the methodology to be used in the assessment of the likely significant effects upon heritage assets to be affected by the Proposed Scheme.

8.2 Definitions

8.2.1 Heritage assets are defined by Government in (National Planning Policy Framework (NPPF) Annex 2 Glossary[39]) as 'A building, monument, site, place, area or landscape identified as having a degree of significance meriting consideration in planning decisions. Heritage assets include designated heritage assets identified by the local planning authority (including local listing). Heritage assets include those that are designated under legislation (refer to NPPF Annex 2 Glossary Designated heritage assets) as well as that are undesignated assets. Undesignated assets are heritage assets formally identified by Local Authorities and recognised through their inclusion within the local Historic Environment Record - HER.

8.2.2 Cultural Heritage is generally and most easily divided into three key areas comprising:

- Archaeological and palaeo-environmental remains
- Historic landscapes; and
- Historic buildings.

8.3 Effects

8.3.1 Effects to be assessed are direct and indirect, temporary, permanent and cumulative. Each of these is examined below in the context of the Cultural Heritage assessment.

8.3.2 A direct effect is one that will occur to the physical fabric or land of an asset and its curtilage, and will include any effect upon the setting of that asset arising directly from the Proposed Scheme.

8.3.3 An indirect effect is one that might arise as a consequence of the operation or construction of the railway by, for example, affecting viability of land leading to dereliction of buildings and land leading to changes in the management or land use of archaeological or historic landscape features.

[39] Department for Communities and Local Government (DCLG), 2012, *National Planning Policy Framework*, The Stationery Office

8.3.4 A permanent effect will occur for example as a result of the construction and operation of the railway including the permanent works for the railway, some temporary activities and mitigation areas. A permanent effect is not reversible and will involve the all time loss of a cultural heritage asset.

8.3.5 A temporary effect will occur for example as a result of soil storage, contractor's site compounds and access routes and erection of other facilities and structures associated with the construction of the railway. These developments are to be removed following construction and prior to the operation of the railway and their effect on, for example, the setting from a range of sources is therefore reversible. These effects may also be permanent as identified in section 8.3.4 above.

8.3.6 A cumulative effect is one arising from the incremental effects of multiple developments on heritage assets.

8.4 Establishment of baseline and definition of survey

8.4.1 The baseline to be assessed is that which is current as at the time of the publication of the Environmental Statement (ES).

8.4.2 The Proposed Scheme passes through both urban and rural environments of varied historical characteristics that help to inform the data gathering process. In the process of data gathering it is recognised that there are interfaces with other disciplines for example ecology, sound and vibration, landscape and townscape. These interfaces will be actively addressed as part of the EIA process to ensure that an integrated assessment is undertaken.

8.4.3 Data in respect of heritage assets will be collected for the following designated and undesignated assets:

Designated assets:

- World Heritage Sites;
- Designated historic buildings (Listed Buildings, Grade I, II* and Grade II);
- Scheduled Monuments, including archaeological assets of schedulable quality;
- Registered Parks and Gardens, including London Squares;
- Designated Conservation Areas;
- Registered Historic Battlefields;
- Registered Commons; and
- Ancient Woodlands.

Undesignated assets:

- Undesignated historic buildings, structures and built monuments including:
    - Locally listed buildings, buildings of local merit; and
    - Buildings, structures and monuments included in the HER.

- Undesignated archaeological or historic landscape sites including:
    - Sites listed in the HER and the English Heritage National Monuments Record;
    - Archaeological assets of schedulable quality and as identified in PPS5 paragraph 9.6;
    - Sites or areas predicted or known from desk based or fieldwork study;
    - Palaeo-environmental remains etc.;
    - Known historic settlements including those identified as being of archaeological interest in local planning authority documents;
    - Hedges protected under Hedgerow Regulations (*The Hedgerow Regulations*, 1997[40]), and;
    - Non-designated parks, gardens and battlefields.

8.4.4 Baseline data sources will include:

- Details of designated sites held by English Heritage;
- Local Authority mapping and appraisal documents (where available) of conservation areas;
- Records of Ancient Woodland maintained by Natural England, Defra and the Forestry Commission;
- Historic landscape character mapping;
- HER data, for an area of 5km either side of the route, held by local authorities and English Heritage, including the National Buildings Record (NBR) and National Monuments Record (NMR);
- Archaeological assets of schedulable quality and as identified in NPPF paragraph 130.
- Aerial photographs;
- Geological mapping as held by British Geological Survey;
- Site visit and walkover survey from public land, or from private land where access has been previously arranged and approved;
- Zone of theoretical visibility (ZTV) as identified by the Townscape and Visual Assessment;
- Documentary, cartographic and other resources as deposited within local studies libraries, County and National Records Library;
- Readily available published material, building surveys and gazetteers;
- Data from preliminary works such as boreholes or test pits already collected or collected/created during the lifetime of the assessment scheme;
- Implementation of a programme of geophysical survey, the scope of which is to agreed, subject to land access and the restrictions of other disciplines;
- Light detection and ranging (Lidar) and other remote sensing surveys as appropriate and agreed; and
- Archaeological trial trenching and other intrusive techniques as appropriate and agreed.

[40] HM Government, 1997 No. 1160, *The Hedgerows Regulations 1997*, The Stationery Office

8.4.5 Any requirement for, and the scope of intrusive survey, is to be developed and agreed in consultation with HS2 Ltd and English Heritage. In determining the need and scope for such survey a risk based approach will be adopted by all parties.

8.5 Definition of survey

8.5.1 The definition of the survey and study area for cultural heritage between London and the West Midlands and extending into Birmingham will depend upon a series of particular conditions. The particular survey and baseline data requirements for the metropolitan and country areas are identified below. Section 8.8 of this report provides further specific information on baseline requirements for the route wide scope. In developing the baseline and consideration of effects consideration of the historic landscape, as opposed to point specific assets, will be the primary concern.

London and West Midlands Metropolitan areas

8.5.2 The London Metropolitan section of the Proposed Scheme includes the London Euston and Old Oak Common stations. It passes through predominantly urban areas and lies within the Greater London Authority area. Substantial parts of this route will be in tunnel and ground settlement is therefore an issue to be considered. Developments around Euston station and other sections of the route where excavation or development is required may result in demolitions and ground disturbance and may impact upon cultural heritage assets.

8.5.3 The West Midlands section of the Proposed Scheme passes through the suburban and urban areas of Solihull and Birmingham and includes the Washwood Heath maintenance depot, station interchange at Birmingham International and a new station at Curzon Street, Birmingham. These developments may result in demolitions and ground disturbance and may impact upon cultural heritage assets.

8.5.4 To identify those heritage assets that may be affected, a study area of 250 metres (m) from the edge of the land take for the Proposed Scheme or as defined by the zone of theoretical visibility (ZTV) as identified by the Townscape and Visual Assessment will be established.

8.5.5 Field visits will be carried out to designated heritage assets and archaeological sites of schedulable quality (where access is permitted) within the study area. A survey (consisting of a field inspection to identify heritage assets) of the study area to examine its broad historic urban landscape will also be carried out. A more targeted walkover survey of 100m from the land take for the Proposed Scheme will be carried out where practicable in order to verify the baseline research, asses the nature and condition of known heritage assets and identify hitherto unidentified features which may be affected by the Proposed Scheme.

Country south and country north

8.5.6 The Country south section of the Proposed Scheme passes through the Chilterns. Much of the Proposed Scheme will be in either tunnel or cutting but elements are also elevated on viaduct or embankment.

8.5.7 The Country north section of the Proposed Scheme passes through the rural and suburban areas of Warwickshire and Staffordshire and will be partly in cutting and on viaduct but with substantial sections at grade.

8.5.8 To identify those heritage assets that may be affected by the Proposed Scheme a study area of 500m from the edge of the land take for the Proposed Scheme or as defined by the zone of theoretical visibility (ZTV) as identified by the Townscape and Visual Assessment will be established.

8.5.9 Field visits will be carried out to designated heritage assets and archaeological assets of schedulable quality (where access is possible) within the study area. A survey of the study area to examine its broad historic landscape will also be carried out. A more targeted walkover survey of 250m from the land take for the Proposed Scheme will be carried out in order to verify the baseline research, asses the nature and condition of known heritage assets and identify hitherto unidentified features which may be affected by the Proposed Scheme.

8.6 Consultation

Consultation on the AoS

8.6.1 A large number of consultation responses were received in respect of the Appraisal of Sustainability (AoS). Responses included those from formal bodies including English Heritage, the National Trust, the Garden History Society and local planning authorities. Other responses were received from local amenity societies, specialist interest groups and other stakeholders.

8.6.2 The response from English Heritage in relation to heritage assets focused on matters affecting setting. English Heritage is of the opinion that a 350m study area either side of the line is inadequate to assess impacts on setting. As a consequence of this response it is proposed that the study area will be determined by the defined ZTV.

8.6.3 English Heritage was also concerned over the omission within the AoS of known archaeological assets. They were concerned that this omission did not therefore take into account those undesignated archaeological assets of schedulable quality.

8.6.4 English Heritage acknowledges the distinction in gradation between Grade I and Grade II* buildings and those listed at Grade II. It is their view that a 'regionally important' classification does not reflect the national designation of Grade II listed buildings. A geographical based terminology is not part of

government or English Heritage policy which, as embodied in NPPF, is based on the significance/value of assets. A significance based criteria (refer to NPPF Annexe 2 Glossary) is therefore proposed as set out in Table 8.1.

8.6.5 Responses from both the National Trust and Garden History Society are concerned particularly with impacts that might arise to Hartwell House and gardens. The methodology for assessment acknowledges the impacts that can arise to the setting or fabric of designated assets (including Registered Parks and Gardens) and acknowledges the high sensitivity given to those of Grade I or Grade II* such as at Hartwell. The methodology provides a robust framework for the assessment of impacts on this and other assets of this type.

8.6.6 In respect of the London Metropolitan area of the Proposed Scheme, London Borough of Camden has issued a consultation response in which they are opposed to the scheme for amongst other matters, the impact it will have on built heritage assets particularly around the Euston station development area. London Borough of Camden requested that proper consideration be given to the setting of heritage assets including conservation areas and that relocation of listed structures (monuments) be considered in mitigation. The scope and methodology of assessment allows these issues to be identified and addressed as part of the EIA.

Consultation as part of the EIA process

8.6.7 English Heritage, the National Trust and the Garden History Society are proposed consultees and engagement with these organisations and others such as the Society for the Protection of Ancient Buildings and the Historic Houses Association will continue throughout the EIA process.

8.6.8 Consultation with London Borough of Camden and other local planning authorities along the Proposed Scheme will continue throughout the EIA process to ensure that matters addressed are considered in an appropriate manner so that impacts can be determined and assessed.

8.6.9 Other key consultees for the topic will include the County Archaeologists/Curators or their equivalents for Hertfordshire, Buckinghamshire, Oxfordshire, Northamptonshire, Warwickshire and Staffordshire, the Birmingham City Archaeologist as well as local authority Conservation Officers.

8.6.10 It will be necessary to consult the relevant English Heritage Greater London Archaeological Advisors and the regional scientific advisors where this consultation does not occur as part of the wider English Heritage consultation. This will be undertaken to ensure comprehensive consultation with all relevant parts of English Heritage who have an interest in HS2.

8.7 Key aspects of the scheme in relation to heritage assets

8.7.1 Key aspects of the Proposed Scheme for this topic may include:

- Construction works which require the physical excavation, demolition, removal or alteration to heritage assets;
- Settlement of heritage assets induced by tunnelling, deep excavations or construction of retaining walls;
- Impacts upon the setting of heritage assets affecting significance, public appreciation or understanding of the resource;
- Loss of coherence of heritage assets, such as through severance;
- Temporary setting effects on designated assets;
- Ground disturbance caused through the implementation of ecological and other mitigation measures;
- Damage to waterlogged deposits through changes in groundwater regimes;
- Increased noise effects upon heritage assets affecting public appreciation or understanding of the resource;
- Vibration effects upon heritage assets during both construction and operation; and
- Protection of heritage assets during construction activities.

8.8 Scope of assessment

Spatial scope

8.8.1 All heritage assets, designated and undesignated within the defined study areas that may be affected by the proposals will be identified and assessed.

8.8.2 Within both the rural and metropolitan sections as defined, a study area will be set. This will allow identification and assessment of setting to be adequately considered. Within the maximum extent of the study only designated heritage assets of the highest significance as defined in PPS5 paragraph 9.1 will be identified and their setting assessed. Further assessment of Proposed Scheme impacts will be carried forward only for those heritage assets where the Proposed Scheme would impact upon the setting of the asset such that significance (archaeological, architectural, artistic or historic) would be affected.

Temporal scope

8.8.3 Within both the rural and metropolitan sections as defined, a study area will be set. This will allow identification and assessment of setting to be adequately considered. Within the maximum extent of the study only designated heritage assets of the highest significance as defined in NPPF paragraph 132 will be identified and their setting assessed. Further assessment of Proposed Scheme impacts will be carried forward only for those heritage assets where the Proposed Scheme would impact upon the

setting of the asset such that significance (archaeological, architectural, artistic or historic) is would be affected.

8.8.4 The assessment will consider both temporary and permanent impacts on heritage assets and their setting. The temporal scope of the assessment assumes a baseline with current conditions as of the date of publication of the ES with construction commencing in 2017 and the Proposed Scheme being operational by 2026.

Technical scope

8.8.5 Within the areas of targeted survey all designated heritage assets and archaeological assets of schedulable quality will be identified and their setting assessed. Further assessment of Proposed Scheme impacts will be carried forward only for those assets where the Proposed Scheme would impact upon the setting of the asset such that significance (archaeological, architectural, artistic or historic) would be affected.

8.8.6 Only those undesignated heritage assets that may experience physical impact will be identified and assessed. The settings of undesignated heritage assets will only be considered where the undesignated asset has a close and direct association or relationship with a designated asset whose setting is also being considered.

8.9 Assessment methodology

Legislation and guidance

8.9.1 There is no specific national guidance on the methodology for preparation of impact assessments for heritage assets. There are however a number of documents that address specific aspects of the relationship between development impact and heritage. *The Design Manual for Roads and Bridges (DMRB) Volume 11* published by the Highways Agency provides an approach for the assessment of impacts arising from highway schemes and Section 3, (HA 2008/007) covers Cultural Heritage including historic landscape (Annex 7).

8.9.2 In May 2010 the International Council on Monuments and Sites (ICOMOS) issued draft guidance on Heritage Impact Assessments for Cultural World Heritage Properties[41]. Though specifically addressing World Heritage Sites and development impact on their Outstanding Universal Value, the document provides an approach to assessment and the assessment or evaluation of impact.

[41] The International Council on Monuments and Sites (ICOMOS), 2010, *Guidance on Heritage Impact assessments for Cultural World Heritage Properties*, ICOMOS

8.9.3 In May 2011 English Heritage published its guidance '*Seeing History in the View*'(2011a)[42]. The guidance which deals specifically with assessing impact upon heritage views and multiple assets contains a useful approach of baseline analysis and assessment of impact with a series of tables to assist in the process. More recently in 2011 English Heritage published its guidance on the Assessment of Setting which sets out an approach to the analysis and assessment of setting and its relationship to the heritage significance of an asset (English Heritage, *The Setting of Heritage Assets*, 2011b[43]).

8.9.4 Policy in respect of heritage assets is set out in NPPF.

Approach

8.9.5 The methodology set out in each of these documents can be summarised as follows:

- Identify the baseline assets and their setting;
- Assess the significance/value of the baseline assets and their setting;
- Identify and define the magnitude of impact and the significance of the effects;
- Identify any mitigation and or scope for mitigation; and
- Assess the development impact and its effect on the significance of the asset taking into consideration any mitigation proposed.

Assessment of significance – value of baseline assets

8.9.6 The significance of a heritage asset is defined as 'The value of a heritage asset to this and future generations because of its heritage interest. That interest may be archaeological, architectural, artistic or historic'. (Annex 2 Glossary). Assets can be designated or un-designated. Designated assets are so designated in accordance with national or international criteria (conservation areas are a regional designation) and have statutory protection. In assessing the significance of an asset English Heritage has outlined a number of values which contribute to overall significance. These include evidential, historical, aesthetic and communal value (Conservation Principles – Policies and Guidance for the Sustainable Management of the Historic Environment (2008))[44]. Non-designated heritage assets may exhibit equivalent values to those which have been granted statutory protection.

[42] English Heritage, 2011a, *Seeing History In The View; A Method For Assessing Heritage Significance Within Views*, English Heritage

[43] English Heritage, 2011b, *The Setting Of Heritage Assets, English Heritage Guidance*, English Heritage

[44] English Heritage, 2008, *Conservation Principles – Policies and Guidance for the Sustainable Management of the Historic Environment*, English Heritage

8.9.7 Taking these criteria into account, each identified heritage asset is assigned a level of significance in accordance with a five-point scale as shown in

8.9.8 Table **7**.

8.9.9 Setting can also contribute to significance. Setting is not simply a visual consideration and specific guidance on the analysis of setting is set out by English Heritage (2011a).

Table 7 - Factors for assessing the significance/value of heritage assets

Significance (value)	Asset Categories
High	Remains of inscribed international importance, such as World Heritage Sites. Grade I and Grade II* Listed Buildings. Grade I and Grade II* Registered Parks and Gardens. Scheduled Monuments. Undesignated archaeological assets of schedulable quality and importance. Buildings or landscapes that can be shown to have exceptional or particularly important qualities in their fabric or historical association. Areas of Ancient Woodland (Ancient semi-natural woodland as mapped and designated by Natural England) Cemeteries.
Moderate	Grade II listed Buildings. Conservation Areas. Grade II Registered Parks. Historic or archaeological assets of regional or county importance. Sites of high archaeological resource rating. Registered Common Land. Places with important qualities in their historic or community association. Other buildings, monuments or sites that are of special interest and can be shown to have important qualities in their fabric or historical association. Existing commons and greens.
Low	Locally listed buildings. Locally important historic or archaeological sites, sites with a local value for education or cultural appreciation, sites that are so badly damaged that too little remains to justify inclusion into a higher grade, sites of medium archaeological resource rating. Parks and gardens of some local interest. Historic Hedgerows. Historic Townscapes with historic integrity. Other buildings, monuments or sites of local importance or of

Significance (value)	Asset Categories
	modest quality. Historic Townscapes with historic integrity.
Not Significant	Assets identified as being of no historic, evidential, aesthetic or communal value. Assets whose values are compromised by poor preservation or survival or of contextual associations to justify inclusion into a higher grade.
Uncertain	Areas of identified archaeological potential, and areas not yet prospected.

Magnitude of impact

8.9.10 Development Impacts can be direct or indirect, and can be characterised in terms of timing, scale, duration, reversibility and the likelihood of the impact occurring. Impacts can be short, medium and long-term, permanent and temporary and can be positive or negative.

8.9.11 An impact can occur to the setting of a heritage asset such that significance is affected. Guidance on how to establish impact on an asset's significance is set out by English Heritage (2011a).

8.9.12 The magnitude of an impact can vary from 'High' to 'No change' as set out in Table 8 and can be beneficial or adverse.

Table 8 - Factors influencing the assessment of magnitude of impacts

Impact Rating	Description of Impact
High	Change such that the significance of the asset is totally altered or destroyed. Comprehensive change to setting affecting significance, resulting in changes in our ability to understand and appreciate the resource and its historical context and setting.
Moderate	Change such that the significance of the asset is affected. Changes such that the setting of the asset is noticeably different, affecting significance resulting in changes in our ability to understand and appreciate the resource and its historical context and setting.
Low	Change such that the significance of the asset is slightly affected. Changes to the setting that have a slight impact on significance resulting in changes in our ability to understand and appreciate the resource and its historical context and setting.
Minimal	Changes to the asset that hardly affect significance. Changes to the setting of an asset that have little effect on significance and no real change in our ability to understand and appreciate the resource and its historical context and setting.
No change	The development does not affect the significance of the asset. Changes to the setting do not affect the significance of the asset or our appreciation of it.

Significance of effects

8.9.13 Only those heritage assets where there is a potential for impact will have that impact assessed. Assessment of the significance of effects will take into consideration any design mitigation or additional mitigation proposed during development of the Proposed Scheme for example planting, noise barriers etc. It should be recognised that mitigation measures, for example landscaping or areas of ecological compensation can themselves be a source of impact.

8.9.14 The assessment of the level of overall significance of the effect taking into consideration mitigation is arrived at by cross reference between the significance (value) of the asset (

8.9.15 Table **7**) and the magnitude of impact (Table 8) as shown in

8.9.16 Table **9**. Major and moderate effects may be considered to be significant. The assessment of overall effect can be either adverse or beneficial.

Table 9 - Matrix for establishing overall significance of effect

Significance and value of asset	**Magnitude of impact**				
	No Change	Minimal	Low	Medium	High
High	Neutral	Minor	Moderate	Major	Major
Moderate	Neutral	Minor	Minor	Moderate	Major
Low	Neutral	Neutral	Minor	Minor	Moderate
Not Significant	Neutral	Neutral	Neutral	Minor	Minor
Uncertain	Determinable only on definition of the asset				

Cumulative effects

8.9.17 The construction of the Proposed Scheme will generate economic stimulus for development within its corridor and particularly at stations to take advantage of the economic benefits such a location will bring. This, combined with developments that are already taking place or anticipated within the route of the project, will result in increased pressure on heritage assets through total or partial loss, impacts on significance (value) or increased urbanisation resulting in adverse impacts on the setting of heritage assets. The criteria for the selection of developments included in the cumulative impact assessment are provided in section 2.4 of this report.

8.10 Assumptions

8.10.1 Key assumptions for this topic are that relevant data will be available from the various archive and record holding bodies consulted (i.e. HERs, English Heritage National Monuments Record, records of Designated sites) and that collections of historic maps and other sources held by external record offices

(such as the County Records Offices and Metropolitan Records Centres) will be available to the project teams.

9 Ecology

9.1 Introduction

9.1.1 This section of the report sets out the scope for the ecology component of the Environmental Impact Assessment (EIA) of the Proposed Scheme.

9.1.2 It describes the methodologies that will be used to identify the potential for adverse effects upon species and habitats, including sites recognised or designated for their significance for nature conservation that are found along the route of the Proposed Scheme. In addition, it includes effects on geological and geo-morphological features of recognised nature conservation significance.

9.2 Establishment of baseline and definition of survey

9.2.1 A description of the baseline environment for the Proposed Scheme for consultation in 2011 is contained within the Appraisal of Sustainability (AoS) (February 2011) Section 8, Sustainability of the HS2 Proposed Scheme in Main Report Volume 1 Section 8.6 describes the baseline environment in relation to Ecology (Biodiversity) and further details are provided in Appendix 4.

9.2.2 The baseline conditions for the EIA will be established through a combination of desk study, field survey and consultation.

9.2.3 Existing biological data for the route corridor will be obtained from relevant Biological Records Centres and from national and local specialist data sources, such as Bat Groups. National and Local Biodiversity Action Plans and ancient woodland inventories will be consulted. The data to be collated will include:

- Statutory designated sites within 10km of the route;
- Non-statutory designated sites within 5km of the route;
- Records of protected, priority or otherwise notable species within 5km of the route (in some locations and for some species including bats, the corridor of search will be extended up to 10km to ensure that a complete baseline for the assessment is gathered); and
- Priority or otherwise notable habitats or features within or adjacent to the route.

9.2.4 In addition, existing ecological data available from other sources, such as Environmental Statements (ESs) associated with other relevant developments or Nature Reserve monitoring records, will be consulted where these are available within the time-frame of the study.

9.2.5 The width of the survey corridor will be defined by the potential area of ecological impact. This will vary depending on a number of factors, including the engineering of the route, the topography of the landscape, and the ecological receptor. In rural sections, the survey corridor for some species, such as Great Crested Newt, could extend up to 500 metres (m) either side of the route; in urban sections, the survey corridor will in general be much narrower as the zone of impact will be more restricted.

9.2.6 Phase 1 habitat surveys will be carried out. On the basis of the habitats present, and on the basis of professional judgement as to the potential for the presence of protected or otherwise notable species, and where land access is permitted, further detailed specialist surveys will be undertaken.

9.2.7 Specialist surveys will include:

- Detailed botanical surveys (National Vegetation Classification, NVC);
- Amphibian Habitat Suitability Index (HSI) surveys of water bodies;
- Amphibian surveys of water bodies;
- Reptile surveys;
- Breeding bird surveys;
- Wintering bird surveys;
- Badger surveys;
- Hazel dormouse surveys;
- Bat surveys of suitable features, to determine suitability as bat roosts, and emergence and activity surveys to determine presence and patterns of use by bats (where Habitats Directive Annex II species are thought to be present, additional surveys will be agreed with Natural England);
- River Habitat Surveys and River Corridor Surveys;
- Otter surveys;
- Water vole surveys;
- Terrestrial invertebrate surveys;
- Aquatic macro-invertebrate surveys;
- White-clawed crayfish surveys; and
- Fish surveys.

9.3 Consultation

Consultation on the AoS

9.3.1 In response to the findings of the AoS a number of organisations raised ecology matters. These included:

- Natural England;
- Environment Agency;
- Bat Conservation Trust;
- Royal Society for the Protection of Birds;
- Wildlife Trusts; and
- Defra.

9.3.2 Natural England comments included the following:

- The AoS could not conclude that an Appropriate Assessment is not necessary for the South West London Waterbodies Special Protection Area;
- The impacts on three Sites of Special Scientific Interest (SSSI) were under-estimated in the AoS;
- Further investigation is required to understand the likely impacts on groundwater-dependent habitats, including three SSSIs;
- Impacts on veteran trees, wood pasture/parkland sites and small ancient woodlands should be assessed; and
- The requirements of National policy should be fully addressed (e.g. in respect of ancient woodland, Local Wildlife Sites, Local Geological Sites, wider habitat networks and Biodiversity Action Plan habitats).

9.3.3 The Wildlife Trusts also emphasised the importance of looking at the landscape-scale ecological networks, as promoted within the Government's White Paper on the natural environment (2011)[45].

Consultation as part of the EIA process

9.3.4 During the EIA, the above organisations will remain key consultees, along with (although not limited to) the National Trust, Amphibian and Reptile Conservation, and Butterfly Conservation.

9.3.5 In addition, at a local level, other organisations will be consulted to provide existing data and contribute context to the assessment. These will include:

- Local bat groups;
- Local badger groups;
- Local amphibian and reptile groups;
- Local ornithological groups;
- Local groups associated with individual nature reserves and other sites; and
- The Chilterns Conservation Board and the Chiltern Society.

9.4 Key aspects of the scheme for the topic

9.4.1 Adverse effects on nature conservation could arise most obviously through direct land-take, resulting in habitat loss, fragmentation and barriers, and affecting the ability of habitats and populations to maintain conservation status. At least in the short to medium-term, temporary land take may give rise to effects as significant as permanent land-take, due to the slow recovery or even irreplaceability of species, populations and habitats.

[45] HM Government; 2011, *Cm 8082 - The natural choice: securing the value of nature*, The Stationery Office

9.4.2 Disturbance as a result of sound, movement and/or light during site clearance, construction and operation could give rise to effects on some species. Ecological effects can also result from air and water pollution, arising once again during site clearance and construction.

9.4.3 In addition, there is the potential for the Proposed Scheme to have beneficial effects when compared with a 'do nothing' scenario, for example as a consequence of habitat creation that could be designed as part of the railway corridor to extend and link fragments of semi-natural habitat.

9.5 Scope of assessment

9.5.1 The assessment will consider all ecological receptors with the potential to be directly or indirectly affected by the Proposed Scheme, including sites designated for their nature conservation value, legally protected or otherwise notable species, and habitats.

9.5.2 The assessment will consider how the activities to be undertaken during construction and operation of the Proposed Scheme could alter the conservation status of habitats and species.

Temporal scope

9.5.3 The baseline for this assessment will be taken as conditions at the time of the 2012 and 2013 surveys. Where the baseline is considered likely to change between the date of the surveys and the date of opening (2026), this will be made clear in the text. In particular, the assessment will consider the influence of other factors, such as climate change and how those might affect the baseline conditions.

9.6 Assessment methodology

9.6.1 The impact assessment methodology for the Proposed Scheme broadly follows the standard method for ecology as set out by the Institute of Ecology and Environmental Management (IEEM) in their Guidelines for Ecological Impact Assessment (2006)[46]. It is also influenced by the principles in Department for Transport's Design Manual for Roads and Bridges (DMRB) Volume 11 (Ecology and Nature Conservation) and Interim Advice Note 130/10 (Ecology and Nature Conservation: Criteria for Impact Assessment).

Legislation

9.6.2 The assessment will take into account relevant national and international legislation. Legislation of relevance to consideration of the ecological resources includes:

- *The Wildlife and Countryside Act 1981* (as amended);
- *The Conservation of Habitats and Species Regulations 2010*;

[46] Institute of Ecology and Environmental Management (IEEM), 2006, *Guidelines for Ecological Impact Assessment*, IEEM

- *Protection of Badgers Act 1992*;
- *The Hedgerow Regulations 1997*;
- *Countryside and Rights of Way Act 2000*; and
- *Natural Environment and Rural Communities Act 2006*.

Guidance

9.6.3 The assessment also takes into account relevant guidance set out in national, regional and local planning policy. Relevant planning policy documents include the explanatory notes provided in Defra Circular 06/05[47]. In addition, the assessment will consider Making Space for Nature: A Review of England's Wildlife Sites and Ecological Network (2010; the 'Lawton Report')[48].

Significance criteria

9.6.4 In the IEEM Guidelines, an effect on the integrity of a defined site or ecosystem and/or the conservation status of a habitat or species is deemed to be significant. The value of any feature that will be significantly affected is then used to identify the geographical scale at which the effect is significant. This reflects the consequences of the predicted effect in terms of legislation or policy.

9.6.5 In order to test whether or not there will be an effect on the integrity of a site or ecosystem, it is necessary to understand whether the changes arising from the Proposed Scheme are predicted to move the baseline conditions at the site or ecosystem closer to, or further away from, the condition which constitutes "integrity" for that system. The integrity of a site may be defined as "the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified".[49] A site or ecosystem that achieves this level of integrity is described as being at favourable condition.

9.6.6 In terms of assessing whether there will be a significant effect on a habitat or species, the concept of conservation status is used. This is particularly relevant where there are formal targets for the conservation status of a species or habitat in a particular geographical context, in respect of distribution, numbers etc.

9.6.7 Relevant information on policy relating to the conservation status of species and habitats will be identified through reference to Biodiversity Action Plans,

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[48] Defra, 2010, *Making Space for Nature: A Review of England's Wildlife Sites and Ecological Network*, Defra

[49] Office of the Deputy Prime Minister (ODPM), 2005, *Circular 06/05: Biodiversity and Geological Conservation - Statutory Obligations and Their Impact Within the Planning System*, The Stationery Office

published conservation notes (where available) from Natural England, and relevant local planning policies.

9.6.8 The importance of ecological features will be determined according to their value for biodiversity on a geographic scale, namely International, National, Regional, County/Metropolitan, Borough/District, and Local.

9.6.9 It is important that there is a consistent approach to the definition of significance across the different topics reported in the ES. There is therefore likely to be a need to define an approach to relating significant ecological effects on receptors at different geographical scales to the overall significance categories used by other topic areas. This is usually achieved by identifying significant effects on sites of International or National value as being of "greater significance" than significant effects on sites of County or District value. This process will also ensure that the overall assessment focuses on the key significant ecological issues.

Construction effects

9.6.10 Potential impacts resulting from construction activities include:

- Temporary and permanent land-take;
- Severance;
- Barrier effects (to movement of fauna);
- Noise and visual disturbance;
- Disturbance from lighting;
- Dust deposition;
- Risk of water quality changes from surface water run-off; and
- Hydrological effects.

9.6.11 The Proposed Scheme also offers opportunities for habitat creation (including the extension and linkage of habitat fragments) and habitat improvements, as part of the landscape design of the Proposed Scheme.

Operational effects

9.6.12 Potential operational activities that could give rise to ecological effects include:

- Barrier effects (to movement of fauna);
- Noise and visual disturbance; and
- Disturbance from lighting.

Cumulative effects

9.6.13 The assessment will consider the cumulative effects of localised effects along the length of the railway, for example the potential of cumulative loss of certain habitat types.

9.6.14 Interaction between effects arising from the Proposed Scheme and those from other relevant projects and plans will also be considered in a cumulative assessment.

9.7 Assumptions

9.7.1 The ecological assessment follows the general assumptions made regarding the boundaries of the assessment and in particular the scope of the in combination/cumulative impact assessment.

9.7.2 The assessment within this Section considers the natural heritage from the perspective of nature conservation. The value of natural heritage features from landscape, social/recreational and heritage points of view is considered in Sections 12 and 8 of this report, respectively.

9.7.3 Effects on geology and geomorphology are considered only from a nature conservation perspective in this section of the report.

10 Electromagnetic interference

10.1 Introduction

10.1.1 This section of the report covers Electromagnetic Interference (EMI) which includes the environmental topic areas of Electro Magnetic Compatibility (EMC). In particular it will consider the aspects described below.

10.1.2 Electromagnetic Interference is disturbance that affects an electrical system due to either electromagnetic induction or electromagnetic radiation emitted from an external source.

10.1.3 EMC is the ability of equipment to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbance to other equipment in that environment.

10.1.4 The principal sources of EMI from the Proposed Scheme will be generated by the traction power supply system, the rolling stock, the signalling system, electrical and mechanical systems and the control and communications systems. In addition, equipment located within the rolling stock maintenance depots and the stations/interchanges contain similar control and communications systems, together with other EMI sources such as lifts and escalators and other large items of plant such as, wheel lathes, lifting jacks and overhead cranes within the depot. Each of these systems could also be susceptible to EMI together with any third party electrical and electronic infrastructure located adjacent to the Proposed Scheme.

10.2 Establishment of baseline and definition of survey

10.2.1 A description of the baseline environment for the Proposed Scheme for consultation in 2011 is contained within the Appraisal of Sustainability (AoS) (February 2011) Section 8, Sustainability of the HS2 Proposed Scheme in Main Report.

10.2.2 In constructing and operating the Proposed Scheme, there will be key interface issues that require evaluation and management. The key elements have already been described in the introduction above, however a definitive list of interfaces will be established as part of the initial survey scope. The new infrastructure will have an impact on and be impacted on by its surroundings, which will differ throughout the route.

10.2.3 Where the route is adjacent to an existing railway corridor, there will be a significant interface between the existing railway networks. Although the existing infrastructure may have in place systems and procedures that mitigate against the effects of EMI, it is possible that the introduction of new HS2 infrastructure may have an adverse affect on that which exists. Similarly,

the existing railway infrastructure may have an effect on the new HS2 infrastructure and rolling stock.

10.2.4 It is therefore important to obtain all available relevant records for the existing railway network and identify possible interface issues, which can then be assessed as a desk-top exercise for risk within an EMC hazard log. The hazard log may have to consider the effect of potential changes that have yet to happen, such as future advancements in transformer technology or changes to the existing infrastructure.

10.2.5 For the areas not adjacent existing railway, the HS2 infrastructure is likely to have a greater impact on its surroundings. It is therefore important to identify any key areas along the route where EMI could be an issue. These may include residential and business premises, hospitals and light industrial areas, telephone and communications systems.

10.2.6 The new rolling stock could be a major source of EMC issues and it is therefore vital that the rolling stock specification is compatible with the operational limits of the infrastructure and the Technical Specification for Interoperability (TSI).

10.3 Consultation

10.3.1 In producing the hazard log a list of interested parties shall be produced. This list will include, but not be limited to:

- Network Rail;
- Transport for London;
- London Underground;
- Electricity supply authorities;
- Electricity distribution companies;
- Data and telecom companies;
- Local authorities;
- Hospitals; and
- Airports.

10.4 Key aspects of the scheme for the topic

10.4.1 The following are potential sources of EMI:

- Temporary sources; direct effects could be caused by construction from significant activities such as tunnelling, as a result of the use of electrical machinery, such as pumps, generators and compressors. Tunnel boring machines utilise high voltage electricity supplies. These activities will be supported from local work compounds close to the structure / tunnel being constructed, local worksites, or larger construction compounds where equipment may be used.
- Permanent sources; direct effects could be caused by the operational railway and its supporting systems (e.g. Overhead line equipment (OLE)

and traction distribution, stations, depots, ventilation shafts and other line side equipment, traction depots and rolling stock, both existing and proposed).

10.5 Scope of assessment

10.5.1 A desk-top study will be undertaken to identify all potential sources of EMI that exist or may be produced for both the construction and operational phases of HS2. The list will identify the potential risk and the potential impact and be part of a hazard log.

10.5.2 Base-line measurements will be made at key locations throughout the railway and the results recorded. These will be used to evaluate the effects using theoretical calculations and industry available data.

10.6 Assessment methodology

Legislation and guidance

10.6.1 The following standards are relevant;

- BS EN 50121-1:2006 Railway applications - Electromagnetic compatibility – General;
- BS EN 50121-2:2006 Railway applications - Electromagnetic compatibility – Emissions of the whole railway system to the outside world;
- BS EN 50121–3-1:2006 Railway applications - Electromagnetic compatibility – Rolling stock – Train & Complete Vehicle;
- BS EN 50121–3-2:2006 Railway applications - Electromagnetic compatibility – Rolling stock – Apparatus;
- BS EN 50121-4:2006 Railway applications - Electromagnetic compatibility – Emission and immunity of the signalling and telecommunication apparatus;
- BS EN 50121-5:2006 Railway applications - Electromagnetic compatibility - Fixed Power Supply Installations;
- BS EN 61000-6-1:2007 Electromagnetic compatibility (EMC). Generic standards. Immunity for residential, commercial and light-industrial environments;
- BS EN 61000-6-2:2005 Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments;
- BS EN 61000-6-3:2007 Electromagnetic compatibility (EMC). Generic standards. Emission standard for residential, commercial and light-industrial environments;
- BS EN 61000-6-4:2007 Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments;
- BS EN 50122-1:1998 Railway applications. Fixed installations. Protective provisions relating to electrical safety and earthing;

- BS EN 50122-2:1999 Railway applications. Fixed installations. Protective provisions against the effects of stray currents caused by d.c. traction systems;
- BS EN 50122-3:2008 Railway applications. Fixed installations. Electrical safety, earthing and bonding. Mutual interaction of a.c. and d.c. traction systems; and
- BS EN 61000-4-16:2009 Electromagnetic compatibility (EMC). Testing and measurement techniques. Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz.

Significance criteria

EMC Zones

10.6.2 The definition of an EMC zone is a bounded area in which specific levels of electromagnetic (EM) energy exist. It follows that some EMC zones contain higher levels of EM energy than others. In the railway environment the zone containing most energy in these EMC zones exists on the trackside of the railway (where traction power is returned to the running rails) and close to traction or non-traction power distribution equipment.

10.6.3 The zoning principle will be used to determine the required test levels and control methods to be applied to equipment operating in this area. Essentially, three zones are identified each with its boundary determined from a reference point (the centre-line between the two running rails). As distance increases from this point test level requirements become less onerous as a new EMC boundary zone is crossed. It must be noted that there may be special circumstances in which the zoning approach cannot guarantee compatibility. Each potential hazard that falls into this category will have additional methods adopted to ensure electromagnetic compatibility in its EM operating zone.

10.6.4 EM Zone 1: For equipment less than 10 metres (m) from the centreline of the nearest track rails or from non-traction power equipment i.e. Cables transformers or switchgear. BS EN 50121 Part 4 (Signalling & Telecommunications Equipment) and Part 5 (Fixed Power Supply Installations) will be applied in this zone. The Emission and Immunity levels are given in the standard. Part 4 applies to any safety critical equipment located in this zone.

10.6.5 EM Zone 2: For equipment greater than 10m, but less than 20m from the centreline of the nearest track rails or from non-traction power equipment i.e. cables, transformers or switchgear. BS EN 61000-6-2 (Generic standard – Immunity for Industrial Environments) and BS EN 61000-6-4 (Generic standard – Emissions for Industrial Environments), will be applied in this zone. The emission and immunity levels are given in the standards. Any safety critical equipment located in this zone would also apply to this standard.

10.6.6 EM Zone 3: For equipment greater than 20m from the centreline of the nearest track rails or non-traction power equipment i.e. cables transformers or switchgear. BS EN 61000-6-1 (Generic standard – Immunity for Residential, Commercial and Light Industrial Environments) and BS EN 61000-6-3 (Generic standard – Emissions for Residential, Commercial and Light Industrial Environments), will be applied in this zone. The Emission and Immunity levels are given in the standard.

10.6.7 Where risk is identified, calculations will be undertaken to assess the impact of EMC. Best practice will be used wherever possible to limit the effect. For example, the use of standard separation distances for cables of different voltage and screening techniques.

10.6.8 In creating the hazard log the impact and risk levels will be established that will highlight the key areas on which to concentrate. Base-line measurements will be taken to ensure that the existing environment is compliant with the standards identified above. Preliminary calculations will be used to identify the potential impact of the new infrastructure, using industry standards and best practice.

10.6.9 Measurements will be taken at testing and commissioning of the infrastructure to confirm the theoretical calculations. Where actual readings exceed the recommended levels, further mitigation measures will be applied, following additional risk analysis.

Construction effects

10.6.10 In producing the hazard log, the effects of construction will be evaluated and mitigation measures implemented if required. On-going measurements and monitoring will be considered during construction, where significant risks are identified.

Operational effects

10.6.11 In producing the hazard log, the effects of operation will be evaluated and mitigation measures implemented if required.

Cumulative effects

10.6.12 It is possible that equipment that may comply individually will produce a cumulative effect once installed together as part of a wider system. Traction substations are an example. The cumulative effect of the whole system must be considered when any evaluation or calculation is made.

10.6.13 Degradation of systems and equipment over a period of time, may contribute to a worsening effect of EMI.

10.7 Assumptions

10.7.1 The following assumptions are made;

- Access for taking measurements may be restricted and therefore in these circumstances, best practice or professional judgement may have to be used to reach a sensible conclusion. It may be possible, subject to review, to use information from other recent railway construction projects;
- The compilation of information from which to assess the base-line measurements will be dependent on the availability of record information, which is assumed to be readily available; and
- In accordance with good safety management principles, it is assumed that risks due to EMI will be reduced using the ALARP (as low as reasonably practicable) principle.

11 Land quality

11.1 Introduction

11.1.1 This section of the report covers 'land quality' which includes the environmental topic areas of Land Contamination and Geology. This topic was considered within the Appraisal of Sustainability (AoS) within the wider topic of 'Sustainable Consumption and Production'.

Land Contamination

11.1.2 Land and groundwater along the route of HS2 may have become contaminated through previous industrial usage. Such land or groundwater could adversely affect people and the wider environment (including effects on groundwater quality, surface water quality and ecology). Construction of the Proposed Scheme will require earthworks, cut and cover and bored tunnelling, deep foundations, temporary dewatering and other construction activities. Where the route crosses or lies close to existing sources of contamination, these activities could result in the disturbance of the contamination, which needs to be assessed so that it can be mitigated.

11.1.3 The Land Quality chapter of the Environmental Statement (ES) will present the findings of the assessment identifying significant areas of contamination along the route and in associated developments, and where appropriate, present a range of mitigation measures that would need to be considered in order to remediate significant areas of contamination.

11.1.4 It should be noted, that with respect to contamination issues, the contaminated land or groundwater which is already present at a site, may already be causing environmental impairment. The purpose of the land quality assessment is to ensure that construction and operation of the Proposed Scheme does not introduce new pathways by which contamination can spread, and where there is a significant risk of this happening, to consider mitigation measures to prevent it.

Other Geological Features

11.1.5 Along the route there may also be areas of land that have special geological significance, either from a scientific, mining or mineral resources point of view, such as

- Geological Sites of Special Scientific Interest (SSSI) or Local Geological Sites, also known as Regionally Important Geological Sites (RIGS);
- Areas of previous or current underground or opencast mining; and
- Areas of potential and designated mineral resources.

11.2 Establishment of baseline and definition of survey

11.2.1 The AoS contained references to baseline conditions with respect to Land Quality and noted that the route of the Proposed Scheme would cross 16 old landfill sites, thereby giving rise to opportunity to re-use currently disused land.

11.2.2 The method for determining the baseline conditions will involve a combination of the following:

- Data collected for the Appraisal of Sustainability (AoS);
- Analysis of the results of previous investigations carried out in the immediate area of the Proposed Scheme;
- Historical Ordnance Survey (OS) mapping;
- Published geological and hydrogeological mapping;
- Data held by local authorities;
- Route wide site inspections, including depot areas;
- Unexploded ordnance data; and
- Other publicly available environmental data.

11.2.3 Documentary data are available from a number of governmental and non-governmental organisations including:

- The EA;
- British Geological Survey; and
- County councils and district councils.

Much of the data is also held on commercial environmental databases.

11.2.4 Site inspections will be used to supplement and 'ground truth' the documentary study data obtained.

11.2.5 A width of 250 metres (m) from either side of the route alignment, and land required for construction of stations, depots, and other land required for the works will be reviewed. This width has been developed using professional judgement on the basis that contamination migration beyond this distance is likely to be minimal or could be mitigated. This principle has been applied in assessing previous railway projects such as Crossrail.

11.2.6 A risk based approach in accordance with Defra and EA guidance would be taken to identifying contamination which may have a significant impact on the construction of the Proposed Scheme. Where, from the review of desk study data, the AoS and the site inspections, the identified past uses of the land indicate a high risk of previous contamination and potential risk to receptors, intrusive investigations may be carried out (where practicable) as part of geotechnical investigations prior to works commencing on site, in order to provide additional data on which risks and impacts can be assessed. Such investigations would be carried out in line with CLR 11 guidance and BS10175. For further details see section 11.6.2 below.

11.2.7 With regards to other sites of geological interest, information will be obtained from Natural England, the Coal Authority and from local authorities (usually county councils) who hold information on such sites.

11.3 Consultation

Consultation on the AoS

11.3.1 During the consultation on the AoS, both the EA and local authorities were consulted although there were very few responses on the topic of Land Quality.

Consultation as part of the EIA process

11.3.2 During the preparation of the EIA, wider and more comprehensive consultation on the topic will be undertaken with the following organisations:

- Environment Agency;
- Natural England (if 'geological SSSI' are affected);
- GeoConservation UK (if RIGS are affected);
- Landfill and mineral abstraction companies; and
- Local authorities.

11.4 Key aspects of the scheme for the topic

11.4.1 Impacts from disturbance to contaminated land will principally arise where the works break such ground during the construction phase (e.g. construction of portals, ventilation shafts or stations/interchanges) or where the ground is disturbed (e.g. through removal of existing structures). Contaminated land may be present as a result of historical activities at a particular location or as a result of current operations. Contaminated groundwater issues are dealt with in section 17 of this report.

11.4.2 The urban areas of London and Birmingham are areas where existing contamination is likely to be most prevalent. In London, to the west of Old Oak Common, the proposed route passes adjacent to existing Network Rail and London Underground lines in an area with significant adjacent industry. Similarly in Birmingham the route will pass through the industrial areas adjacent to the M6, Washwood Heath and the route to Curzon Street terminus (Birmingham Eastside).

11.4.3 In the rural areas between the London and Birmingham conurbations, the incidence of existing contaminated land will be smaller. Nevertheless, there may be localised industries, old and existing landfill sites, old sewage farms and other issues that need to be assessed with respect to contaminative effects. For example, at Calvert (Buckinghamshire) the route of the Proposed Scheme runs adjacent to both old and operational landfill sites to the north and south of the village.

11.4.4 The impairment or destruction of geological sites of interest would be considered an adverse impact. Although new exposures of rock and soil may be created by the Proposed Scheme (e.g. within new cuttings) they would not be accessible to the public and this is therefore considered to be a negligible impact.

11.4.5 Mining issues (for example a requirement to treat or mitigate underground mining voids from previous mine workings) will be concentrated in two areas: the potential for old chalk mines in the Chiltern Hills and coal mining areas in the Midlands.

11.5 Scope of assessment

11.5.1 The EIA will identify the likelihood of existing contamination being encountered during the construction process, such that it could cause significant environmental or health effects if not addressed adequately at the construction stage. Impairment of geological resources will likewise be addressed.

11.5.2 The maintenance of the railway once it is operational will be in compliance with appropriate environmental legislation in order to prevent land, surface water or groundwater contamination during its operation. Therefore operational effects can be scoped out of the Land Quality assessment.

11.5.3 The temporal scope will therefore be limited to the construction period.

11.6 Assessment methodology

Legislation

11.6.1 Part 2A of the Environmental Protection Act 1990 (as amended) provides a statutory definition of contaminated land:

"Contaminated Land is any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that significant harm is being caused or there is a significant possibility of such harm being caused; or pollution of controlled waters is being, or is likely to be caused."

Guidance

11.6.2 In the guidance that accompanies the Act, there is advice on what constitutes significant harm and what constitutes a significant possibility. This advice is currently being revised and is being re-issued in April 2012 (see below). The following reports provide further guidance on the risk assessment process, and introduce the Contaminated Land Exposure Assessment (CLEA) model:

- EA/Defra '*Contaminated Land Report* '(CLR) 11 (2004)[50];

[50] Environment Agency/Defra, 2004, *Contaminated Land Report (CLR) 11*, Environment Agency/Defra

- Defra '*Guidance on the legal definition of contaminated land*' (2008)[51];
- EA (August 2008) '*Human Health Toxicological Assessment of Contaminants in Soil*'. Science Report – SC050021/SR2[52];
- EA (August 2008) '*Updated Technical Background to the CLEA Model*'. Science Report – SC050021/SR3[53];
- EA *Guiding Principles on Land Contamination* (GPLC) March 2010[54]; and
- Defra (April 2012) *Contaminated Land Statutory Guidance*[55].

11.6.3 The impacts associated with contaminated land are generally assessed by means of a source/hazard-pathway-receptor methodology in accordance with CLR 11 *Model Procedures for the Management of Land Contamination* (Defra and the EA, 2005) and British Standard (BS) 10175 *Investigation of Potentially Contaminated Sites – Code of Practice* (1999)[56], where the following definitions apply:

- *Source/Hazard:* a hazardous substance that has the potential to cause adverse impacts to a receptor;
- *Receptor:* a target that may be affected by contamination; examples include human occupants/ users of the site, water resources or structures; and
- *Pathway:* a route whereby a hazardous substance may come into contact with the receptor; examples include ingestion of contaminated soil and leaching of contaminants from soil into water resources.

Significance criteria

11.6.4 The above approach forms the basis of the methodology to be used in the assessment of Land Quality. For contamination to present a significant potential effect, it must be demonstrated that there is an identifiable source of contamination (be it an on site or off site source), potential sensitive receptors and potential pathways through which the former may affect the latter.

11.6.5 The sensitivity of potential receptors can be described qualitatively according to the categories shown in Table 10. The distance criteria quoted is a guideline only and may be reduced, if pathways between source and receptor are weak (for example, where underlying ground is impermeable to groundwater flow, the groundwater migration pathway can be negligible).

[51] Department of Environment, Food and Rural Affairs (Defra), 2008, *Guidance on the legal definition of contaminated land*, Defra
[52] Environment Agency (EA), 2008, *Science Report – SC050021/SR2 - Human Health Toxicological Assessment of Contaminants in Soil*, EA
[53] Environment Agency (EA), 2008, *Science Report – SC050021/SR3 - Updated Technical Background to the CLEA Model*, EA
[54] Environment Agency (EA), 2010, *Guiding Principles on Land Contamination*, EA
[55] Department of Environment, Food and Rural Affairs (Defra), 2012, *Contaminated Land Statutory Guidance*, Defra
[56] British Standard (BS), 1999, 10175 *Investigation of Potentially Contaminated Sites – Code of Practice*, BSi

Table 10 – Criteria for assessing receptor sensitivity

Receptor sensitivity/ Value of Resource	Receptor/ Resource
High	Residential areas, schools and playing fields within 50m of below ground construction. Nearby water bodies of high quality and/or route on Principal Aquifer. Nationally designated areas eg Sites of Special Scientific Interest (SSSI). Major mining or mineral resource areas.
Moderate	Residential areas, schools and playing fields within 250m of below ground construction. Allotments and market gardens. Nearby water bodies of moderate quality, and/or route on Secondary Aquifer. Regionally designated areas e.g. local nature reserves or RIGS. Locally important mining or mineral resource areas.
Low	Adjacent commercial or industrial development. Forestry areas, ornamental plant nurseries. Nearby water bodies of low quality, and/or route on unproductive strata. Non-designated land.

Based on Design Manual for Roads and Bridges: Assessment Management of Environmental Effects (2008)

11.6.6 Construction workers are not included in the list of receptors, as it will be a fundamental requirement that any construction workers on the project are adequately protected from the effects of any contamination through project specific health and safety plans and procedures.

11.6.7 The magnitude of potential scheme impacts regarding contamination issues will be assessed using a 4 point scale as shown in the Table 11:

Table 11 - Impact magnitude criteria

Impact Magnitude	Criteria	Examples
High	Results in loss of attribute and/or likely to cause exceedance of statutory objectives and/or breach of legislation.	Likely significant contamination of a primary aquifer, major land remediation, or loss of major mineral resource.
Moderate	Results in impact on integrity of attribute/or loss of part of attribute, and/or possibly cause exceedance of statutory objectives and/or breach of legislation.	Reduction in the value of a feature, moderate remediation of land, loss of regional/local mineral resource.
Low	Results in minor impacts on attribute.	Measurable change in attribute, but of limited size/proportion.
Negligible	Results in no change or impact on attribute.	No significant loss in quality of feature.

Based on Design Manual for Roads and Bridges: Assessment and Management of Environmental Effects (2008).

11.6.8 The prediction of significance is based on the magnitude of the impact and the importance or sensitivity of the receptors. The significance of the potential effects is identified, as well as those of the residual effects for geological, mining and mineral impacts. Once remediated, there should be no residual effects with respect to land contamination issues.

11.6.9 Effects have the potential to be adverse, beneficial or negligible. For example, in terms of beneficial effects, the Proposed Scheme may remove a source of contamination or it may break a pathway that currently links a source to a receptor.

11.6.10 The significance of the effect will be affected by:

- The value of the resource;
- The sensitivity of the receptor;
- The strength and length of the pathway; and
- The size of the area affected.

Adverse and beneficial effects are further classified as being minor, moderate or major in significance.

11.6.11 Table 12 summarises the criteria for assessing effect significance.

Table 12 - Significance of effects criteria

Significance	Description
Major adverse	Considerable detrimental effect (by extent, duration or magnitude) of more than local significance or in breach of recognised acceptability/legislation/policy standards.
Moderate Adverse	Limited detrimental effect (by extent, duration or magnitude) that may be considered significant.
Minor Adverse	Slight, very short or highly localised detrimental effect.
Negligible	No appreciable effect.
Minor Beneficial	Minor reduction in risk (slight, short or highly localised effect).
Moderate Beneficial	Moderate reduction in risk.
Major Beneficial	Major reduction in risk.

Generally based on the Design Manual for Roads and Bridges: Assessment and Management of Environmental Effects (2008).

Construction effects

11.6.12 The impact of land contamination will be manifest only during the construction phase. A fundamental requirement of the project will be to carry out sufficient mitigation or remediation of any significant contamination such that, following construction, there are no continuing significant adverse effects from the contamination during the operational phase of the Proposed Scheme.

11.6.13 Remediation of contaminated land can lead to a number of secondary effects such as potential issues of dust migration and surface water impairment during the remediation process.

11.6.14 Where remediation of soil and groundwater is carried out for the Proposed Scheme, this would be regarded as a beneficial effect, as future risks to human health and the wider environment from the pre-existing contamination would have been reduced by the remedial works.

Operational effects

11.6.15 The maintenance of the Proposed Scheme, once it is operational, will be in compliance with appropriate legislation in order to prevent land or groundwater contamination during the operation of the railway. Therefore operational effects are scoped out of the assessment.

Cumulative effects

11.6.16 The assessment of cumulative effects would be limited to those areas/sites at which contamination remediation is likely to be required and at which

construction of the Proposed Scheme would be undertaken at the same time as other nearby construction work within an area of contaminated land.

11.6.17 Cumulative effects would also need to be taken into account, for example, when assessing the Proposed Scheme impact on mineral resources; effects at a local scale on a number of mineral resources may have a cumulative effect at a regional scale.

11.7 Assumptions

11.7.1 A width of 250m either side of the route alignment, and land required for construction of stations/interchanges, depots, and other land temporarily acquired for the construction works will be reviewed. This width has been chosen on the basis that contamination migration beyond this distance will be minimal or can be mitigated and has been used in assessing previous railway projects, such as Crossrail.

11.7.2 The assessment within this topic area considers land quality from the perspective of land contamination. It excludes soils quality from an agricultural or forestry perspective. Such an assessment will be found in Section 5 of this report.

11.7.3 Land contamination has the potential to affect groundwater resources. Wider issues of groundwater and surface water resources are contained within Section 17 of this report.

11.7.4 Land contamination has the potential to affect ecological resources. Other ecological issues are contained in Section 9 of this report.

11.7.5 Remediation of contamination can lead to a requirement for disposal of contaminated materials. Issues of waste generation and disposal are dealt with in Section 16 of this report.

12 Landscape, townscape and visual assessment

12.1 Introduction

12.1.1 This section of the report sets out the methodology for assessing the likely significant effects of the Proposed Scheme on landscape, townscape and visual receptors.

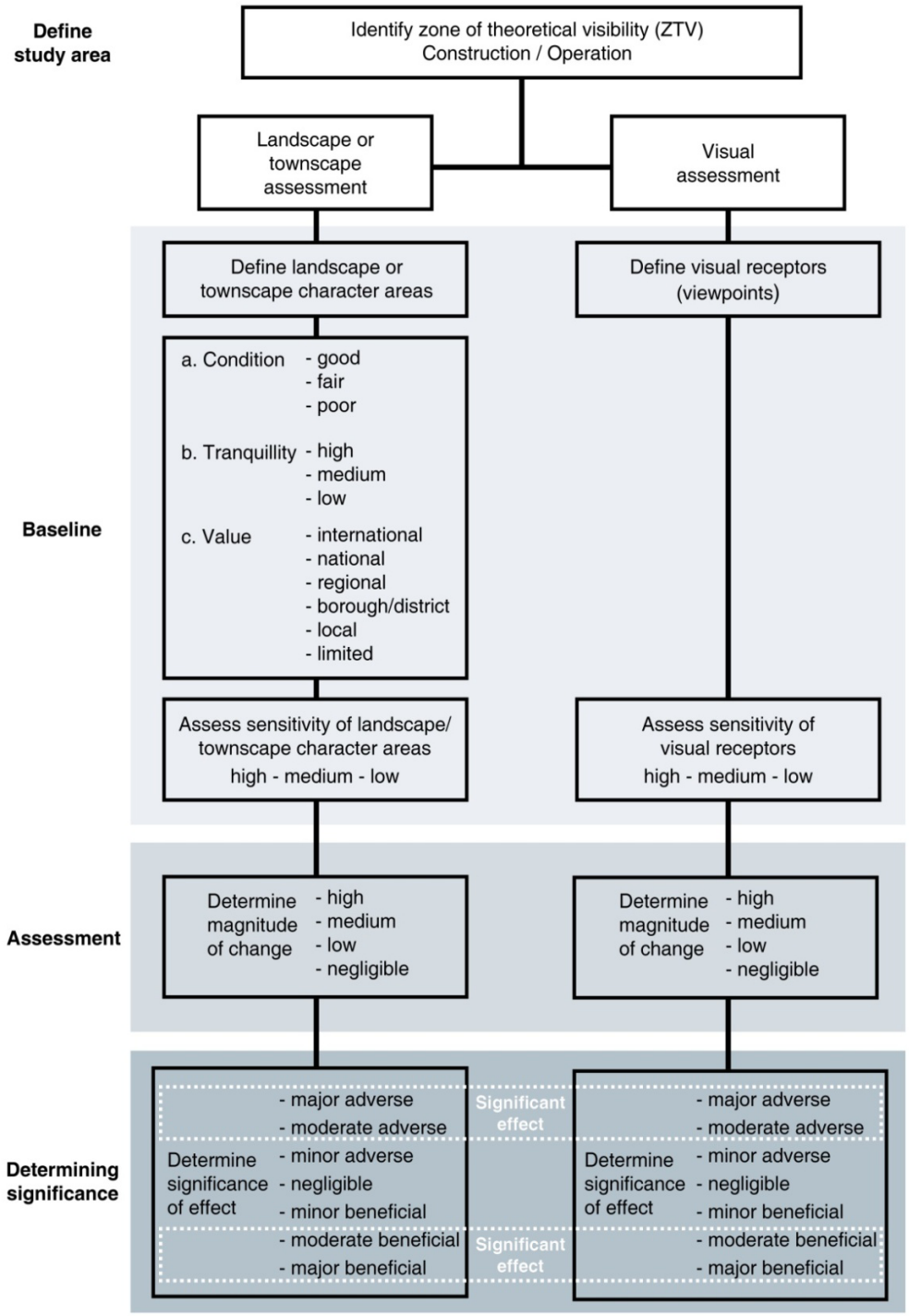
12.1.2 The topic specific methodology presented in this section builds upon the general assessment methodology summarised in Section 2 of this report. This has been developed to take account of the range of likely significant environmental effects on the landscape, townscape and visual receptors arising from the construction and operation of the Proposed Scheme.

12.1.3 The definition of 'landscape' encompasses all types and forms of open space and development in the countryside, villages, towns and cities. 'Townscape' has emerged as a term that is commonly used for landscape assessment that focuses on the predominantly developed landscape of urban areas, in which buildings and related infrastructure form the dominant components. For the purposes of this project, the following definitions would be used:

- 'Townscape' would be used for predominately urban sections such as the London Metropolitan and West Midlands Metropolitan areas; and
- 'Landscape' would be used for predominately rural sections.

12.1.4 The process for the landscape, townscape and visual assessment is illustrated in Figure 3. Each stage of the assessment process is then described in more detail through the following sections.

Figure 3 Assessment process for the landscape, townscape and visual assessment



12.2 Establishment of baseline and definition of survey

12.2.1 A description of the baseline environment for the Proposed Scheme for consultation in 2011 is contained within the Appraisal of Sustainability (AoS) (February 2011), Section 8, Sustainability of the HS2 Proposed Scheme in Main Report [57].

12.2.2 Volume 1; Section 8.4 of the AoS describes the baseline environment in relation to landscape, townscape and visual receptors, and further details are provided in Appendices 2, 3 and 5.

12.2.3 The Proposed Scheme would pass through a wide range of different landscape and townscape character areas between Central London and the West Midlands. The overall character of the proposed route from south to north is as follows:

- The townscape of central London from the urban centre around Euston Station to the predominantly residential suburbs of the outer London boroughs;
- The rural landscapes of Buckinghamshire, Oxfordshire, Northamptonshire and Warwickshire including the nationally important Chilterns Area of Outstanding Natural Beauty (AONB);
- The suburban and urban landscapes of Solihull District and Birmingham; and
- The agricultural landscape of Warwickshire and Staffordshire north of Birmingham, where the Proposed Scheme joins the West Coast Main Line (WCML) north of Lichfield.

12.2.4 The landscape and townscape character of the study area and the nature of existing views would be established through desk based research and field survey.

12.2.5 The landscape, townscape and visual surveys would be carried out by landscape architects. Survey work would be carried out in summer and winter, so that the full effect of seasonal change would be considered in the assessment. The survey work would be carried out in a methodical order as follows:

- Verification of the zone of theoretical visibility (ZTV) i.e. the study area (see 12.5.2);
- Definition of the landscape and townscape character areas (see 12.2.8);
- Assessment of the condition, tranquillity and value of each of the character areas (see 12.2.10 to 12.2.12);
- Establishment of the sensitivity of each of the character areas (see 12.2.14);
- Definition of visual receptors (viewpoints) within the ZTV (see 12.2.17);

[57] Booz & Co.(UK) Ltd, Temple Group Ltd,(February 2011) *HS2 London to the West Midlands Appraisal of Sustainability*

- Definition of the type and nature of the view from each viewpoint (see 12.2.21); and
- Determination of the magnitude of change for each character area (see 12.6.3) and visual receptor (see 12.6.10).

12.2.6 The field study would include a comprehensive photographic record during both summer and winter, to illustrate each character area and viewpoint (see 12.2.20).

Landscape and townscape baseline

12.2.7 The landscape and townscape baseline will be based on information available at the time of producing the Environmental Statement (ES). The description will include an overview of the elements that form the baseline within the study area, using text and plans to describe:

- Topography and geology;
- Cover, distribution and type of land use and open space;
- Development patterns and scale;
- Vegetation patterns and extents;
- Transport routes and Public Rights of Way and other routes (PRoW), National Trails to include roads, railways, cycleways, bridleways, footpaths, historic green lanes and drovers roads and waterways;
- Existing landscape and townscape character assessments and/or local green infrastructure strategies or plans prepared by county councils and local planning authorities; and
- Landscape and townscape statutory and non-statutory designations including AONB, Areas of Great Landscape Value, Green Belt, registered parks and gardens and conservation areas.

Landscape and townscape character assessment

12.2.8 The landscape and townscape baseline elements would be used to prepare a character area assessment covering the full extent of the study areas. Landscape and townscape character areas are defined as areas with broadly homogenous characteristics.

12.2.9 The character of each landscape and townscape character area would be described, influenced by existing documentation where available, including character assessments prepared by county councils and local planning authorities, historic landscape character assessments and Conservation Area character appraisals where available.

Condition

12.2.10 The condition of each character area would be described with reference to the following criteria:

- Good - components are regularly maintained to a high standard;
- Fair - components are relatively well maintained; and

- Poor - components are poorly maintained or damaged.

Tranquillity

12.2.11 The tranquillity of each character area would be described with reference to the following criteria:

- Land use;
- Level of seclusion or isolation;
- Extent and type of enclosure by surrounding land uses;
- Level of screening afforded by vegetation, ground level change or boundary treatments;
- Levels of vehicular traffic within, or close to the character area;
- Levels of pedestrian traffic within, or close to the character area; and
- The absence or presence of major infrastructure routes within or in the vicinity of the character area.

12.2.12 Tranquillity may be considered to be high, moderate or low.

Landscape and townscape value

12.2.13 An assessment would be made of the likely scale at which the character areas are valued. This would be based on which users may value the areas and, where relevant, any statutory, non-statutory or local plan designations. The presence of any combination of attributes may be considered when assessing the value of a character area. Factors that influence the scale which a character area is valued at are described in Table 13. These criteria are based on guidance provided by the Landscape Institute.

Table 13 - Landscape and townscape value

Scale of landscape and townscape value	**Definition** **The character area is:**
International	Located within a World Heritage Site. Considered an internationally important component of the country's character, experienced by significant numbers of international tourists.
National	Located within an AONB. A nationally significant historic or cultural resource. Considered a distinctive component of the country's character, experienced by significant numbers of tourists from around the country.

Scale of landscape and townscape value	Definition The character area is:
Regional	Located within green belt, Metropolitan Open Land (MOL) or a regional scale park. Considered a distinctive component of the region's character, experienced by a large proportion of its population.
Borough/District	Designated open space within the local authority Unitary Development Plan (UDP) or Local Development Framework (LDF). Designated as a Conservation Area. Experienced by a significant proportion of the borough's or district's population.
Local	A landscape of local significance (recognised at local authority level where criteria based assessments have been undertaken and locally adopted). A public, semi-public or private open space that serves the local community or residents. A residential area, likely to be valued by the local community.
Limited	A commercial, industrial or disused area that has limited landscape/townscape value to the local community or residents.

Sensitivity criteria

12.2.14 With reference to condition, tranquillity and landscape and townscape value, the sensitivity of the character areas would be assessed. The assessment of sensitivity requires the application of professional judgement, in line with guidance provided by the Landscape Institute. The presence of any combination of attributes may be considered when assessing the sensitivity of a character area. This allows professional judgement to be used when determining the relative importance of different attributes. The attributes which influence the sensitivity of a character area are described in

12.2.15 **Table 14** below.

Table 14 – Landscape and townscape sensitivity

Sensitivity	Definition The character area:
High	Is valued at the international, national, regional or borough/district scale. Is predominantly characterised by landscape/ townscape components that are rare and distinctive and/or listed. Is designated as a conservation area, registered park and garden or public open space. Has an elevated tranquillity. Has limited tolerance to change. Has components that are not easily replaced or substituted (e.g. mature trees). Has limited scope for effective mitigation in character with the existing landscape/ townscape.
Moderate	Is locally valued. Has moderate levels of tranquillity. Is fairly tolerant of change. Has components that are easily replaced or substituted. Has scope for effective mitigation in character with the existing townscape.
Low	Has limited townscape value. Has few or no distinctive components, or components that detract from the overall character of the site. Has limited tranquillity. Is tolerant of change. Has components that are easily replaced or substituted. Has scope for effective mitigation in character with the existing townscape, and opportunities for an improvement in character.

12.2.16 The night time character of the areas would be described, only where significant effects arising from lighting during construction or operation are considered likely.

Visual baseline

Selection of viewpoints

12.2.17 Viewpoints would be selected to allow an assessment of effects from receptors within the study area. Individual residential, hotel, healthcare, employment and educational receptors would be identified and those with the same or similar view grouped together. Representational viewpoints would be identified for recreational, transport and active sports receptors.

12.2.18 All viewpoints would be agreed with the local planning authorities and other relevant stakeholders, for example the Chilterns Conservation Board.

12.2.19 Photos during winter and summer would be included in the ES for each viewpoint. The composition of the view would be described, including foreground and background characteristics, the nature of the view towards the site, and what, if anything, obstructs the view and whether a view is panoramic, framed, glimpsed or sequential.

12.2.20 The view at night would be described, only where significant effects arising from lighting during construction or operation are likely.

Sensitivity

12.2.21 Within the study area, visual receptor types would be mapped by category in the following hierarchy shown in Table 15, based on people's level of interaction with the landscape or townscape. These categories are based on best practice guidance from the Landscape Institute.

Table 15 - Visual sensitivity

Sensitivity	
High	Occupiers of residential properties. Recreational users or tourists whose attention may be focussed on the landscape. Designated or protected views.
Moderate	People travelling through the landscape or townscape. People staying in hotels and healthcare institutions.
Low	People at work and in educational institutions. People engaged in formal sports activities.

12.3 Consultation

Consultation on the AoS

12.3.1 Effects on landscape, townscape and visual effects were raised during consultation, with reference also given in relation to the Chilterns Area of Outstanding Natural Beauty (AONB). For further details see '*Review of HS2 London to West Midlands Appraisal of Sustainability: A Report to Government by HS2 Ltd' (January 2012)*.

12.3.2 Any new large infrastructure project, especially road and railway routes could have effects on landscape and townscape receptors. In this respect, and following consultation on the AoS, a large number of changes along the route were incorporated that were driven by an approach to minimise the landscape and townscape effects and respond to other environmental concerns. This approach has included lowering viaducts and embankments and the extensive use of cuttings, bunds and other landscape design to help blend into, or screen the railway within the landscape.

12.3.3 Substantial efforts have been made to avoid effects on the landscape and townscape by following the existing contours of the land or along existing transport corridors. In addition, natural screening of the railway would be incorporated with the use of landscape earthworks, trees, hedgerows and other planting. The Government has committed to plant at least two million trees as a means of providing habitat and landscape benefits.

12.3.4 The Chiltern Hills form a long chalk escarpment lying on a direct line between London and the West Midlands, much of which is designated as an AONB. Specific concerns were raised during consultation relating to the AONB asking whether it was appropriate for such a development to effects on the landscape designation and associated features. Reference was made to policy and regulations in this respect. Additional tunnelling has been incorporated within the AONB prior to Government's announcement.

Consultation as part of the the EIA process

12.3.5 Consultees for this chapter of the ES would include (but not be limited to) local planning authorities, county councils, the Greater London Authority, Natural England, English Heritage, the Environment Agency, the Forestry Commission and the Chilterns Conservation Board.

12.4 Key aspects of the scheme for the topic

12.4.1 The main features of relevance to the landscape, townscape and visual assessment during construction include:

- Construction sites (including vehicles, construction lighting);
- Site compounds and storage areas;
- Earthworks (including temporary stockpiles or earth bunds for screening);

- Demolitions;
- Construction traffic; and
- Infrastructure and utility diversions.

12.4.2 The main features of relevance to the landscape, townscape and visual assessment during operation include:

- The track and track bed;
- Traffic (including trains and maintenance vehicles);
- The overhead line equipment (OLE);
- Tunnel portals and ventilation shafts;
- Viaducts;
- Demolitions;
- Earthworks including cuttings, embankments and earthworks such as earth bunding and regrading works, much of which would assist with screening and integrating the Proposed Scheme;
- Planting;
- Noise barriers and visual screens;
- New stations and depots; and
- Associated development, such as utility diversions.

12.5 Scope of assessment

12.5.1 The methodology for the landscape, townscape and visual assessment takes into account the guidance set out in the following documents:

- *Guidelines for Landscape and Visual Impact Assessment* (GLVIA) Landscape Institute and the Institute for Environmental Management and Assessment (Currently 2nd Edition, 2002)[58]; and
- *Design Manual for Roads and Bridges* (DMRB), Volume 11 Section 3 Part 5 'Landscape Effects' (1993).

Spatial scope

12.5.2 The landscape, townscape and visual assessment study area would be determined through the production of a zone of theoretical visibility plan (ZTV). Separate study areas would be established for:

- Construction – defined as the area over which the proposed construction activity would be visible; and
- Operation year 1 – defined as the area over which the components of the proposed development (including trains) would be visible, taking into account the assumed Limits of Deviation within which the Proposed Scheme would be located.

12.5.3 The ZTVs would be based on the most recently available topographic data. A datum of 1.6m above ground level would be used to represent the eye level

[58] Landscape Institute and the Institute for Environmental Management and Assessment (IEMA), *2002, Guidelines for Landscape and Visual Impact Assessment* (2nd Edition), Landscape Institute and IEMA

view of an average height person. The validity of the routewide ZTV would be checked on site, using professional judgement, to ensure the output is a fair representation of the theoretical visibility of the Proposed Scheme, in line with guidance provided by the Landscape Institute.

12.5.4 Both of the above documents are currently under review and the methodology that has been developed for this assessment seeks to accommodate published revisions as far as practicable. The methodology described in this report has also been developed to ensure a level of assessment appropriate to the unique characteristics of the Proposed Scheme.

12.5.5 Aspects of landscape, townscape and visual assessment are important to consider in respect of the setting of historic buildings and landscapes. The methodology in this section has been made compatible with the heritage study in this respect. The methodology in this section describes the assessment process for effects on landscape and townscape character and on visual receptors. The Cultural Heritage section of this report (Section 8) will consider the effects of the Proposed Scheme on the setting of individual cultural and heritage assets. For example this may include effects on the setting of scheduled monuments, listed buildings and registered parks and gardens.

Temporal scope

12.5.6 The landscape, townscape and visual assessment will be undertaken for the following years:

- Construction - an assessment of effects in winter during the construction phase;
- Operation year 1 - an assessment of effects in winter and summer during operation year 1;
- Operation year 15 - an assessment of effects in summer during operation year 15, once any vegetation planted as part of the Proposed Scheme has matured or has achieved its design intention; and
- Operation year 60 - to consider the benefits and/or negative effects of maturity of screen planting, restoration or offsetting.

12.6 Assessment methodology

12.6.1 Physical changes to the landscape or townscape may give rise to effects on character. Effects may be direct (whereby landscape or townscape components are lost, damaged or altered by the construction or operation of the Proposed Scheme), or indirect (whereby the proposed development alters the setting of surrounding character areas).

12.6.2 For sites where substantial lighting is anticipated during construction of operation, an assessment of landscape and townscape effects at night arising

from additional lighting, would also be made, in line with the methodology described for the day time assessment below.

Determining magnitude of change

12.6.3 The likely nature and magnitude of changes to individual landscape and townscape components and characteristics are described together with the consequential effect on landscape or townscape character. Factors that would be considered in assessing the magnitude of change to the character areas surrounding the site are summarised in Table 16 below. These criteria are based on guidance provided by the Landscape Institute.

Table 16 – Landscape and townscape magnitude of change

Impact magnitude	Definition
High	Total loss of or major alteration to key characteristics of the setting of the character area. Addition of new features or components that substantially alter the setting of the character area. Introduction of elements that markedly alter the tranquillity of the character area.
Moderate	Partial loss or alteration to one or more key characteristics of the setting of the character area. Addition of new features or components that form prominent elements of the setting of the character area, but are largely characteristic of the existing setting. Introduction of elements that noticeably alter the tranquillity of the character area.
Low	Minor loss or alteration to one or more characteristics of the setting of the character area. Addition of new features or components that form largely inconspicuous elements of the existing setting. Introduction of elements that discernibly alter the tranquillity of the character area.
Negligible	No change to, or very minor loss or alteration of inconspicuous characteristics of the setting of the character area. Addition of new features or components that do not influence the overall setting of the character area, or are entirely characteristic of the existing setting.

Impact magnitude	Definition
	Introduction of elements that make no perceptible change to the tranquillity of the character area.

Determining significance of effects

12.6.4 Determination of the significance of an effect requires the application of professional judgement including experience of other major infrastructure schemes to weigh the findings of the sensitivity of the receptor and the magnitude of change. This approach is recommended by the Landscape Institute. The presence of any combination of factors may be considered when assessing the significance of effect. This allows professional judgement to be used when determining the relative importance of different factors, which varies on a site specific basis. Effects may be adverse or beneficial. The broad criteria that influence the level of significance of landscape and townscape effects are noted in Table 17 below. Both the major and moderate categories are considered to comprise a significant effect. Any one aspect described may result in a categorisation within that significance level. These criteria are based on guidance provided by the Landscape Institute.

Table 17 – Landscape and townscape significance of effects

Significance of effect	Description **The proposed development would result in effects that:**
Major beneficial - significant	Would considerably and distinctly improve and enhance the existing character. Would restore valued characteristic features substantially or entirely lost through other land uses.
Moderate beneficial - significant	Would markedly improve and enhance the existing character. Would restore valued characteristics substantially lost through other land uses.
Minor beneficial	Would improve and enhance the existing character. Would restore valued characteristic features partially lost through other land uses.
Negligible	Would be compatible with the existing character.
Minor adverse	Would be slightly at variance with the existing character.

Significance of effect	Description The proposed development would result in effects that:
Moderate adverse -- significant	Would be at variance with the existing character. Would be judged adverse at a local level. Would not be wholly compatible with local environmental policies for the protection and enhancement of the landscape or townscape.
Major adverse - significant	Would be at considerable variance with the existing character, degrading its integrity. Would permanently degrade, diminish or destroy the integrity of valued characteristic features, elements and/or their setting. Would be judged adverse at a national or regional level. Would comprehensively conflict with national, regional or local environmental policies for the protection and enhancement of the landscape or townscape.

Visual assessment methodology

12.6.5 Visual effects relate to:

- The changes that arise in the composition of available views as a result of changes arising from the proposed development; and
- People's likely responses to changes.

12.6.6 For sites where substantial lighting is anticipated during construction or operation, an assessment of visual effects at night time arising from additional lighting, would also be made, in line with the methodology described for the day time assessment below.

12.6.7 The construction phase assessment would be undertaken during winter, when construction works are likely to be most visible.

12.6.8 The operation year 1 assessment would be undertaken during winter and summer to account for seasonal change in the visibility of the proposed development.

12.6.9 The operation year 15 and 60 assessments would be undertaken during summer to account for any vegetation planted as part of the project that has matured or has achieved its design intention, and is in full leaf.

Determining magnitude of change

12.6.10 The factors that would be considered in assessing the magnitude of change on views and on visual amenity of the identified receptors are summarised in Table 18, based on guidance from the Landscape Institute.

Table 18 - Visual magnitude of change

Impact magnitude	Definition
High	Total loss of or major alteration to key characteristics of the view from a receptor. Addition of new features or components that are continuously highly visible and incongruous with the existing view from a receptor. Substantial changes in close proximity to the visual receptor, within the direct frame of view.
Moderate	Partial loss of or alteration to one or more key characteristics of the view from a receptor. Addition of new features or components that may be continuously highly visible, but are largely characteristic of the existing view from a receptor. Changes a relatively short distance from the receptor, but viewed as one of a series of components in the middle ground of the view. Substantial change partially filtered by intervening vegetation and/or built form, or viewed obliquely from the visual receptor.
Low	Minor loss of or alteration to one or more characteristics of the view from a receptor. Addition of new features or landscape/townscape components that may be continuously or intermittently visible, but are largely characteristic of the existing view from a receptor. Changes within the background of the view, viewed as one of a series of components in the wider panoramic view from a receptor. Change largely filtered by intervening vegetation and/or built form, or viewed obliquely from the visual receptor.

Impact magnitude	Definition
Negligible	Very minor loss or alteration of inconspicuous characteristics of the view from a receptor. Addition of new features or landscape/townscape components that are largely inconspicuous and characteristic of the existing site when viewed from a receptor. Changes within the background of the view, viewed as an inconspicuous element within the wider panoramic view from a receptor. Change from a visual receptor almost entirely obscured by intervening vegetation and/or built form.

Determining significance of effects

12.6.11 Determination of the significance of an effect requires the application of professional judgement to weigh the sensitivity of the receptor with the magnitude of an impact. Effects may be adverse or beneficial. The broad criteria that influence the level of significance of visual effects are set out in Table 19 below. Both the major and moderate categories are considered to comprise a significant effect. The significance for visual effects follows the guidance provided by the Landscape Institute.

Table 19 - Significance of effects for visual assessment

Significance of effect	Description The proposed development would result in:
Major beneficial - significant	A marked improvement in the existing view.
Moderate beneficial - significant	A noticeable improvement in the existing view.
Minor beneficial	A discernible improvement in the existing view.
Negligible	No perceptible deterioration or improvement in the existing view.
Minor adverse	A discernible deterioration in the existing view.
Moderate adverse - significant	A noticeable deterioration in the existing view.
Major adverse - significant	A marked deterioration in the existing view.

Verifiable photomontage methodology

12.6.12 In some locations, to be agreed with statutory consultees, the assessment of visual effects would be supported by the production of verifiable photomontages. These would be prepared for viewpoints where:

- the receptor is highly sensitive to change and/or the viewpoint is identified in the London View Management Framework Supplementary Planning Guidance (SPG), Local authority Unitary development Plans (UDPs), Local Development Frameworks (LDFs) and SPGs, and Conservation Area character appraisals; or
- the magnitude of effect cannot be easily assessed with reference to plans, sections, elevations and 3D visualisations (e.g. where views may be partially filtered or screened by vegetation or built form, or where the precise position of elements has a particular importance in relation to the composition of a view).

12.6.13 Verifiable photomontages would be produced for construction, operation year 1 and operation year 15 as required.

Cumulative effects assessment

12.6.14 Cumulative effects arising from the Proposed Scheme in conjunction with other developments within the study area would be described with reference to how the findings of the main assessment would change. No magnitude of change or significance of effect would be described for cumulative effects.

12.6.15 The construction phase cumulative assessment would consider the effects of construction of the Proposed Scheme in conjunction with all other major developments likely to be under construction at the same time within the construction phase study area.

12.6.16 The operation year 1 cumulative assessment would consider the effects of the operation of the Proposed Scheme in conjunction with all other major developments in operation in year 1 within the operational phase study area.

13 Sound and vibration

13.1 Introduction

13.1.1 This section of the report presents the proposed approach to assessing sound and vibration effects. This has been divided into two parts, the first dealing with ground-borne sound and vibration and the second dealing with air-borne sound.

13.2 Ground-borne sound and vibration

Introduction

13.2.1 This section of the report presents the proposed approach to assessing ground-borne sound and vibration associated with the construction and operation of the Proposed Scheme.

13.2.2 Without mitigation, ground-borne vibration created by either construction activities or train services can propagate through the ground to surrounding buildings where it may result in the vibration of floors, walls and ceilings; which could also be heard as a low frequency 'rumbling' sound (called ground-borne sound).

13.2.3 The assessment will cover all sound and vibration sensitive receptors (e.g. occupied buildings), including properties for which planning permission has been granted before the safeguarding date but are not yet completed, subject to the screening distances discussed within the specific subject areas. Where a receptor has multiple uses the assessment will be made based on the most sensitive use.

Establishment of baseline and definition of survey requirements

Ground-borne sound

13.2.4 Absolute criteria, rather than sound change criteria, apply for ground-borne sound for four main reasons.

- There is rarely any appreciable existing ground-borne sound at a receptor;
- The character and nature of ground-borne sound differs from other ambient sound heard inside buildings;
- The body of experience and research available with regard to human response to ground-borne sound has mostly been based on the assessment of the maximum sound level for each train pass-by (i.e. an absolute sound level); and
- Ground-borne sound can affect any room in a property so the criteria consider situations where existing internal background sound levels are at their lowest for a particular classification of receptor (e.g. rooms on a

quiet façade of a residential receptor or new build concert hall or broadcast facility).

13.2.5 No ground-borne sound baseline survey is therefore proposed.

Ground-borne vibration

13.2.6 The majority of receptors adjacent to the HS2 route are not currently subject to appreciable levels of vibration and therefore the ground-borne vibration assessment primarily considers absolute criteria.

13.2.7 The exceptions are receptors close to existing rail sources. Baseline vibration will be calculated in these locations and verified by focused surveys.

Consultation

13.2.8 Principal consultees on the approach to the assessment of ground-borne sound and vibration are the local and county authorities.

13.2.9 Dialogue with local stakeholder groups will be via Community Forums throughout the design and assessment of the Proposed Scheme as well as through public consultation on the draft Environmental Statement (ES).

13.2.10 Responses to the consultation undertaken in 2011 indicated the need to consider ground-borne sound and vibration issues in relation to potential effects associated with vehicle movements and spoil.

Key aspects of the scheme for the topic

13.2.11 The key aspects for ground-borne sound and vibration are the following generic types of significant adverse effect:

- At very high levels, which very rarely occur adjacent to modern railways, vibration could give rise to a risk of cosmetic damage to buildings;
- Perceptible ground-borne sound and vibration in residential buildings;
- Low levels of ground-borne sound caused by imperceptible vibration could adversely affect buildings where low ambient sound levels are critical to their operation (e.g. recording and broadcast studios, concert halls and theatres); and
- Low levels of vibration that would be imperceptible to people can adversely affect buildings where low ambient vibration is critical to operations (e.g. nanotechnology laboratories).

13.2.12 The following are potential sources of ground-borne sound and vibration:

- Temporary sources: e.g. tunnel boring machine(s) and their supporting temporary construction railways, some types of piling and vibro-compaction; and
- Permanent sources: train operation and to a lesser extent other rail systems such as infrastructure maintenance depots.

13.2.13 During construction of the Proposed Scheme, mitigation of temporary ground-borne sound and vibration impacts would be on the basis of a "best practicable means" approach. "Best practicable means" may include the choice of working methods and operation times, the design and maintenance of the temporary railway and proactive community engagement.

13.2.14 For the operational railway, mitigation of ground-borne sound and vibration impacts would result from the performance specification of the rolling stock and infrastructure.

Scope of assessment

13.2.15 Temporal scope: the Proposed Scheme will be assessed at the year of opening and with the highest traffic patterns forecast for the first fifteen years of operation. This will be compared, as necessary, to the future baseline in 2026 (without the Proposed Scheme).

13.2.16 Spatial scope for direct effects: there is very little national guidance available on identifying screening distances for operational ground-borne vibration. The application of the US Federal Railway Administration (FRA) guidance[59] and Federal Transit Administration guidance[60] is consistent with the assessment of previous UK infrastructure projects. For a mitigated scheme and taking account of reasonably foreseeable worst case assumptions, the US guidance sets the following screening distances for the assessment of the potential impact arising from the operation of a new rail system. A quantitative assessment will be undertaken for all receptors within the following areas:

- Residential and non-residential receptors (except as defined below) - 85m from the centreline of the track or nearest construction activity; and
- Non-residential receptors / land uses where low ambient vibration or sound is critical to operations, for example, very sensitive laboratory equipment such as nanotechnology laboratories – 200m from centreline or nearest construction activity.

13.2.17 Spatial scope for indirect effects: a qualitative assessment will be made where the increase or decrease in rail traffic volumes or types caused by the Proposed Scheme would cause a change in the baseline Vibration Dose Value from existing railways greater than 25% (refer to

13.2.18 Table **23**).

[59] U.S. Department Of Transportation, 2005, *High-Speed Ground Transportation Noise and Vibration Impact Assessment,* Federal Railroad Administration
[60] U.S. Department Of Transportation, 2006, *Transit Noise and Vibration Impact Assessment,* Federal Transit Administration

Assessment methodology

Legislation and guidance

13.2.19 Relevant legislation includes the *Control of Pollution Act 1974*, the *Environmental Protection Act 1990*, the *Noise and Statutory Nuisance Act 1993* and the *Land Compensation Act 1973* all as amended. Relevant guidance and standards are identified in each of the following subsections.

13.2.20 The ground-borne sound and vibration potentially generated by the majority of construction activities will be calculated using the guidance in Transport Research Laboratory (TRL) Report 429[61], TRL Report 53[62] and guidance in BS5228[63].

13.2.21 The ground-borne sound and vibration potentially generated by rail operations associated with the Proposed Scheme, both temporary operations during construction and permanent, will be calculated using the calculation method developed and validated initially for the design and construction of HS1[64]. The method is empirical, developed from thousands of measurements, is fully consistent with ISO 14837[65], and takes account of all key parameters, including train design, train speed, track design, tunnel design, tunnel depth, ground conditions, receiving building foundations and receiving building type. The method has been further tested, validated and scrutinised at public inquiry on many urban mass transit systems around the world.

Impact criteria (direct Impacts)

Ground-borne sound – construction and operation

13.2.22 There are no relevant national or international standards setting criteria for ground-borne sound. The impact criteria set out in

13.2.23 **Table 20** and Table 21 have therefore been drawn from similar projects in the UK and Ireland e.g. Crossrail, the Jubilee Line, DART Underground, Dublin Metro North and HS1. These projects assess ground-borne sound in terms of the absolute level of sound generated by a train passing by.

[61] Transport Research Laboratory, 2000, *TRL Report 429: Groundborne vibration caused by mechanised construction works,* Transport Research Laboratory
[62] Transport Research Laboratory, 1986, *TRL Report 53: Ground vibration caused by civil engineering works,* Transport Research Laboratory
[63] British Standards Institution, 2009, BS 5228-2 *Code of Practice for Noise and Vibration Control on Open Construction Sites - Part 2: Vibration,* BSi
[64] Greer R, J., 1999, *Methods for Predicting Groundborne Noise and Vibration from Trains in Tunnels*, Proceedings of the LARIF and IoA Conference
[65] International Standards Organisation, 2005, *14837 Mechanical vibration – Ground-borne noise and vibration arising from rail systems – part 1: General Guidance,* ISO

Table 20 - Ground-borne sound impact criteria for residential receptors

Impact classification	Ground-borne sound level dB $L_{pAS,max,}$ (measured indoors, near the centre of any dwelling room on the ground floor)
Negligible	< 35
Low	35-39
Moderate	40-44
High	45-49
Very high	>49

Table 21 - Ground-borne sound impact criteria for non-residential receptors

Category of Building	Impact criterion dB $L_{pAS,max}$
Theatres / large auditoria & concert halls	25
Sound recording / broadcast studios	30
Places of meeting for religious worship / courts / cinemas lecture theatres / museums / small auditoria or halls	35
Offices / schools / colleges / hospitals / hotels / libraries	40
Factories / warehouses	50

Ground-borne vibration: buildings – construction and operation

13.2.24 The impact criteria for building damage are based upon guidance within BS7385: Part 2 (1993)[66]. The standard differentiates between transient and continuous vibration. For transient vibration the standard notes that the risk of cosmetic damage to residential buildings starts at a Peak Particle Velocity (PPV) of 15mm/s at 4Hz. The standard also notes that below 12.5 mm/s PPV the risk of damage tends to zero. When considering continuous vibration, the standard recommends the guide values are reduced by 50%.

[66] British Standards (BS), 1993, 7385-2 *Evaluation and measurement for vibration in buildings – Guide to damage levels from groundborne vibration*, BSi

Table 22 - Vibration impact criteria for buildings (conservative criteria below which there is no risk of cosmetic damage)

Category of building	Impact criterion: (Peak Particle Velocity - PPV - at building foundation)	
	Transient vibration	Continuous vibration
Potentially vulnerable buildings[67]	≥6 mm/s	≥3 mm/s
Structurally sound and non-listed buildings	≥12 mm/s	≥6 mm/s

Ground-borne vibration: disturbance of occupants and users of buildings – construction and operation

13.2.25 Guidance on the impact of vibration on people in buildings is presented in BS6472: 2008[68]. Part 1 of the standard assesses the impact of vibration using the Vibration Dose Value (VDV). This is a complex indicator taking into account how people respond to vibration in terms of frequency content, vibration magnitude and the number of vibration events during an assessment period.

13.2.26 Vibration from the operation of the permanent railway and the temporary construction railway will be assessed using the criteria presented in

13.2.27 Table **23**.

13.2.28 The change criteria presented in

13.2.29 Table **23** have been developed using the guidance in BS6472 and are consistent with those applied to other projects such as HS1 and Crossrail.

13.2.30 In the majority of locations along the Proposed Scheme no existing appreciable level of vibration exists and therefore an absolute criterion is proposed. In certain locations, such as those close to an existing railway, a change based criteria is used. This approach is consistent with the vibration assessment of other major railway schemes.

[67] BS7385 highlights that the criteria for aged buildings may need to be lower if the buildings are structurally unsound. The standard also notes that criteria should not be set lower simply because a building is important or historic (listed). Where information about these structures is not currently known, the significance criteria for these receptors has been set at a lower level on a precautionary basis.
[68] British Standards (BS), 2008, 6472-1 *Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting,*BSi

Table 23 - Vibration impact criteria for the disturbance (annoyance) of occupants and building users

Impact classification	**In the absence of appreciable existing levels of vibration[(1), (2)]**		**Appreciable existing levels of vibration[(1), (2) and (3)]**
	VDV $ms^{-1.75}$ Daytime (0700-2300)	**VDV $ms^{-1.75}$ Night time (2300 – 0700)**	**% increase or decrease in VDV**
Negligible	≤ 0.2	≤ 0.1	≤ 25
Minor	> 0.2 -0.4	>0.1 – 0.2	25 – 40
Moderate	> 0.4 – 0.8	> 0.2 - 0.4	> 40 – 100
Major	> 0.8 – 1.6	> 0.4 – 0.8	>100 – 185
(1) Highest impact category used, daytime or night–time			
(2) Measured at the worst location on a normally loaded floor (usually the centre of the floor).			
(3) Where there is an appreciable existing level of vibration and daytime and night-time vibration dose vales (VDVs) exceed 0.2$ms^{-1.75}$ and 0.1$ms^{-1.75}$ respectively.			

Ground-borne vibration: particularly vibration-sensitive equipment and processes – construction and operation

13.2.31 As noted in ISO 14837-1 (2005), there are no standard criteria for assessing the potential impact of vibration on sensitive equipment or processes. Where a receptor within the study area is identified that is likely to be especially sensitive to ground-borne sound and / or vibration, a risk assessment will be undertaken for that receptor based on the information currently available for the relevant equipment / process, or information provided by the building owner or equipment manufacturer.

Impact criteria (indirect impacts)

13.2.32 Changes in rail traffic flows on the existing network will be used to calculate changes in vibration, at source, in VDV. These changes will be compared with the criteria in

13.2.33 Table **23** to indicate whether the change could result in a potentially significant impact.

Significance criteria - Residential receptors

13.2.34 For residential receptors, significant effects will be determined by taking into account:

- The magnitude of the impacts;
- The number and grouping of impacts;
- The potential combined impacts of air-borne sound, ground-borne sound and ground-borne vibration;
- The frequency and duration over which temporary construction impacts may occur; and
- The effectiveness of mitigation through design or other means.

Significance criteria - Non-residential receptors

13.2.35 For non-residential receptors, significant effects will be determined by taking into account:

- The type of effect:
- The magnitude of the impact;
- The design of the receptor affected;
- The existing ambient sound and vibration levels in the receptor affected;
- The use and sensitivity of the receptor;
- The potential combined impacts of ground-borne sound and vibration;
- The frequency and duration over which temporary construction impacts may occur; and
- The effectiveness of mitigation through design or other means.

Cumulative Effects

13.2.36 Sound and vibration impacts, both permanent and temporary, will be identified for the Proposed Scheme and other developments, either under construction or consented as referred to in Section 2 of this report. The results of these assessments will then be used to qualitatively assess potential cumulative significant effects arising from the Proposed Scheme and any other developments having regard to, amongst other things, spatial and temporal overlap of the sound and vibration impacts.

13.2.37 Community or health effects arising from significant effects identified for ground-borne sound and vibration will be considered and reported in the community section of the ES.

Assumptions

13.2.38 Assumptions for the ground-borne sound and vibration assessment include:

- Design assumptions (e.g. train specification, revenue service speeds and timetables); and
- Maintenance specifications.

13.3 Airborne sound

Introduction

13.3.1 This section presents the proposed approach to assessing airborne sound associated with the construction and operation of the Proposed Scheme. Sound generated by the project has the potential to cause disturbance to neighbouring sound sensitive receptors.

13.3.2 Without mitigation, during construction, airborne sound would be generated by equipment, construction worksites, construction vehicles on haul routes and local roads, and changes to road traffic.

13.3.3 During operation, airborne sound would be generated by trains and other (fixed) sources such as: line side equipment; ventilation shafts; depots and stations. The Proposed Scheme may also cause changes in road and rail traffic flow on the current road and rail networks.

13.3.4 The assessment will cover all sound sensitive receptors, including properties for which planning permission has been granted before the safeguarding date but are not yet completed, subject to the screening distances discussed within the specific subject areas. Where a receptor has multiple uses the assessment will be made based on the most sensitive use.

Establishment of baseline and definition of survey

13.3.5 Baseline information is important to airborne sound assessment. To facilitate dialogue with stakeholders, baseline information will be gathered incrementally through field surveys focused on locations where likely significant effects are forecast. The baseline and impact assessment for the project will be developed and refined in three stages.

13.3.6 Initially the project will gather available existing data to form the best possible 'desk top' baseline (Baseline 1). The Baseline 1 data will be used early in the programme to support initial dialogue, assessment work and design development. Initial field surveys will be undertaken during the summer of 2012 to fill gaps in Baseline 1 data and provide more detailed information at locations where significant effects are likely. Combined with Baseline 1, these data will form Baseline 2, to be used for the draft ES. Further, more targeted surveys will be undertaken in early 2013 responding to the findings of the draft ES assessments and ongoing stakeholder dialogue. Combined with Baseline 2, these data provide Baseline 3 for the final ES.

13.3.7 The baseline data gathering will focus not just on collecting objective data that describes the ambient sound environment but also information on the local sound environment, including indicators of its soundscape.

Consultation

13.3.8 Principal consultees on the approach to the assessment of airborne sound are the local and county authorities.

13.3.9 Engagement with local stakeholder groups will be via Community Forums throughout the design and assessment of the Proposed Scheme.

13.3.10 Responses to consultation in 2011 raised the following reoccurring matters in respect of the acoustic assessment presented in the Appraisal of Sustainability (AoS):

- Potential effects associated with vehicle movements and spoil disposal;
- Concern that the equivalent continuous sound (L_{pAeq}) indicator 'averages out' the impact associated with intermittent train sound;
- A request to present contour maps;
- The need to consider pantograph sound particularly in respect of the height of the source above ground compared to the height of noise barriers;
- That the assumed 3 dB reduction in train sound emission levels (compared to current high speed trains) may not be reasonable; and
- The need to assess sound levels in terms of the long term expected usage of the Proposed Scheme.

Key aspects of the scheme for the topic

13.3.11 The following are potential sources of airborne sound:

- Temporary sources:
  - Direct effects could be caused by airborne sound from significant construction activities such as tunnelling, demolition, earthworks, viaducts, bridges, road realignments, station construction and track works. These activities would be supported from local work compounds close to the structure / tunnel being constructed, local worksites, or larger worksites from where activities are coordinated;
  - Indirect effects could be caused by temporary changes to road and rail traffic patterns on the existing networks during construction.
- Permanent sources:
  - Direct effects could be caused by the operational railway and its supporting systems (e.g. stations/interchanges, infrastructure maintenance depots, vent shafts and other line side equipment).
  - Indirect effects could be caused by long term changes to road and rail traffic pattern on the existing networks.

13.3.12 During construction of the Proposed Scheme, mitigation of construction sound impacts would be on the basis of a "best practicable means" approach. "Best practicable means" may include the choice of working methods and operation times, logistical planning with sound in mind, physical barriers and proactive community engagement.

13.3.13 Sound levels from the operational railway may be reduced through the performance specification of the rolling stock, infrastructure and environmental barriers.

Scope of assessment

13.3.14 Temporal scope: The Proposed Scheme will be assessed at the year of opening and with the highest rail traffic patterns forecast for the first fifteen years of operation. This will be compared, as necessary, with the future baseline in 2026 (without the Proposed Scheme).

13.3.15 Spatial scope for direct effects - for a mitigated scheme and taking account of reasonably foreseeable worst case assumptions, the following screening distances will be used which are consistent with HS1 and in excess of guidance from sources such as US Federal Railway Administration Guidance for High Speed Rail:

- Construction (from BS 5228 Part 1)[69] - 300m from any construction activity;

[69] British Standards (BS), 2009, 5228-1 *Code of Practice for Noise and Vibration Control on Open Construction Sites - Part 1: Noise*, BSi

- Operational HS2 railway – 500m and 1km from the centreline of the line of route in urban and rural areas respectively or the area within which sound levels from the Proposed Scheme are forecast to exceed 50 dB $L_{pAeq,16hr}$ during the day or 40 dB $L_{pAeq,8hr}$ during the night (consistent with World Health Organisation guidelines).

13.3.16 Spatial scope for indirect effects - a qualitative assessment will be made where the increase or decrease in road or rail traffic volumes or traffic types caused by HS2 would be likely to cause a change in the baseline sound level ($L_{pAeq,T}$) exceeding 3 dB during either the day (07:00 to 23:00) or night time periods (23:00 to 07:00).

Assessment methodology

Legislation and Guidance

13.3.17 Relevant legislation includes the *Control of Pollution Act 1974*, the *Environmental Protection Act 1990*, the *Noise and Statutory Nuisance Act 1993*, the *Land Compensation Act 1973* (including the Noise Insulation Regulations 1996) and *the European Communities Act 1972* (including the Environmental Noise (England) Regulations 2006) all as amended. Relevant guidance and standards are identified in each of the following subsections.

13.3.18 The airborne sound generated by construction activities shall be calculated using the method set out in British Standard BS 5228 Part 1.

13.3.19 The airborne sound generated by rail operations associated with the Proposed Scheme, both permanent and temporary operations during construction, will be calculated using the calculation method developed and validated initially for the environmental assessment, and then the design, of HS1[70]. The method is empirical, developed from over a thousand measurements. The method has been further tested and verified since HS1. The method calculates maximum sound levels for each train as well as equivalent continuous sound levels. The method has been further refined for HS2 to allow for aerodynamic sound sources at speeds over 300 kph.

13.3.20 The airborne sound generated by the Proposed Scheme's rail supporting systems (e.g. stations/interchanges, depots, train stabling, vent shafts, etc) will be calculated using appropriate national or international standards (e.g. ISO9613[71]) Plant is generally not finalised until the detailed design phase. Where insufficient information is available on plant to be used, limits will be set based on baseline sound data.

[70] Williams P,R et al.,1991, *Validation of the AEL Methodology for the Calculation of Train Noise*, Proceedings of the POLMET Conference 1991

[71] International Standards Organisation (ISO), 1996, ISO 9613-2:1996 *Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation*, ISO

13.3.21 The number and location of properties estimated to qualify under the Noise Insulation (Railway and Other Guided Transport Systems) Regulations (1996) will be reported.

Impact criteria (direct impacts)

Airborne sound – construction

13.3.22 The construction sound assessment categories for the Proposed Scheme are presented in

13.3.23 **Table 24**. These are based upon the experience from other major infrastructure projects and BS5228: Part 1: 2009. The criteria are guided by the prevailing baseline ambient sound levels in the locale of the receptor.

Table 24 - Airborne sound from construction - impact criteria at dwellings (construction sound only)

Period	**Assessment category**		
	A	**B**	**C**
Day: T=12hr, Weekdays, 07.00-19.00, T=6hr, Saturday, 07.00-13.00	>65 dB $L_{pAeq,T}$	>70 dB $L_{pAeq,T}$	>75 dB $L_{pAeq,T}$
Evenings and weekends: T=1hr Weekdays 19.00–23.00, Saturdays 13.00–23.00, Sundays 07.00–23.00	>55 dB $L_{pAeq,T}$	>60 dB $L_{pAeq,T}$	>65 dB $L_{pAeq,T}$
Night: T=1hr Every day 23.00–07.00	>45 dB $L_{pAeq,T}$	>50 dB $L_{pAeq,T}$	>55 dB $L_{pAeq,T}$

Notes:

Category A: are values to use when baseline ambient sound levels (rounded to the nearest 5 dB) are less than these values;
Category B: are values to use when baseline ambient sound levels (rounded to the nearest 5 dB) are the same as category A values; and
Category C: are values to use when baseline ambient sound levels (rounded to the nearest 5 dB) are higher than category A values.

If the ambient sound level exceeds the Category C threshold values given in the table (i.e. the ambient sound level is higher than the above values), then an impact is deemed to occur if the total $L_{pAeq,T}$ sound level for the period increases by more than 3 dB due to construction activity.

Airborne sound – operational train movements

13.3.24 Operational sound impacts (positive and negative) will be identified where:

- The Proposed Scheme causes a change in the equivalent continuous sound level between 07:00 and 23:00 hrs ($L_{pAeq,16hr}$) of 3 dB or greater; or
- The Proposed Scheme causes a change in the equivalent continuous sound level between 23:00 and 07:00 ($L_{pAeq,8hr}$) of 3 dB or greater; or
- The maximum sound level ($L_{pAF,max}$) from an HS2 train pass-by is 85 dB or greater at the façade of the receptor.

13.3.25 A change in the equivalent continuous sound level (day or night period) of more than 3 dB will only be considered further if the absolute sound levels from the Proposed Scheme are above the values of 50 dB $L_{pAeq,16hr}$ during the daytime and 40 dB $L_{pAeq,8hr}$ at night.

13.3.26 The magnitude of an impact will be quantified using the semantic scale in Table 25.

Table 25: Airborne sound from operational train movements - impact criteria

Impact Classification	**Sound level change dB $L_{pAeq,T}$ (positive or negative)** T = either 16hr day or 8hr night
Negligible	≥ 0 dB and < 1 dB
Small impact	≥ 1 dB and < 3 dB
Minor Impact	≥ 3 dB and < 5 dB
Moderate Impact	≥ 5 dB and < 10 dB
Major Impact	≥ 10 dB

Airborne sound – operational static sources

13.3.27 Sound from static sources will be evaluated by comparing the rating level against background levels following the principles set out in *BS4142:* 1997[72]. The background level used in the evaluation will be representative of those typically occurring at the receptor during the day and night depending on the source's hours of operation.

13.3.28 Operational static source impacts will be identified where the rating level of the new sound source exceeds the background level by a margin greater than 5 dB. The semantic descriptors used to describe the impact will be as described in Table 26.

[72] British Standards (BS),1997, 4142 *Method for rating industrial noise affecting mixed residential and industrial areas,* BSi

Table 26 - Airborne sound from operational static sources - impact criteria

Impact Classification	Rating level – background level
No impact	< -10 dB
Negligible	≥ -10 dB and < 0 dB
Minor	≥ 0 dB and < 5 dB
Moderate	≥ 5 dB and < 10 dB
Major	≥ 10 dB

Impact criteria (indirect impacts)

13.3.29 Changes in traffic flows on the existing road and rail network will be used to calculate changes, at source, in equivalent continuous sound levels ($L_{pAeq,16hr}$). A minor impact (3 dB or greater) will be taken as an indicator of potential significance unless the receptor is currently exposed to high levels of sound, in which case a small impact (1 dB or greater) may be taken as an indicator of potential significance.

Significance Criteria - Residential receptors

13.3.30 For residential receptors, significant effects will be determined by taking account of the following factors:

- The number and grouping of impacts;
- The magnitude of the impacts;
- The existing sound environment in terms of the absolute level and the character of the existing soundscape. For example, greater weight will be given to a sound level change between 1 and 3 dB if the area is already exposed to high levels of railway sound. A sound level change of less than 1 dB may be taken as an indicator of potential significance if the area is already exposed to high levels of railway sound. High levels of sound exposure will be evaluated having regard to the criteria contained in:
  - the Noise Insulation (Railway and Other Guided Transport Systems) Regulations[73], and
  - the Noise Action Plans in England[74] for 'First Priority Locations'
- The potential combined impacts of sound and vibration;
- The duration of impact for temporary sources; and
- The effectiveness of mitigation through design or other means.

[73] HM Government, 1996, *The Noise Insulation (Railways and Other Guided Transport Systems) Regulations*, The Stationery Office
[74] Department for Environment Food and Rural Affairs (Defra), 2012, *Noise Action Plans,* Defra

Significance Criteria - Non-residential receptors and land uses

13.3.31 For non-residential receptors and land uses, significant effects will be determined, on a receptor-by-receptor basis, by taking into account:

- The use and sensitivity of the receptor or land use;
- The design of the receptor or land use affected;
- The existing sound environment in the receptor, or on the land use, affected;
- The magnitude of the forecast impact;
- The potential combined impacts of sound and vibration;
- The frequency and duration over which temporary construction impacts may occur; and
- The effectiveness of mitigation through design or other means.

Significance Criteria - Quiet areas

13.3.32 Effects on quiet areas or other resources which are prized for providing tranquillity will be assessed having regard to:

- The criteria set out in the Noise Action Plans in England for 'Quiet Areas', and
- Tranquillity indicators (for land use);
- The duration over which temporary construction impacts may occur; and
- The effectiveness of mitigation through design or other means.

Cumulative Effects

13.3.33 Community or health effects arising from significant effects identified for airborne sound will be considered and reported in the community chapter of the ES.

13.3.34 Secondary effects (e.g. on landscape) associated with mitigation (e.g. sound barriers) proposed to reduce or remove airborne sound significant effects will be considered under the relevant chapter of the ES.

13.3.35 Sound and vibration impacts, both permanent and temporary, will be identified for the Proposed Scheme and other developments, either under construction or consented as referred to in section 2.4 of this report. The results of these assessments will then be used to qualitatively assess potential cumulative significant effects arising from the Proposed Scheme and these committed developments having regard to, amongst other things, spatial and temporal overlap of the sound and vibration impacts.

Assumptions

13.3.36 Assumptions for the airborne sound assessment include:

- Design assumptions (e.g. train specification, maintenance specification, revenue service speeds and timetables); and
- Sound emission limits as set by the Technical Specification for Interoperability as amended.[75] [76]

[75] European Commission (EC), 2008, *2008/232/CE - Command decision of 21 February 2008 concerning a technical specification for interoperability relating to the 'rolling stock' sub-system of the trans-European high-speed rail system,* EC

[76] European Commission (EC), 2011, *2011/229/EU - Command decision of 4 April 2011 concerning the technical specifications of interoperability relating to the subsystem 'rolling stock – noise' of the trans-European conventional rail system,* EC

14 Socio-economics

14.1 Introduction

14.1.1 This section sets out the methodology for the socio-economic assessment. The focus will be on identifying significant socio-economic and employment effects at different project stages and in different locations. The need for a Socio-Economic assessment results from the potential for the Proposed Scheme to generate impacts on:

- Existing businesses;
- Local and sub regional economies, including employment;
- Planned growth and development; and
- Wider concentrations of economic activity.

14.1.2 The socio-economic assessment will feed into the community assessment chapter of the ES and will draw upon other assessments where relevant, such as agriculture and soils in relation to farm-based businesses. Specifically this topic will focus on the implications for economic actors and development implications. (The consequent community implications of these effects are covered in the Community Assessment).

14.1.3 The assessment will also complement the wider business case for HS2, focusing on the identifiable implications for jobs, skills and development, particularly along the route of the Proposed Scheme and elsewhere (e.g. relevant locations on the West Coast Main Line (WCML). The assessment is distinguished from the wider business case in that it will identify direct and significant impacts on local and sub-regional economies. The wider business case is related to, but differs from, the Socio-Economic assessment in that it predicts overall benefits to the output of the national economy. These savings represent many rounds of effects over a wide area, which may not have directly observable or significance consequences in the context of EIA.

14.2 Establishment of baseline and definition of survey

Characteristics of communities

14.2.1 The need to minimise negative socio-economic effects has influenced the development of HS2, for example by alignment of the route's centreline to avoid the majority of communities between London and the West Midlands, further extension of tunnels, and provision of green tunnels.

14.2.2 The route nevertheless passes through - and potentially affects - a diverse range of communities and people. The main centres of population comprise the Greater London and Greater Birmingham areas. Other key settlements near the Proposed Scheme include Amersham, Wendover, Aylesbury, Brackley and Kenilworth. The route will also pass close to a number of

villages, hamlets and isolated farmsteads in the countryside. These communities are more dispersed, rural/agricultural communities.

Baseline data and methods

14.2.3 The assessment will rely on two general sources of information: technical evidence and stakeholder views. Stakeholder views will inform how best to approach the more qualitative aspects of the work.

14.2.4 Key data providers are likely to include local authorities, dedicated sub-regional bodies and specialist research organisations.

14.2.5 Baseline information will be presented against comparator statistics for benchmark areas. Benchmark areas will include a local catchment, the host district and wider areas or a county where appropriate. It will draw on a number of sources covering:

- Existing planning, economic and regeneration plans and strategies;
- Population and migration;
- Labour supply;
- Employment and unemployment;
- Enterprises;
- Commuting patterns;
- Development potential/capacity; and
- Existing studies on wider economic effects during operation.

14.2.6 Data will be collected by a variety of methods including: accessing national data sets; requesting and accessing local information; exchange of information with other environmental topics; and carrying out or commissioning new studies and/or field surveys where gaps exist.

14.3 Consultation

Consultation on the AoS

14.3.1 Key stakeholders were consulted through a reference group in preparation for the Appraisal of Sustainability (AoS). Relevant stakeholders included business – local, regional and national; Chambers of Commerce; other bodies representing business e.g. the Federation of Small Businesses; professional bodies; local government; local enterprise partnerships and companies representing specific utility and transport infrastructure interests.

14.3.2 A wider consultation process was also undertaken as part of the AoS; the responses to which focused on jobs, social equity, local benefit and specific proposals. A total of 7,487 responses stated that the proposed network will create jobs across the UK, sustain the competitiveness of the economy, and positively affect regeneration and regional development. A number of respondents expressed doubt about the forecasted economic benefits, with some stating that only a few places will benefit and some may lose activity. Although numerous responses concentrated on the benefits to the UK as a

whole, a recurring issue was the distribution of potential positive impacts and concerns that a North-South divide would be exacerbated. A total of 2,599 respondents were concerned that these benefits would be restricted to a few locations and that, for example, communities having to cope with disruption during construction and operation would not see any benefits.

14.3.3 Specific consultation responses on the interchange proposals were divided on the merit of the interchange at Old Oak Common, with some focusing on the regeneration and economic benefits, whilst others contended that the area is not well connected. In the West Midlands, a common theme for respondents was whether or not the proposed Curzon Street Station is close enough to Birmingham city centre to fully realise the benefits.

Consultation as part of the EIA process

14.3.4 In conjunction with the wider consultation process further consultation will be carried out as part of the Socio-Economic Assessment. Relevant formal and other stakeholders will be contacted, including:

- Local authorities with territory within 1-2km of proposed stations/ interchanges, junctions and depots (and potentially local authorities affected by any secondary effects on the WCML and other routes);
- Major development interests around the stations etc, identified through dialogue with the local planning authorities;
- Local Enterprise Partnerships;
- Other business representative bodies including: Chambers of Commerce and the Federation of Small Businesses;
- Organisations involved with mitigation/enhancement measures, such as Job Centre Plus and specialist industry-based training bodies concerned with engineering and construction;
- The Homes and Communities Agency (HCA);
- Relevant local bodies established to promote enterprise and social enterprise; and
- Inward investment promotional bodies, e.g. UK Trade and Investment and other relevant local regeneration or economic development bodies.

14.3.5 Organisations will be consulted initially to explore issues and to discuss/respond to the first draft Socio-Economic assessment. Engagement will be tailored as appropriate to each organisation.

14.4 Key aspects of the scheme

14.4.1 Relevant aspects of the scheme include:

- Direct, indirect and catalytic effects of construction and operation;
- Demand for labour, particularly during construction, including labour skills and sources;
- Relocation of businesses during construction, e.g. for development of new stations;

- Economic effects of additional passengers and their travel to/from the stations, including effects on existing local transport and businesses;
- Indirect effects on businesses and labour markets served by the existing West Coast Main Line and any other lines affected by HS2;
- The economic and land use effects of changes in accessibility;
- Catalytic effects on planned and anticipated development; and
- Wider catalytic effects and city regeneration.

14.5 Scope of assessment

Spatial scope

14.5.1 The spatial scope of the assessment will vary according to the type of resource or receptor. These are summarised in Table 27 below.

Table 27 – Socio-economic assessment: resources, receptors and spatial scope

Theme/ Resources	Receptors	Spatial scope
Business displacement	Existing businesses and people reliant on the businesses for employment	Generally around the stations and along the area of landtake for the route (including construction land requirements)
Local development and catalytic effects	Businesses and workforces	Within 15-20 minutes' walk or 1-2km of stations/interchanges
Indirect effects of project expenditures	Sub regional economy	Within 30km of the route
Construction labour	Potential construction workers	Within 90 minute travel time of construction access points
Displacement of existing employed labour for construction	Existing businesses	Within 30km of the route
Wider catalytic effects	Regions/locations	Within the wider region

Temporal scope

14.5.2 The temporal scope is outlined in Section 2 of this report. Socio-economic impacts will generally be assessed for the construction period (2017 – 2026) and operational capacity (based on operational services of, at peak, 18 trains per hour) in 2035. Impacts will also be assessed in the future against three scenarios reflecting different service intensities (high, medium and low). For

Socio-Economic impacts 10 years following completion is considered an appropriate timescale[77].

Uncertainty

14.5.3 The assessment of impacts will take into account how uncertainty and variability of impacts could generate different effects. For example, variability in service frequency could have varying impacts on locations experiencing changed accessibility due to the Proposed Scheme.

14.6 Assessment methodology

14.6.1 The effects of the Proposed Scheme will be considered at varying spatial levels according to the nature of the effect in each case, through comparison of the baseline scenario with the proposed development scenario.

Legislation and guidance

14.6.2 The available guidance on socio-economic assessment sets out the overarching principles for the assessment, including the assessment of gross and net impacts and recognition of the wider economic impacts of transport schemes. The HCA employment densities guide will be used where necessary to estimate employment in identified floorspace where it is not practical to undertake a direct survey. Relevant guidance includes:

- *Treasury Green Book* (2003) Appraisal and Evaluation in Central Government;
- DfT WebTAG guidance (on wider economic effects of transport);
- English Partnerships (2008) *Additionality Guide, A standard approach to Assessing Additional Effects of Projects*;
- HCA (2010) *Employment Densities Guide*; and
- Good practice from other EIAs, for example, Crossrail and Thames Tunnel.

Significance criteria

14.6.3 Since there is no definitive guidance on significance criteria for Socio-Economic effects, the assessment will draw on existing practice. The significance of a socio-economic effect will be determined by assessing both the:

- Magnitude of the effect; and
- Sensitivity of receptors.

[77] RDA Evaluation: Practical Guidance on Implementing the Impact Evaluation Framework BIS (2009). Suggests 10 years is an appropriate timescale for persistence effects of major infrastructure projects. This was based on PwC research into persistence effects of publicly funded infrastructure and regeneration projects.

Determining magnitude of impacts

14.6.4 The magnitude of an impact represents its severity or scale, and is influenced by:

- Spatial extent (localised/isolated versus widespread with potential secondary effects);
- Extent (number of groups and/or people, households or businesses affected);
- Duration;
- Conformity with standards for provision or accessibility (as set out in regional or local planning guidance);
- Permanence;
- Likelihood;
- The scope for incorporated environmental design features or mitigation; and
- Value of the resource.

14.6.5 Based on the above considerations, guideline criteria will be used to determine the magnitude of the impacts on the basis of professional judgement and existing practice and are presented in Table 28 below.

Table 28 - Socio-economic impact magnitude criteria

Impact magnitude	Definition
High	An impact that will be very severe/beneficial, and/or very likely to affect large numbers of businesses and/or people (with number depending on the local context), and that will usually continue and effectively constitute a permanent, long-term impact on the base case conditions.
Moderate	An impact that is likely to affect a moderate number of businesses and/or people (with number depending on the local context).
Low	An impact that is likely or may affect a small number of businesses and/or people (with number depending on the local context) and/or that usually does not extend beyond the life of the project so that the base case is not affected beyond a short or medium-term duration.
Negligible	An impact that is temporary in nature and/or is unlikely to measurably affect the well-being of businesses and/or people or a lower value resource so that the existing base case remains constant.

Determining receptor sensitivity

14.6.6 Guideline criteria have been established using professional judgement and existing practice to determine the sensitivity of the receptors. These are presented in Table 29.

Table 29 - Socio-economic receptor value/sensitivity criteria

Receptor value and/or sensitivity	Definition
High	Businesses, workforces or economies that are at risk and that have little or no capacity to experience the impact without incurring a significant Socio-Economic loss (or gain) of an economic resource, or employment.
Moderate	Businesses, workforces or economies that have a limited or average capacity to experience the impact without incurring a significant Socio-Economic loss (or gain) of an economic resource, or employment.
Low	Businesses, workforces or economies that generally have adequate capacity to experience impacts without incurring a significant Socio-Economic loss (or gain) of an economic resource, or employment.

Determining the significance of effects

14.6.7 The significance of a socio-economic effect is a product of the magnitude of the impact and the sensitivity of the receptor, and will be assessed on the basis of professional judgement and existing practice.

14.6.8 The approach to determining significance is summarised in Table 30 below.

Table 30 - Socio-economic - significance of effect criteria

Significance		Impact magnitude			
		High impact	**Medium impact**	**Low impact**	**Negligible impact**
Sensitivity of receptor	High	Major adverse – significant	Major adverse – significant	Moderate adverse – significant	Minor adverse – not significant
	Moderate	Major adverse – significant	Moderate adverse – significant	Minor adverse – not significant	Negligible – not significant
	Low	Moderate adverse -	Minor adverse –	Negligible – not	Negligible – not

Significance		Impact magnitude			
		High impact	**Medium impact**	**Low impact**	**Negligible impact**
		significant	not significant	significant	significant

14.6.9 Effects are considered to be significant if both impact magnitude and receptor sensitivity are high or medium. Additionally, effects are considered to be significant if impact magnitude is high and receptor sensitivity is low, or alternatively if receptor sensitivity is high and impact magnitude is low. This equates to major and moderate adverse/beneficial effects.

14.6.10 Other effects, equating to minor adverse/beneficial and negligible effects, are not considered to be significant.

Construction effects

14.6.11 Construction effects will be assessed following accepted EIA assessment processes including:

- Establishment of the baseline with definition and collection of relevant data and information as outlined in 14.2 above;
- Consultations including those outlined in 14.3 above;
- Assessment of impacts and effects against key aspects of the scheme as outlined in 14.4 above, covering the scope outlined in 14.5 above and using the significance criteria outlined above;
- Consideration and integration of EqIA and HIA assessments; and
- Iterative further assessment of impacts identified through other EIA work.

Operational effects

14.6.12 The same process will be used for assessment of operational effects as outlined for construction effects above.

Cumulative effects

14.6.13 Cumulative effects will be identified on the basis of a high level assessment of projects individually or cumulatively in the planning pipeline that have the potential to interact significantly with the Proposed Scheme. Relevant projects will include any major infrastructure projects e.g. HS2 phase 2 and large scale urban development, e.g. urban extensions. The known characteristics of such projects will be converted into an employment effect using productivity assumptions and identified in relation to the Proposed Scheme's own timeline.

14.7 Assumptions

14.7.1 Key assumptions include:

- The assumption that labour productivity underpinning the labour demand curve remains constant over the life of the project (e.g. no major changes in technology and method of work that lead to changes in the skills mix, etc); and
- The assumption that projections of the baseline/counterfactual (without HS2 economic trends) remain constant over the lifespan of the Proposed Scheme (in terms of known major projects, macro economic conditions, etc).

15 Traffic and Transport

15.1 Introduction

15.1.1 The traffic and transport assessment will assess the impacts on pedestrians, cyclists, equestrians, mobility impaired people, highways, public transport, stations and interchanges and depots. It covers the impacts that are likely to occur temporarily during the construction phase and also during the permanent operational period.

15.1.2 The Proposed Scheme is a transport project and therefore by its very nature will affect existing transport networks. A transport modelling exercise is being undertaken which will inform this section of the EIA. The development of the transport model may result in refinements to the proposed scope and criteria described below.

Issues to be Considered

15.1.3 The following key effects will be among those assessed:

- Changes in traffic (including lorries), public transport, pedestrian and cyclist flows;
- Alterations to road layout/road closures/ road diversions/ road widening/alterations (including stopping and passing places)/ junction improvements/diversion of rights of way;
- Changed access to properties and worksites;
- Changes to journey times and journey distances for private and commercial vehicle occupants;
- Changes in accessibility, journey times, distances or frequencies for stations, interchanges and public transport;
- Changes to interchange, taxi parking/ operation, and delivery and servicing;
- Changes to bus routes and stop locations; and
- Changed journey times and distances, and changes in amenity, for vulnerable road users and waterway users.

15.2 Establishment of baseline and definition of survey requirements

15.2.1 Traffic data, traffic surveys and modelling will be undertaken to inform the transport models along the route. These transport models will also be used to provide information to determine the baseline for this Traffic and Transport assessment for the EIA.

15.2.2 The future baseline will include consideration of the growth in travel demand, including the changes arising from committed developments and proposed transport network improvements.

15.3 Consultation

Consultation on the AoS

15.3.1 The main traffic and transport themes raised during consultation on the Appraisal of Sustainability (AoS) are set out below:

- Issues about whether the highway and public transport networks around the stations and interchanges could cope with the additional demands that would be placed upon them;
- Traffic and transport issues were raised in relation to the need to minimise potential disruption and disturbance during the construction of the Proposed Scheme, including tunnels and viaducts;
- Some respondents were concerned that footpaths and rights of way would become inaccessible or be closed. Others mentioned that some waterways would be negatively affected; and
- Concerns were raised about general disruption to roads from increasing traffic levels and reduced access to local areas during construction of the Proposed Scheme. These concerns were raised in relation to both the local road network and parts of the strategic road network as well.

Consultation as part of the EIA process

15.3.2 The following organisations will be amongst those to be consulted on traffic and transport issues:

- Department for Transport (DfT);
- Highways Agency;
- Network Rail;
- Transport for London;
- Centro;
- County, District and Parish Councils;
- Local Enterprise Partnerships;
- Rail Passengers Council;
- Disabled Persons Transport Advisory Committee;
- Office of Rail Regulator; and
- Emergency Services.

15.4 Key aspects of the scheme for the topic

15.4.1 Construction and operation of the following elements of the Proposed Scheme are relevant to the topic of traffic and transport:

- The railway itself;

- The new stations and interchanges at Birmingham Curzon Street, Birmingham International Interchange, Old Oak Common and Euston Station;
- Stabling, infrastructure maintenance and rolling stock depots;
- Interfaces with other public transport and highway networks;
- Rights of way and users (pedestrians, cyclists etc); and
- All construction including tunnelling, tunnel portals and vent shafts

15.5 Scope of assessment

Spatial Scope

15.5.1 The spatial scope of the traffic and transport assessment will be different for the construction (temporary) and operational (permanent) impacts being assessed. These are discussed in further detail below:

Spatial scope – temporary

15.5.2 The assessment will focus on traffic and transport issues resulting from land taken for worksites, the presence of construction HGV traffic on the local road network, and effects on routes crossing the construction areas (footpath and highways). The extent of the assessment will include:

- The highway network (including parking, loading and access arrangements) affected by construction worksites and on routes used by construction traffic, focusing on routes between worksites and the strategic road network surrounding the Proposed Scheme;
- Public transport networks directly affected by construction works including heavy rail, light rail, the London Underground and bus and coach services, including lines, routes and stations that may be indirectly affected by the Proposed Scheme;
- Transport interchange arrangements such as bus to rail in the vicinity of stations, interchanges and worksites;
- Pedestrian, cyclist and equestrian routes in the vicinity of the Proposed Scheme;
- Railways used to transport materials and excavated materials; and
- Navigable waterways.

Spatial scope – permanent

15.5.3 When operational the spatial scope will include the transport routes where there is a significant change in the usage either through people accessing HS2, or from the effects of modal shift. It will also include roads and other rights of way that are permanently diverted or stopped up.

15.5.4 The assessment will therefore include:

- The highway network where changes are likely to occur as a result of the Proposed Scheme;
- The public transport system where it is affected by the increased usage or changed journey patterns arising from the Proposed Scheme, including heavy and light rail, underground and bus and coach services;
- Pedestrian, cyclist and equestrian routes in the vicinity of the Proposed Scheme; and
- Navigable waterways potentially affected by the Proposed Scheme.

Temporal Scope

15.5.5 Potential effects will be considered for the following:

- Construction Period (2017-2026): impacts arising from construction;
- Year 1 operation (2026): impacts associated with operation; and
- Year 15 operation (2041): assumed to reflect the full technical capacity operation as HS2 as a whole (i.e. 18 trains per hour per direction in the peaks).
- In addition, a qualitative assessment will be undertaken with Phase 1 operating at its capacity prior to opening of Phase 2.

15.6 Assessment methodology

15.6.1 The Transport Assessment developed for the Proposed Scheme will be used as the basis for the forecasts of passenger and vehicle movements and transport network characteristics that will be used in this EIA. The traffic and transport effects arising from the construction strategy and engineering design for the Proposed Scheme will also be assessed within this process.

15.6.2 Having established the likely changes on the road and public transport networks during construction and operation, impacts will be assessed using a set of criteria developed for the Proposed Scheme.

15.6.3 The detailed criteria used for the identification and assessment of potentially significant impacts are provided below. The magnitude of each impact and its significance will be predicted by a variety of mechanisms, including computer modelling and professional judgement.

Guidance

15.6.4 Whilst there is no legislation on how Transport Assessments should be undertaken the following guidance documents are relevant:

- *Guidance on Transport Assessment, Department for Transport, March 2007.*
- *Transport Assessments Best Practice, Guidance Document, TfL, April 2010.*

Significance criteria for construction assessment

15.6.5 The criteria outlined below will be used to assess the significance of temporary traffic and transport impacts during the construction of the Proposed Scheme at stations, interchanges, depots and work sites along the route.

15.6.6 The criteria have been based on information included in the following documents, and professional judgement:

- Department of Transport (1993 and updates), *Design Manual for Roads and Bridges Volume 11, Environmental Assessment;*
- Department for Transport, Transport Analysis Guidance, *WebTAG,* www.webtag.org.uk;
- Institute of Environmental Assessment (1993), *Guidelines for the Environmental Assessment of Road Traffic;* and
- Institution of Highways and Transportation (1994), *Guidelines for Transport Impact Assessment (TIA).*

Public transport delay

15.6.7 A significant impact on journeys by bus, heavy and light rail, and Underground will be identified from the transport modelling results and is defined as any of the following:

- Changes of more than 20% in a majority of journey times by rail or Underground, where this lasts for more than four weeks in any 12 month period;
- Changes in journey distance by bus of more than 400m in urban areas and 1km in rural areas, where this lasts for more than four weeks in any 12 month period; and
- A relevant delay, disruption or overcrowding impact affecting the public transport network over a wide area for a period of more than five days.

Disruption at stations/interchanges

15.6.8 A significant impact on stations/interchanges is defined as a change in the vicinity that lasts for more than four weeks in any 12 month period including:

- Loss of physical linkage for the next stage of the journey;
- Loss of or relocation of more than 100m of bus facilities and operations (e.g. of bus stops, passenger waiting facilities, bus stands or operator facilities);
- Loss of or relocation of more than 100m of taxi facilities and operations (e.g. taxi stands, passenger waiting facilities or operator facilities); and
- Loss of or relocation of more than 100m of 'kiss-and-ride' facilities or operations (e.g. dropping off areas).

Traffic flows and delays to vehicle occupants

15.6.9 A significant increase in traffic levels and driver/vehicle passenger delay (including delays to bus and coach passengers) is defined as any one of the following[78] :

- A 30% increase in traffic flows (i.e. Heavy Goods Vehicles (HGVs) or all vehicles) where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas, and the change must last for more than four weeks in any 12 month period. Individual increases of up to five days will not count towards the four-week period;
- A 100% increase in traffic flows (i.e. HGVs or all vehicles) where the increase is more than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas, and the change must last between five days and four weeks in any 12 month period. Increases of up to five days will not count towards the four week period;
- A diversion for more than four weeks in any 12 month period that leads to an increase in journey length of more than 1km on a route carrying more than 100 vehicles per day, or 5km on a route carrying more than 40 vehicles per day, or 10km on any other route;
- Where a significant delay relating to junction congestion is forecast in the Transport Assessment. This will be based on the increase in the level of congestion at junctions, measured either as the forecast Ratio of Flow to Capacity (RFC) or Degree of Saturation (DoS). The assessment criteria are as follow, where:
  - The RFC or DoS increases to over 85% or 90% in the with-HS2 scenario, and these have increased by more than 2%: or;
  - The RFC or DoS is already over 85% or 90% in the future baseline and flows increase by more than 2% in the with-HS2 scenario; and.
  - Above, the 90% criteria will be used for signal controlled junctions and the 85% criteria for other non-signal controlled junctions.

Parking and loading

15.6.10 A significant impact on parking and loading, where facilities are identified to be heavily used, is defined as the loss for more than four weeks in any 12 month period.

On-street facilities

- Any on-street parking bays for a designated user or vehicle, including disabled persons, buses, taxis, doctors, ambulances, police vehicles or car club bays;
- Ten or more on-street parking bays for residents and businesses;

[78] Based on The Institute of Environmental Management and Assessment (IEMA), 1993, *Guidelines for the Environmental Assessment of Road Traffic*, IEMA

- Ten or more on-street pedal or motor cycle parking spaces;
- Unrestricted kerb space equivalent to 60m in length; and
- Any on-street loading bays.

Public off-street parking

- Any public off-street spaces designated for disabled persons, buses, taxis, doctors, ambulances, police vehicles or car club bays; and
- Any public off-street loading bays or facilities where replacement facilities are more than 5 minutes' walk away.

Private parking

- Any private off-street parking or loading facilities.

Vulnerable road user delay and loss of amenity

15.6.11 Impacts of delays on pedestrians, cyclists, equestrians and others will be assessed based on changes in the 'person-minutes' of the journey times of pedestrians and other non-motorised travellers[79]. The following information will be addressed:

- Numbers of pedestrians, cyclists and equestrians; and
- Changes in journey time in minutes.

15.6.12 The changes in journey times will be defined in proportion to the scale of the impacts being assessed, for example as minor (less than one minute), moderate (between one and two minutes) and major (greater than three minutes) and the numbers of travellers affected as: minor (less than 200 in total), moderate (between 200 and 1000) and major (greater than 1000). The assessment will then be based on the matrix of combined impacts shown in Table 31 where beneficial impacts occur if journey times are reduced or adverse impacts if journey times are increased. A combined assessment resulting in a "major" impact as defined in Table 31 will be reported as significant.

Table 31 - Significance levels for travellers affected by delay during construction

	Number of Travellers Affected		
Journey time changes	**Minor**	**Moderate**	**Major**
Minor	Neutral	Neutral	Minor
Moderate	Neutral	Minor	Moderate
Major	Minor	Moderate	Major - significant

Source: Based on WebTAG, Unit 3.5.5

[79] Based on Department for Transport (DfT) WebTAG Unit 3.5.5

Accidents and safety

15.6.13 Significant impacts on accidents and safety risks will be defined for links and junctions:

- Links and junctions for which data is available that have experienced on average more than nine personal injury accidents in a three-year period ending in 2011-12 and which would be subject to an increase of 30% or more in total traffic flow during construction for a period of more than four weeks in any 12 month period.

Severance

15.6.14 Severance can affect travellers using non-motorised modes, especially pedestrians. Where ever possible public footpaths and routes would be reinstated or alternatives provided. Cyclists and equestrians are less susceptible to severance because they can travel more quickly than people on foot, although there may still be significant impacts on these groups. Severance[80] will be classified according to the following four broad levels: no impact, minor, moderate and major.

15.6.15 To ensure a consistent approach, the classification and assessment will be based only on pedestrian movements. The proposed categories of effect are discussed below.

15.6.16 *Minor*: In general the current journey pattern is likely to be maintained, but there may be some hindrance to movement for example:

- Pedestrian at-grade crossing of a new road carrying below 8,000 vehicles per day (AADT);or
- A new bridge will need to be climbed or a sub-way traversed; and/or
- Journey lengths being increased by up to 250m.

15.6.17 *Moderate*: Some residents, particularly children and elderly people, are likely to be dissuaded from making trips. Other trips will be made longer or less attractive, for example:

- Two or more of the hindrances set out under `minor' applying to an individual journey; or
- Pedestrian at-grade crossing of a new road carrying between 8,000-16,000 vehicles per day (AADT) in the opening year; and/or
- Journeys lengths being increased by 250 – 500m.

[80] Based on Department for Transport (DfT) WebTAG Unit 3.6.2 and Design Manual for Roads and Bridges (DMRB) Volume 11, Section 11, Part 8

15.6.18 *Major*: People are likely to be deterred from making trips to an extent sufficient to induce a change in their habits. This could lead to a change in the location of centres of activity or in some cases to a permanent loss to a particular community. Alternatively, considerable hindrance will be caused to people making their existing journeys. Such impacts can result from:

- Pedestrian at-grade crossing of a new road carrying over 16,000 vehicles per day (AADT) in the opening year;
- Journey lengths being increased by over 500m; and/or
- Three or more of the hindrances set out under 'minor' or two or more set out under 'moderate'.

15.6.19 An overall assessment for the option will then be based on the following guidelines (in each case, the assessment is beneficial if severance is reduced, adverse if severance is increased):

- The overall assessment is likely to be of no impact if increases in severance are broadly balanced by relief of severance;
- The overall assessment is likely to be minor where change in severance is slight or the total numbers of people affected across all levels of severance is minor (less than 200 per day);
- The overall assessment is likely to be major where change in severance is major, and affects a moderate or high number of people or the total numbers of people affected across all levels of severance is major (greater than 1,000); and
- The overall assessment is likely to be moderate where greater than 200 and less than 1,000).

15.6.20 Table 32 provides guidance on how the categories are combined to estimate the numbers of people likely to be affected by changes in severance. A combined assessment resulting in a "major" impact as defined in Table 32 will be reported as significant.

Table 32 - Assessment of Change in Severance Scoring

	Severance scoring "With HS2"			
Severance scoring "Without HS2"	**No Impact**	**Minor**	**Moderate**	**Major**
No Impact	No Impact	Minor Negative	Moderate Negative	Major Negative - Significant
Minor	Minor Positive	No impact	Minor Negative	Moderate Negative
Moderate	Moderate Positive	Minor Positive	No Impact	Minor Negative
Major	Major Positive - Significant	Moderate Positive	Minor Positive	No Impact

Source: Based on WebTAG, Unit 3.6.2

Waterways

15.6.21 Where identified as being well used, a significant impact on waterways or waterways users is defined as the loss of, or prevention of access to, for a period of more than five days:

- Moorings, waterside or water-borne facilities; and
- Closure of a route with a diversion distance of more than 1km.

15.6.22 Any impacts on waterside pedestrians, cyclists, mobility impaired persons and equestrians will be assessed in relation to the vulnerable road user criteria.

Significance criteria for operational assessment

15.6.23 The criteria outlined below will be used to assess the significance of traffic and transport impacts during the operational phase.

Public transport delay

15.6.24 Significant permanent impacts on journeys by bus, heavy and light rail, and Underground will be identified from the modelling results and are defined as any of the following :

- A 10% change in a majority of journey times by any public transport mode; and
- A change in journey distances by bus of more than 400m in urban areas and 1km in rural areas.

Station / interchange impacts

15.6.25 Impacts that may be caused by additional HS2 passengers arriving and departing at the stations and interchanges will be assessed using modelling information, taking account of:

- Forecast numbers of additional HS2 passengers;
- Local transport conditions at each location;
- Resulting increases in congestion levels arising from increased usage or changed journey patterns arising from HS2 passengers arriving and departing by all available modes; and
- Any loss of physical linkage for the next stage of the journey.

15.6.26 The results from the transport assessment and modelling will be used to identify if there are any significant journey time, interchange and accessibility changes for travellers.

Traffic flows and delays to vehicle occupants

15.6.27 A significant impact in traffic levels (i.e. HGVs and all vehicles) and driver and vehicle passenger delay will be defined as any of the following [81] :

- A 10% increase in peak hour two-way traffic flows;

[81] Based on Institute of Environmental Management and Assessment (IEMA), 1993, *Guidelines for the Environmental Assessment of Road Traffic*, IEMA

- Increases in traffic flows that cause the design capacity to become exceeded, on links that would not otherwise be congested
- A 30% increase in off-peak hourly two-way traffic flows;
- There will be a permanent diversion that results in an increase in journey length of more 1km; and
- A significant junction or link congestion related delay problem is forecast in the transport assessment. This will be based on the increase in the level of congestion at junctions, measured either as the forecast Ratio of Flow to Capacity (RFC) or Degree of Saturation (DoS). The assessment criteria are as follow, where:
  - The RFC or DoS increases to over 85% or 90% in the with-HS2 scenario, and these have increased by more than 2%; or
  - The RFC or DoS is already over 85% or 90% in the future baseline and flows increase by more than 2% in the with-HS2 scenario; and
  - Above, the 90% criteria will be used for signal controlled junctions and the 85% criteria for other non-signal controlled junctions.

Vulnerable road user delay and loss of ambience and amenity

15.6.28 The assessment criteria for the permanent situation during operation of the Proposed Scheme will be the same as those described above for the temporary situation during its construction.

Parking and loading

15.6.29 Where identified as being well used and presently identified as a constraint, a significant permanent impact on parking and loading is defined by any of the following:

- A predicted increase in on-street parking demand in the vicinity of a station or interchange;
- A loss of any designated on-street or off-street spaces, including spaces for disabled persons, buses, taxis, doctors, ambulances, police vehicles and car club bays;
- A loss of five or more private off-street car parking spaces;
- A loss of five or more off-street station car parking spaces;
- A loss of five or more pedal or motorcycle parking spaces; and
- A loss of any public off-street loading bays or facilities.

Severance

15.6.30 The assessment criteria for the permanent situation during operation of the Proposed Scheme will be the same as those described above for the temporary situation during its construction.

Waterways

15.6.31 The assessment criteria for the permanent situation during operation of the Proposed Scheme will be the same as those described above for the temporary situation during its construction.

Accidents and safety

15.6.32 The assessment criteria for the permanent situation during operation of the Proposed Scheme will be the same as those described above for the temporary situation during its construction.

15.7 Assumptions

15.7.1 The following assumptions are relevant to the traffic and transport assessment:

- HS2 operational patterns and capacities;
- Number of HS2 train services;
- Change in operational patterns and stations serviced by other operators; and
- Construction impacts.

15.7.2 A general set of assumptions including relevant service assumptions is detailed in Section 1 above.

15.7.3 The modelling for the transport assessment and future year assessments will require a number of assumptions to be made, including:

- Committed developments and transport schemes;
- Socio-economic forecasts (e.g. population, employment, economic conditions);
- Demand forecasts; and
- Travel characteristics including:
  - Modal share of trips;
  - Traffic flows;
  - Public transport passenger flows;
  - Traffic speeds and congestion; and
  - Journey times.

16 Waste and material resources

16.1 Introduction

16.1.1 This section describes the scope and methodology that will be used to assess the likely significant environmental effects associated with the generation of solid waste during the construction and operational phases of the Proposed Scheme. Liquid waste is covered in Section 17 of this report.

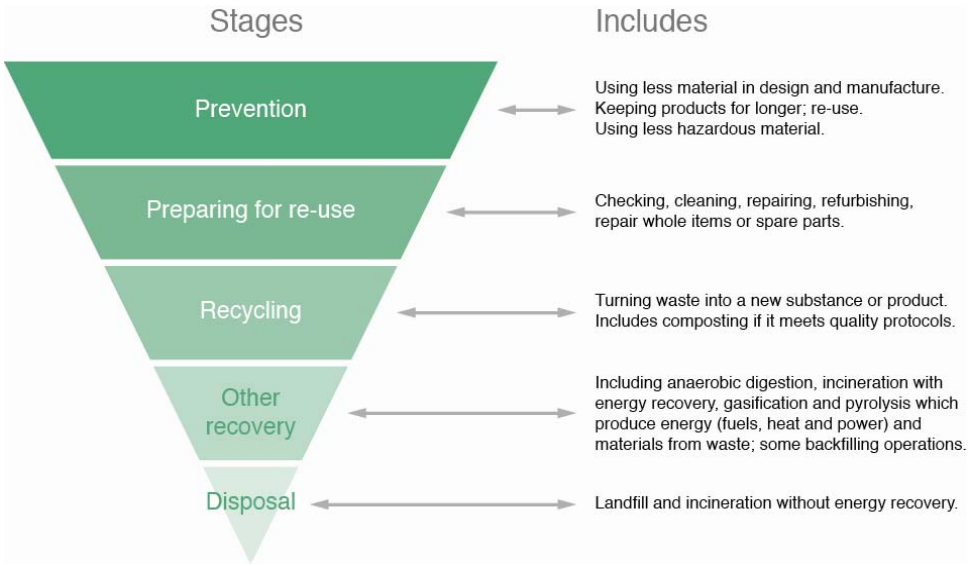
16.1.2 Types and quantities of waste for each phase of the Proposed Scheme from initial design through to construction, operation and eventual deconstruction will be considered in the assessment.

16.1.3 The principle objective of sustainable waste and material resources management is to use material resources more efficiently thereby preventing and reducing the amount of waste generated as well as minimising the quantity of waste that requires final disposal to landfill.

16.1.4 Where waste is generated, HS2 Ltd proposes that it will be dealt with in line with the Government's waste hierarchy (see Figure 4), which is a guide to sustainable waste and material resource management, and implements the revised EU *Waste Framework Directive*.

16.1.5 The waste hierarchy advocates the use of disposal only as a last resort, due to the range of potential adverse environmental effects associated with its use, such as loss of valuable land resources, greenhouse gas emissions, and nuisance effects (e.g. dust and odour emissions).

Figure 4 – Government's Waste Hierarchy[82]



[82] Department for Environment, Food and Rural Affairs (Defra), 2011, *Government Review of Waste Policy in England 2011*, Defra

16.2 Establishment of baseline and definition of survey

16.2.1 A description of the baseline environment for the Proposed Scheme is contained within the Appraisal of Sustainability (AoS) (February 2011) Section 7 'Sustainability baseline' of the Proposed Scheme in the Main Report Volume 1. Section 7.6 'Sustainable consumption and production' describes the baseline environment in relation to (materials and waste).

16.2.2 Baseline conditions shall be identified with respect to:

- Types, quantities and management of construction, demolition and excavation waste (CDEW) generated along the route corridor of the Proposed Scheme and sites identified for the railway stations/interchanges, stabling and maintenance depots, and other works sites within the local and regional area;
- Types, quantities and management of commercial and industrial waste generated by users and workers of existing railway stations/interchanges and buildings, and within the local and regional area; and
- Availability (types and capacity) of existing and planned waste infrastructure for managing CDEW and commercial and industrial waste in the local and regional areas.

16.2.3 The local area will be defined as the relevant district or county councils of the regional areas, which include Greater London, South East, Eastern, East Midlands and West Midlands (see Local Government Boundary Commission for England www.lgbce.org.uk).

Local and Regional Baseline: Waste Arisings

16.2.4 Data on CDEW arisings for the route corridor of the Proposed Scheme will be identified as part of baseline data gathering where this information exists using information from, for example, the Environment Agency (EA) and other public domain sources.

16.2.5 Data on commercial and industrial waste generated for the route corridor of the Proposed Scheme will be identified as part of the baseline data gathering where this information exists. Sources of information that shall be used to provide this information include, but shall not be limited to:

- Operational waste data from Eurostar and Southeastern trains for HS1, where available; and
- Operational waste data for existing railway stations along the route corridor of the Proposed Scheme (e.g. Euston station and Birmingham International) and rail stabling and maintenance depots operated by Network Rail, where available.

16.2.6 This information will be used to establish the baseline waste quantities.

Local and regional baseline: waste management infrastructure capacity

16.2.7 Information on the availability of waste management infrastructure will be identified as part of the baseline data gathering from published sources of information and in consultation with the relevant waste disposal authorities. Sources of information that will be used to provide this information include, but will not be limited to:

- Department for Environment, Food and Rural Affairs (Defra) Waste and Recycling Statistics (www.defra.gov.uk/statistics/environment/waste/);
- Department of Energy and Climate Change Renewable Energy Statistics (RESTATS) online database (http://restats.decc.gov.uk/app/pub/map/map/);
- Environment Agency Waste Data and Information (www.environment-agency.gov.uk/research/library/data/34169.aspx);
- Various waste disposal authority Waste and Minerals Development Plan Documents (e.g. West London Waste Plan, North London Waste Plan, Buckinghamshire Waste and Minerals Development Plan Documents etc); and
- London Capital Waste Facts information (www.capitalwastefacts.com).

16.2.8 Site visits to the existing railway stations/interchanges, depots and landfill sites located within the route corridor of the Proposed Scheme will also be undertaken.

16.3 Consultation

Consultations on the AoS

16.3.1 During the public consultation of the Proposed Scheme, which was reported in November 2011, very few comments were made relating to waste and material resources management. However, a number of comments were made regarding the generation of 'spoil' from the construction of the Proposed Scheme, the impacts of transporting the spoil on local communities and road congestion and safety. The EA recommended that the management of construction waste is considered as early as possible.

16.3.2 It was proposed to reduce the amount of waste generated as a result of the Proposed Scheme through the use of the waste hierarchy and include waste minimisation as a design aim, which was supported by the EA.

Consultation as part of the EIA process

16.3.3 Consultation will be undertaken primarily with the EA to agree the approach for re-use of excavation materials in, for example, scheme-wide landscaping works such as construction of noise and landscape bunds.

16.3.4 Consultation will also be undertaken with county and district councils to identify and confirm the following:

- Local and regional waste arisings that should be used to inform the baseline and assessment of the likely significant environmental effects of waste;
- Availability of local and regional waste infrastructure that should be used to inform the baseline and assessment of the likely significant environmental effects of waste;
- Planning, development management and waste management policies that should be taken into account during the assessment process; and particularly with respect to defining any mitigation measures required.
- Mineral resources located along the route corridor of the Proposed Scheme.

16.3.5 This information will be used to establish the baseline waste quantities, understand the future regional disposal capacity and to identify opportunities for re-use and recovery of excavation materials from the construction works of the Proposed Scheme.

16.4 Key aspects of the scheme for the topic

16.4.1 The construction of the Proposed Scheme will generate large quantities of soils and other aggregate materials mainly associated with the excavation of cuttings, cut and cover tunnels, bored tunnels and foundations. In addition, the demolition of existing commercial and residential buildings in the line of the route corridor will generate large quantities of demolition materials such as steel, broken concrete, timber, brick etc. The rebuilding of railway stations/interchanges, and the construction of stabling and maintenance depots will also generate construction waste.

16.4.2 Waste will also arise from the interaction with operational and closed landfill sites, removal of fly-tipped waste and management of contaminated land where present along the route corridor, which will be addressed as part of the land quality assessment.

16.4.3 Waste will be generated during the operation of the Proposed Scheme by passengers, railway staff and maintenance activities of the rolling stock. Environmental effects associated with the management of this waste are likely to be relatively small compared with the management of arisings from tunnelling and earthworks, which will generate the majority of waste to be managed.

16.5 Scope of assessment

16.5.1 The likely significant environmental effects of solid waste generation associated with the Proposed Scheme will be assessed with respect to both the construction and operational phases. These effects may be positive or

negative dependent on the measures employed to prevent and/or manage the waste generated.

Construction

16.5.2 Construction effects will address the temporary, indirect effects of solid waste that would be generated during demolition, excavation and construction activities. Demolition waste would be generated as a result of site clearance works and from the demolition of buildings and other structures currently in existence along the proposed route. Natural, uncontaminated and contaminated materials are likely to be excavated or generated as a result of the construction of the Proposed Scheme. It is likely that the majority of the excavated materials will comprise natural and inert soils. Contaminated soils and materials will be addressed in Section 11 of this report.

16.5.3 Solid waste is likely to be generated during the construction and fit-out of above ground structures such as new and redeveloped stations/interchanges, stabling and maintenance depots. Waste would also be generated by the construction and installation of all rail infrastructure components, including tunnelling sections, the laying of new tracks and installation of line-side equipment including new power supply connections and sub-stations.

16.5.4 Uncontaminated excavated materials that can be used, in their natural state, for site engineering and restoration purposes will be excluded from the assessment of likely significant environmental effects of construction. This is in accordance with the scope of the revised EU *Waste Framework Directive* and should reflect the measures taken during the design phase to prevent waste.[83] This is in accordance with Article 2 of the revised EU *Waste Framework Directive* and would reflect incorporated mitigation measures that have been considered during the design phase to prevent waste. However, this position would be subject to agreement with the EA. It is also assumed that such materials would meet the requirements of The Definition of Waste: Development Industry Code of Practice.[84] This industry Code of Practice has been developed to enable the direct transfer or re-use of clean naturally occurring soil materials, and provides a framework for proactively managing contaminated materials on the site of production.

[83] The Scope of Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on Waste and Repealing Certain Directives excludes 'uncontaminated soil and other naturally occurring material excavated in the course of construction activities where it is certain that the material will be used for the purposes of construction in its natural state on the site from which it was excavated'.

[84] Contaminated Land: Applications in Real Environments (CL:AIRE), 2011, *The Definition of Waste: Development Industry Code of Practice*, CL:AIRE

Operation

16.5.5 Operational effects shall address the permanent, indirect impacts of solid waste that would be generated during the first full year operation of the Proposed Scheme. This includes solid waste that would be generated by passengers and staff at new and redeveloped stations, and at staff depots *and rail maintena*nce facilities. Waste would also be generated by passengers and staff on trains whilst these are in use along the route corridor.

16.6 Assessment methodology

16.6.1 There is no recognised methodology or waste significance criteria to assess the likely significant environmental effects of solid waste generation from either construction or operation. The proposed assessment methodology is, therefore, based on professional judgement and experience of EIA for rail-related and other large scale transport infrastructure projects.

16.6.2 The assessment would consider the types and quantities of solid waste that would be generated during construction and operation and the severity of the likely significant environmental effects that might arise from the quantity of waste requiring off-site disposal to landfill (this being a finite and least preferred waste management option). The assessment would take into account waste arisings and waste infrastructure capacity at local and regional levels alongside the Proposed Scheme route corridor.

Legislation and guidance

16.6.3 The assessment shall have regard to relevant waste management legislation, policies and guidance applicable to all buildings and infrastructure components along the proposed route. This will include, but will not be limited to:

Legislation

16.6.4 *The Waste Management (England and Wales) Regulations 2011*.[85] These regulations transpose the revised EU Waste Framework Directive (2008/98/EC) into English law.

16.6.5 *Site Waste Management Plans Regulations 2008 (as amended)*. These regulations require the preparation of a site waste management plan (SWMP) for any construction projects with an estimated capital cost of over £300,000. The purpose of the SWMP is to identify opportunities to design out waste as well as identifying the types and quantities of waste likely to be produced during construction, the opportunities for sustainable management of the waste identified and to monitor and report on the actual management of these wastes throughout the construction period.

Policy

16.6.6 *Government Review of Waste Policy in England 2011* (DEFRA, June 2011). This sets out the Government's long-term strategy for the prevention and management of waste in England. It follows the waste hierarchy approach set out in the EU Waste Framework Directive.

[85] HM Government, 2011, *Waste Management Regulations 2011*, The Stationery Office

16.6.7 *Planning Policy Statement 10: Planning for Sustainable Waste Management* (Department for Communities and Local Government, March 2011). This sets out Government policy on waste planning which would be relevant to the management strategy for solid waste generated during the construction and operation of the Proposed Scheme.

16.6.8 Regional and local planning policy, such as the *London Plan* (Spatial Development Strategy for Greater London), which set out strategic planning policies for the management of waste generated in Greater London and elsewhere along the proposed route[86]. Specifically, these policies seek to minimise the amount of waste generated, increase the re-use and recycling of waste and reduce waste to landfill.

Guidance

16.6.9 The Definition of Waste: Development Industry Code of Practice[87].

16.6.10 Waste & Resources Action Programme (WRAP) guidance and tools developed to achieve better resource efficiency in construction projects such as designing out waste tools (e.g. Designing Out Waste Tool for Civil Engineering and Net Waste Tool) etc[88].

Significance criteria

16.6.11 There are no recognised significance criteria against which direct and indirect waste effects for both the construction and operational phases of the Proposed Scheme can be assessed. As such, the criteria for the assessment have been derived from professional experience of large-scale development projects and take into account:

- The net change in solid waste arisings overall as a result of the proposed development;
- The magnitude of the quantity of waste requiring landfill disposal;
- The availability of landfill disposal capacity in the local and regional area; and
- Significance criteria to be used for the assessment of the likely significant environmental effects of solid waste generation are shown in Table 33 for inert waste and

[86] Greater London Authority (GLA), 2011, *The London Plan: Spatial Development Strategy for London*, GLA

[87] http://www.claire.co.uk/index.php?option=com_content&view=article&id=210&Itemid=82

[88] http://www.wrap.org.uk/construction/tools_and_guidance/index.html

- **Table 34** for non-hazardous waste.

Table 33 – Waste significance criteria for inert waste

Degree of Significance	Waste Criteria
Major adverse	Net increase in waste arisings relative to the base case leading to a severe, national-scale reduction in landfill void space capacity for inert waste. Need for additional large-scale waste treatment and/or disposal capacity of greater than 10,000,000 tonnes. Effect may be judged to be of importance in the national planning context and, therefore, of potential concern to a project depending upon the importance attached to the issue in the decision-making.
Moderate adverse	Net increase in waste arisings relative to the base case leading to regional-scale reduction in landfill void space capacity for inert waste. Need for additional medium-scale waste treatment and/or disposal capacity of between 2,000,000 to 10,000,000 tonnes. Effect may be judged to be important in the regional planning context, e.g. where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required.
Minor adverse	Net increase in waste arisings relative to the base case leading to local-scale reduction in landfill void space capacity for inert waste. Need for additional small scale waste treatment and/or disposal capacity of up to 2,000,000 tonnes. Effect is of low importance in the decision-making process but may be of relevance to the detailed design and mitigation of a project.
Negligible	No significant increase in waste arisings relative to the base case or reduction in landfill void space capacity for inert waste. No appreciable adverse or beneficial effects.
Beneficial	Net reduction in waste arisings and diversion of waste from landfill relative to the base case resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of waste treatment and disposal infrastructure.

Table 34 – Waste significance criteria for non-hazardous waste

Degree of Significance	Waste Criteria
Major adverse	Net increase in waste arisings relative to the base case leading to a severe, regional-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional large-scale waste treatment and/or disposal capacity of greater than 100,000 tonnes per annum.[89] Effect may be judged to be of importance in the regional planning context and, therefore, of potential concern to a project depending upon the importance attached to the issue in the decision-making.
Moderate adverse	Net increase in waste arisings relative to the base case leading to regional-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional medium-scale waste treatment and/or disposal capacity of between 50,000[90] to 100,000 tonnes per annum. Effect may be judged to be important in the local planning context, e.g. where effects are permanent or long-term and the effect on local waste treatment and disposal infrastructure is such that additional capacity may be required.
Minor adverse	Net increase in waste arisings relative to the base case leading to local-scale reduction in landfill void space capacity for non-hazardous waste. Need for additional small scale waste treatment and/or disposal capacity of up to 50,000 tonnes per annum. Effect is of low importance in the decision-making process but may be of relevance to the detailed design and mitigation of a project.
Negligible	No significant increase in waste arisings relative to the base case or reduction in landfill void space capacity for non-hazardous waste. No appreciable adverse or beneficial effects.
Beneficial	Net reduction in waste arisings and diversion of waste from landfill relative to the base case resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of waste treatment and disposal infrastructure.

[89] Waste throughput capacity based on large-scale waste infrastructure project experience.
[90] The waste throughput capacity of greater than 50,000 tonnes per year has been selected with reference to the EIA Circular 02/99: Environmental Impact Assessment, which states in Annex A: Indicative Thresholds and Criteria for Identification of Schedule 2 Development Requiring EIA, 'Installation for the disposal of non-hazardous waste' A36: "*…EIA is more likely to be required where new capacity is created to hold more than 50,000 tonnes per year…*".

Construction effects

16.6.12 The assessment will identify the types and quantities of solid waste forecast to be generated during each of the demolition, excavation and construction stages of development. Quantification will be on the basis of survey information, using published waste generation rates or forecasting tools such as the WRAP Net Waste Tool.

16.6.13 Assumptions regarding the type and quantity of waste to be diverted from landfill via re-use, recycling and recovery will be applied. Following this, the type and quantity of demolition waste, excavated material and construction waste requiring landfill disposal will be assessed in relation to the projected quantity of landfill disposal capacity in the designated local and regional areas throughout the proposed construction period.

Operation effects

16.6.14 The assessment will identify the types and quantities of solid waste forecast to be generated during the first full year of operation of the Proposed Scheme. Quantification may be on the basis of existing operational waste management performance data (e.g. for stations) or using published operational waste generation rates for the relevant land-use activities.

16.6.15 Assumptions regarding the quantity of waste to be diverted from landfill via re-use, recycling and recovery will be applied. Following this, the quantity of operational waste requiring landfill disposal will be assessed in relation to the projected quantity of landfill disposal capacity during the first full year of operation of the Proposed Scheme.

Cumulative effects

16.6.16 The construction of the Proposed Scheme will generate economic stimulus for development within its corridor and particularly at railway stations/interchanges to take advantage of the economic benefits such a location will bring. This, combined with developments that are already taking place or anticipated within the route of the Proposed Scheme, will result in increased pressure on material resources and waste generation.

16.6.17 Cumulative effects will be assessed qualitatively (based on professional judgment) taking into account other major development proposals along the route corridor of the Proposed Scheme, which have been identified as part of the assessment process.

Mitigation, enhancement and off-setting

16.6.18 Mitigation, enhancement and off-setting measures for waste and resources management during construction and operation will be considered where applicable and residual environmental effects identified.

16.7 Assumptions

16.7.1 Liquid waste such as wastewater from dewatering operations and sewage from buildings and operation of the rolling stock is covered in Section 17 of this report.

16.7.2 It has been assumed that all existing land uses along the route corridor of the Proposed Scheme would remain unchanged should the proposed development not proceed.

16.7.3 The assessment of likely significant environmental effects resulting from waste generated due to the interaction with operational and closed landfill sites, fly-tipped waste and contaminated land present along the route corridor will be covered in Section 11 of this report. This will also include hazardous materials.

16.7.4 There is currently no information available to inform the quantities of solid waste likely to arise from the demolition and construction stages of the Proposed Scheme. Whilst these activities are likely to generate smaller quantities of waste than during excavation, they will contain a wider range of materials such as concrete, brick, metals, timber, plasterboard, insulation, plastics etc. Following best practice for large infrastructure projects all such activities are in the scope of the assessment of construction effects. This also applies to the generation of solid waste during operation of the Proposed Scheme.

16.7.5 Assumptions would be required as to the proportion of solid construction and operational waste that would be diverted from landfill via re-use, recycling and recovery. This would be informed by information gathered at the time of the assessment as to any waste management measures proposed to divert waste from landfill. Alternatively, landfill diversion performance for other similar rail-related projects such as Crossrail will be considered.

16.7.6 Waste transferred off-site would be handled by a registered waste carrier authorised by the EA and taken to a permitted or exempt facility authorised to receive and handle that waste, i.e. this assessment does not consider the likely significant environmental effects of any illegal waste management and disposal. It has been assumed that all construction and operational activities would be in accordance with the relevant environmental regulatory requirements.

16.7.7 The assessment of likely significant environmental effects associated with waste-related transport, including the interactive effects of air quality and sound will be addressed in Sections 3 and 13 respectively, of this report.

17 Water resources and flood risk assessment

17.1 Introduction

17.1.1 This topic section explains the scope and methodology to be used for assessing the likely significant effects of the Proposed Scheme on the water environment. This includes effects on water resources, (both surface water and groundwater), hydrology, flooding and drainage. Surface waters include natural water bodies such as rivers, streams and lakes, and artificial ones such as canals and reservoirs. Drainage includes both surface water drainage and foul water drainage, where it is combined with surface water drainage. Flooding includes the risk from rivers, surface water, groundwater, drainage, canals and reservoirs.

17.2 Establishment of baseline and definition of survey

17.2.1 The baseline conditions will be those set at the time of assessment, i.e. documented during the baseline data collection phase. Given the variable nature of the water environment through time it is not feasible to set a baseline for the future at time of construction or operation.

17.2.2 The Proposed Scheme crosses 24 major rivers (having an upstream catchment greater than 50 km^2) 88 minor rivers, 12 navigable canals and 11 lakes or reservoirs. Many of these rivers are of good water quality and many have adjacent flood plains. There is a total of 16.2 kilometres (km) in Flood Zone 3 and 19.1km in Flood Zone 2. The Proposed Scheme also crosses lengths of aquifer, including 4.9km of SPZ1 and 15.7km of SPZ2.

17.2.3 Baseline conditions will be set for:

- Floodplain extent (1 in 20, 100, 100 + climate change and 1,000 year return periods);
- Floodplain depth/velocity/hazard (1 in 20, 100, 100 + climate change and 1,000 year return periods);
- Surface water flood depth (1 in 200 year);
- Surface water quality and Water Framework Directive (WFD) Status (both physico-chemical and hydromorphology);
- Surface water designations, licences/consents;
- Groundwater quality and quantity (including WFD Status);
- Hydrogeology, including geology, aquifer hydraulic parameters, groundwater level and flow directions;
- Groundwater yield, licences/consents;

- Groundwater WFD Status; and
- Hydro-meteorological conditions and variability arising from climate change.

Baseline Data and Method

17.2.4 The following baseline data will be collected. A method of collection and/or source is suggested:

Table 35 - Baseline data and sources

Baseline data	Method/Source
Flood plain extent, depth, velocity, hazard Surface water flood depths Groundwater level and flow directions Groundwater yield	Targeted hydraulic modelling, Information held by Environment Agency (EA), British Geological Survey, Internal Drainage Boards (IDBs), British Waterways, Water Companies, and Lead Local Flood Authorities. Information contained within local planning authorities' Strategic Flood Risk Assessments.
Surface water quality Groundwater quality	Targeted water sampling and testing at accredited laboratory. Information held by EA, River Basin Management Plans, Local Authorities
Surface water designations	Information held by EA and Natural England
Surface water licences/consents Groundwater licences/permits Unlicensed abstractions	Information held by EA Information held by Local Authorities
Hydro-meteorological data	Met Office, EA

17.3 Consultation

Consultation on the AoS

17.3.1 As reported in the review of the AoS the following key organisations responded to the consultation:

- The Environment Agency (EA);
- British Waterways Board;
- The Inland Waterways Association;
- Water and sewerage companies; and
- Water supply companies.

17.3.2 The EA noted that developments in Flood Zone 3, if not properly mitigated, can put people and property at increased risk of downstream flooding. It advised that the detailed design of viaducts and raised embankments in floodplains consider these possible effects.

17.3.3 British Waterways requested to see details of any effects of the Proposed Scheme on the hydrology of any water courses feeding their canals or reservoirs and to see details of proposed storm water runoff.

17.3.4 The concerns of both these organisations will be addressed by ensuring that appropriate designs and mitigation are considered to manage the flood risks. Any floodplain lost to viaducts or embankments would be fully compensated for by creating new floodplain nearby. The rate of discharge of storm runoff would be controlled to match existing conditions.

17.3.5 The route of the tunnel line under the Chilterns was re-aligned in part to be further away from three public water supply groundwater sources.

Consultation as part of the EIA process

17.3.6 As part of the EIA process the following organisations will be consulted:

- The EA;
- British Waterways Board (likely to become the Canal & River Trust in 2012);
- Water and sewerage companies;
- Water supply companies;
- Internal Drainage Boards;
- Lead Local Flood Authorities (all counties and unitary authorities); and
- Environmental Protection Officers.

17.4 Key aspects of the scheme for the topic

17.4.1 The following aspects of the Proposed Scheme are of particular relevance to this topic:

- Sections of the Proposed Scheme located in Flood Zones 2 or 3. The route crosses about 16km of land in Flood Zone 3 (land having a greater than 1% probability of flooding any one year) and a further 19km in Flood Zone 2 (land having an annual flooding probability of between 1% and 0.1%).These lengths include 24 crossings of rivers with an upstream catchment exceeding 50km^2, of which five may require river diversions of at least 200m;
- The Proposed Scheme also crosses 88 smaller rivers, of which eight may require a diversion, 12 navigable canals and 11 lakes or reservoirs. The

assessment will consider whether there is any likely increase in the flood risk in these areas and if not to consider appropriate mitigation measures. For those lengths of river to be diverted, the assessment will consider likely effects on the river hydrology and riparian habitats. The assessment of habitats is included in Section 9 of this report;

- Sections of the Proposed Scheme located above aquifers and planned to be in cutting or in tunnel may require dewatering. The route announced in January 2012 has a length of 230km with approximately 36km of tunnels and 90km of cuttings. The route was altered to reduce the length of tunnel passing through the chalk aquifer in the Chilterns. Nevertheless the Proposed Scheme requires cut or tunnel through principal and secondary aquifers and close to licensed abstractors with protected rights particularly through the Chilterns. The assessment will consider the likely effects on the quality and yield of the aquifers protected rights and how these can be mitigated;
- Redevelopment of Euston station, development of the Birmingham Curzon Street station and Old Oak Common interchange, the depots at Steeple Claydon and Washwood Heath. In these areas the assessment will consider the likely effects of surface water flooding from the increase in impermeable area and the possible effects of pollution from their operation, including road transport use; and
- The risk of pollution of water bodies from the construction and operation of the Proposed Scheme.

17.4.2 Possible environmental benefits that may result from the project could include more natural river channels after diversion, and a reduction of flood risk to some adjacent properties.

17.5 Scope of assessment

Spatial scope

17.5.1 The spatial scope of the assessment will be based upon the identification of surface water features within 1km of the route of the Proposed Scheme, except in urban areas where the extent will be 500m as outside of these distances it is unlikely that direct impacts upon the water environment will be attributable to the Proposed Scheme.

17.5.2 All groundwater bodies will be considered that are within 1km horizontally of the route of the Proposed Scheme and where there is an aquifer within 10m of the lowest possible construction or dewatering depth.

17.5.3 When considering the possible effects of the Proposed Scheme on the hydrology of a water course or aquifer, the assessment will consider the possible effects throughout the catchment of the impacted water course or the wider aquifer extent.

17.5.4 Exceptions to this will be required in some locations where:

- Major groundworks are required (e.g. green tunnels);
- Infrastructure is to be placed within floodplains;
- The route intersects groundwater Source Protection Zones or Principal Aquifers where the abstraction may lie over 1km away;
- Pathways are identified to the wider environment (e.g. canal or stream routing to distant river, or highly transmissive aquifer); and
- Others, as deemed necessary when the route is reviewed in line with data received.

17.5.5 It is not considered that the Proposed Scheme will be affected by coastal or tidal impacts, so this aspect of the topic has been excluded.

Temporal scope

17.5.6 The effect of construction impacts will be assessed (up to 2026 when the Proposed Scheme is due to open). Most mitigation measures are expected to take effect immediately, but for those associated with river diversions or interference with groundwater flow, an assessment will be made at Year 1 (2027) and at Year 15 (2041), by when all measures will be fully effective or conditions will have stabilised.

17.6 Assessment methodology

Legislation and guidance

17.6.1 The following legislation, policy and guidance will be taken into account in the assessment of water resources and flood risk. Assessment of the Proposed Scheme and its impacts in relation to with the provisions of this legislation and policy will form an essential step in the assessment of the significance of effects associated with the Proposed Scheme.

- EU Water Framework Directive (WFD); EU Groundwater Directive; EU Floods Directive and associated UK Flood Risk Regulations; EU Habitats Directive;
- Flood and Water Management Act; Water Act and any new provisions brought in through the current Water White Paper; Environmental Protection Act; Water Resources Act; Land Drainage Act;

- Water and flood risk local planning policy for local authorities along the route of the Proposed Scheme (saved local plan policies and adopted Local Development Framework [LDF] policy); and
- EA Groundwater Protection: Policy and Practice (GP3).

17.6.2 The WFD is the most relevant in terms of likely impacts and effects on water resources and flood risk from the Proposed Scheme, and as a result, tests against the provisions of this legislation has been built into the assessment methodology for this topic.

17.6.3 The assessment will also need to have due regard to the National Planning Policy Framework (NPPF) and also to Environmental Permitting Regulations and amendments.

Significance criteria

17.6.4 The significance of an effect is defined by the magnitude of the impact and the value/sensitivity of the receiving water body or receptor (the "attribute"). This is illustrated in Table 36 below. Table 36, Table 37and Table 38 have been adapted from the tables in the Design Manual for Roads and Bridges (DMRB) Volume 11.3.10: Road Drainage and the Water Environment.

Table 36 - Significance of effects

Sensitivity and Rarity of Receptor	Magnitude of Impact			
	Negligible	**Minor**	**Moderate**	**Major**
Very high	Neutral	Moderate / Large	Large / Very Large	Very Large - Significant
High	Neutral	Slight / Moderate	Moderate / Large	Large / Very Large - Significant
Moderate	Neutral	Slight	Moderate	Large
Low	Neutral	Neutral	Slight	Slight / Moderate

17.6.5 The following table gives an indication of possible impacts and their magnitude. These may be reported as either positive or negative:

Table 37 - Magnitude of possible impacts

Magnitude	Criteria	Example
Major	Negative: Loss of an attribute; decrease in integrity Positive: Creation of new attribute or increase in integrity	Negative: Loss of flood plain; measurable decrease in river quality or in the yield or quality of aquifer. Positive: Creation of flood plain; measurable increase in river quality; increase in yield or quality of aquifer.
Moderate	Negative: temporary decrease in integrity of attribute Positive: temporary increase in integrity of attribute	Negative: temporary loss of flood plain; measurable temporary decrease in river quality or in the yield or quality of an aquifer. Positive: measurable temporary increase in river quality or in the yield or quality of aquifer.
Minor	Negative: Loss of part of an attribute or measurable decrease in attribute, but not crossing a defined threshold. Positive: Measurable increase in attribute, but not crossing a defined threshold.	Negative: Loss of small part of flood plain; measurable decrease in river quality; decrease in yield or quality of aquifer not affecting existing status or users. Positive: Measurable decrease in river quality; decrease in yield or quality of aquifer not affecting existing status.
Negligible	No change to integrity of attribute	Discharges to water course or changes to an aquifer which lead to no change in the attribute's integrity.

17.6.6 The following table gives an indication of the value of receiving water body or receptor.

Table 38 - Examples of the value of possible water bodies or receptors

Value	Criteria	Examples
Very high	Nationally significant attribute of high value	Any SPZ, Flood Zone 3 with residential dwellings, good quality or Principal aquifer, Surface water having WFD physico-chemical class: high
High	Locally significant attribute of high value	Poor quality or Principal aquifer, Surface water having WFD physico-chemical class: good, Flood Zone 3 without residential dwellings
Moderate	Of moderate quality and rarity	Other water courses, Secondary aquifer, Flood Zone 2
Low	Lower quality	Surface water sewer, non aquifer

Construction effects

17.6.7 The following possible effects arising from the construction of the Proposed Scheme will be assessed:

- Effects on the water quality of receiving water bodies due to the deposition or spillage of soils, sediment, fuels or other construction materials, or through mobilisation of contamination following disturbance of contaminated ground or groundwater, or through uncontrolled site runoff;
- Effects on river or stream flows during temporary disruption, discharges or diversion of flows during adjacent works;
- Effects on aquifers from groundworks, temporary abstractions, from discharges to ground, where permitted and from obstructions to groundwater flow by tunnelling, cuttings, cut offs etc;
- Effects of liquid wastes on the environment;
- Effects on flood defence schemes;
- Effects on licensed users; and
- Effects on local flood risk due to uncontrolled site runoff, deposition of silt, sediment in drains or ditches, temporary diversion of rivers, sewers or ditches, temporary earthworks affecting natural drainage paths.

17.6.8 When assessing the effects on the quality of surface water courses, a simple mass balance approach will be used to estimate the quantity of pollution that could be released during routine construction operations and details of the receiving water course. Estimates will be conservative and assume little

or no dispersion. An assessment will be made of the risk of accidental spillages and the possible effect on water quality.

17.6.9 The effects on groundwater, both in quantitative and qualitative terms, will be assessed using a suitable combination of expert judgement, analytical calculation and computational modelling. This will include the impacts of any contaminated land causing an effect on groundwater quality.

17.6.10 The assessment of flood risk will be made using the guidance in BS8533:2011 and. National policy.

Operational effects

17.6.11 The following examples of possible operational effects will be assessed:

- Effects on water quality due to the contamination of groundwater or surface waters from both routine discharges from the railway or associated infrastructure and from accidental spillages;
- Effects on river or stream quality, habitats and flows caused by the permanent discharge to or diversion of water courses;
- Effects on aquifers, such as changes to groundwater flows, recharge rates and quality, resulting from the permanent works: typically tunnels and cuttings, including dewatering of these structures;
- Effects on flood defence schemes;
- Effects on licensed users; and
- Effects on flood risk due to loss of flood plain storage, uncontrolled runoff, accumulation of silt, sediment in drains or ditches, the diversion of rivers, drains, sewers or ditches, and new infrastructure affecting natural drainage paths.

17.6.12 The assessment methods used to assess the operational effects will be the same as for construction effects.

Cumulative effects

17.6.13 Cumulative effects may occur due to the combination of one or more separate impacts. These may be due to the coincidence of impacts or the cumulative impact of separate events occurring at different times. The following examples of possible cumulative effects will be assessed:

- Impacts from the Proposed Scheme will be assessed together with impacts from any adjacent flood defence scheme to derive an assessment of the cumulative effects from all the schemes together;

- Accumulation of minor or major impacts on a river or aquifer that when considered together constitute a major impact leading to a significant or more significant effect; and
- A minor impact on river hydrology which together with a minor impact on the riparian habitat (an ecological impact) that when considered together constitute a major impact leading to a significant effect. The assessment of habitats is included in Section 9 of this report.

17.7 Assumptions

17.7.1 It has been assumed that with the WFD in force the baseline conditions for the quality of all water courses will be at least "good" status, as that is the aim of the WFD over the lifetime of this Proposed Scheme.

17.7.2 The assessment will assume that track drainage will wherever possible be kept separate from existing land drainage that crosses the route. Discharge from the new infrastructure will go directly to a receiving water body or sewer, in accordance with the principles of the draft national standards for sustainable drainage, published for consultation by Defra in December 2011.

17.7.3 The assessment of the effects on water courses will be affected by third party abstractions and discharges, and the assessment will take consideration of all that are recorded.

17.7.4 The assessment of the ecological effects on riparian habitats will be included in Section 9 of this report.

Part C

18 Structure of the Environmental Statement

18.1.1 There is no defined form or structure for Environmental Statements given in the relevant legislation or regulations. Therefore the structure of the ES is currently under consideration with the intention that it provides an assessment of the environmental impacts of the Proposed Scheme in a logical and comprehensive structure and in accordance with the requirements of EIA, including the need to be accessible, understandable and readable to a broad audience. It is intended that it will contain appropriate signposting and web-links to make navigation through the document easier for those seeking information relevant to their needs.

18.1.2 It is anticipated that the ES will comprise several volumes dealing with the following matters:

- The HS2 project, the need for the project and the main alternatives studied;
- The consultation and assessment processes;
- Project-wide and cumulative effects assessment;
- Effects in each of a number of sections of the route (the number of these is currently under consideration);
- Non-Technical Summary; and
- Scheme drawings / illustrations.

18.1.3 Further documents will be produced to support the Environmental Statement including;

- Scope and Methodology Report;
- Environmental Minimum Requirements;
- Environmental Design Aims;
- Code of Construction Practice;
- Health Impact Assessment;
- Equalities Impact Assessment;
- Report on Sustainability achievements (with particular reference to the significant effects described in the Appraisal of Sustainability (AoS);
- Report on public participation; and
- Transport Assessment.

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20 Annex A – List of Consultees

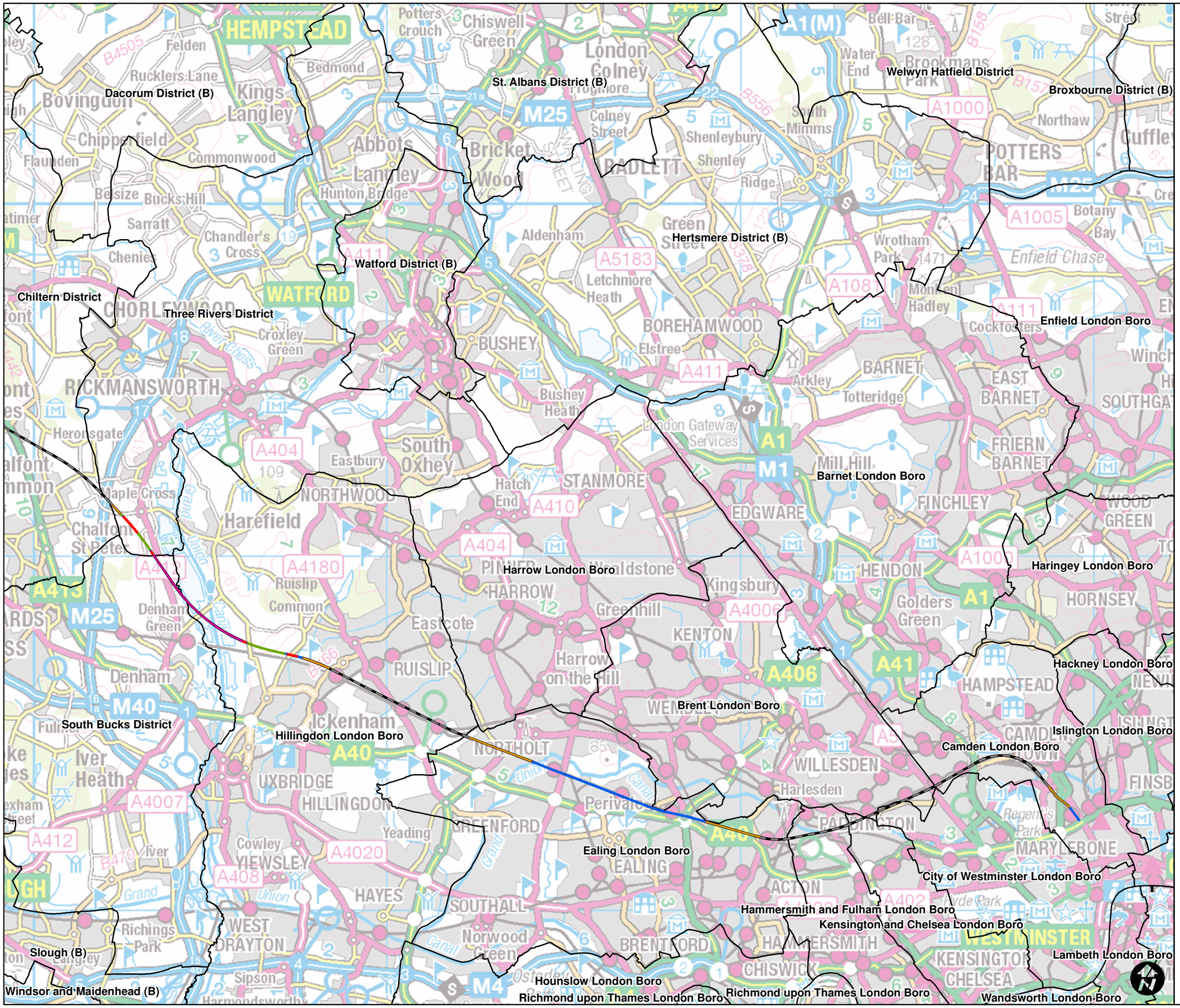
Comment will be sought from the following list of formal consultees on the content of the Scope and Methodology Report. Consultees are not limited to this list and responses received from others will be taken into account where they are relevant to the Scope and Methodology consultation.

Organisation
Natural England
The Environment Agency
English Heritage
The Association of National Parks Authorities
Health and Safety Executive
Coal Authority
The English Sports Council
The British Waterways Board
Highways Agency
Network Rail
Transport for London
London Borough of Camden
London Borough of Islington
London Borough of Brent
London Borough of Ealing
London Borough of Hammersmith and Fulham
Royal Borough of Kensington and Chelsea
City of Westminster
London Borough of Hillingdon
Greater London Authority
Buckinghamshire County Council
Hertfordshire County Council
Oxfordshire County Council
Northamptonshire County Council
Warwickshire County Council
Solihull Metropolitan Borough Council
Staffordshire County Council
Birmingham City Council
South Buckinghamshire District Council
Three Rivers District Council
Chiltern District Council
Aylesbury Vale District Council
Cherwell District Council
South Northamptonshire District Council
Stratford on Avon District Council
Warwick District Council

North Warwickshire District Council
Lichfield District Council
Amersham CP
Armitage with Handsacre CP
Aston le Walls CP
Aylesbury CP
Barton Hartshorn CP
Berkswell CP
Bickenhill CP
Boddington CP
Brackley CP
Calvert Green CP
Castle Bromwich CP
Chalfont St Giles CP
Chalfont St Peter CP
Chelmsley Wood CP
Chetwode CP
Chipping Warden & Edgcote CP
Coleshill CP
Cubbington CP
Culworth CP
Curdworth CP
Denham CP
Drayton Bassett CP
Ellesborough CP
Finmere CP
Fleet Marston CP
Fradley & Streethay CP
Godington CP
Great Missenden CP
Greatworth CP
Grendon Underwood CP
Hampton in Arden CP
Hints CP
Kenilworth CP
King's Bromley CP
Kingsbury CP
Ladbroke CP
Lea Marston CP
Lichfield CP
Little Missenden CP
Little Packington CP
Long Itchington CP
Marston St Lawrence CP
Middleton CP

Mixbury CP
Newton Purcell with Sherswell CP
Offchurch CP
Preston Bissett CP
Quainton CP
Radbourn CP
Radstone CP
Smiths Wood CP
Southam CP
Steeple Claydon CP
Stoke Mandeville CP
Stone with Bishopstone and Hartwell CP
Stoneleigh CP
Stoneton CP
Swinfen & Packington CP
The Lee CP
Thorpe Mandeville CP
Turweston CP
Twyford CP
Ufton CP
Waddesdon CP
Water Orton CP
Weeford CP
Wendover CP
Westbury CP
Weston under Wetherley CP
Whitfield CP
Whittington CP
Wishaw CP
Wormleighton CP

21 Annex B – Route Maps



Legend

Proposed Route

- At Grade
- Cutting
- Fill
- Green Tunnel
- Retained Cutting
- Retained Fill
- Tunnel
- Viaduct

Issue	Date	By	Chkd	Appd
1	30/03/12	DMc	PJ	CB

Kilometres

0 1.5 3 6

ARUP

The Arup Campus, Blythe Gate
Blythe Valley Park, Solihull, West Midlands, B90 8AE
Tel +44 (0)121 213 3000 Fax +44 (0)121 213 3001
www.arup.com

Client

hs2

Job Title

High Speed 2

Key Plan

Drawing Title

HS2 Scope and Methodology Report - Proposed Scheme Route (1of6)

Scale at A3

1:100,000

Discipline

GIS

Drawing Status	Job No	Issue
For Information	**209742-00**	**1**

Drawing No

C221-HS2-EV-MAP-000-000001

Legend

Proposed Route

- At Grade
- Cutting
- Fill
- Green Tunnel
- Retained Cutting
- Retained Fill
- Tunnel
- Viaduct

Issue	Date	By	Chkd	Appd
1	30/03/12	DMc	PJ	CB

Kilometres

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Client

hs2

Job Title
High Speed 2

Key Plan

Drawing Title
HS2 Scope and Methodology Report - Proposed Scheme Route (2of6)

Scale at A3
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Discipline
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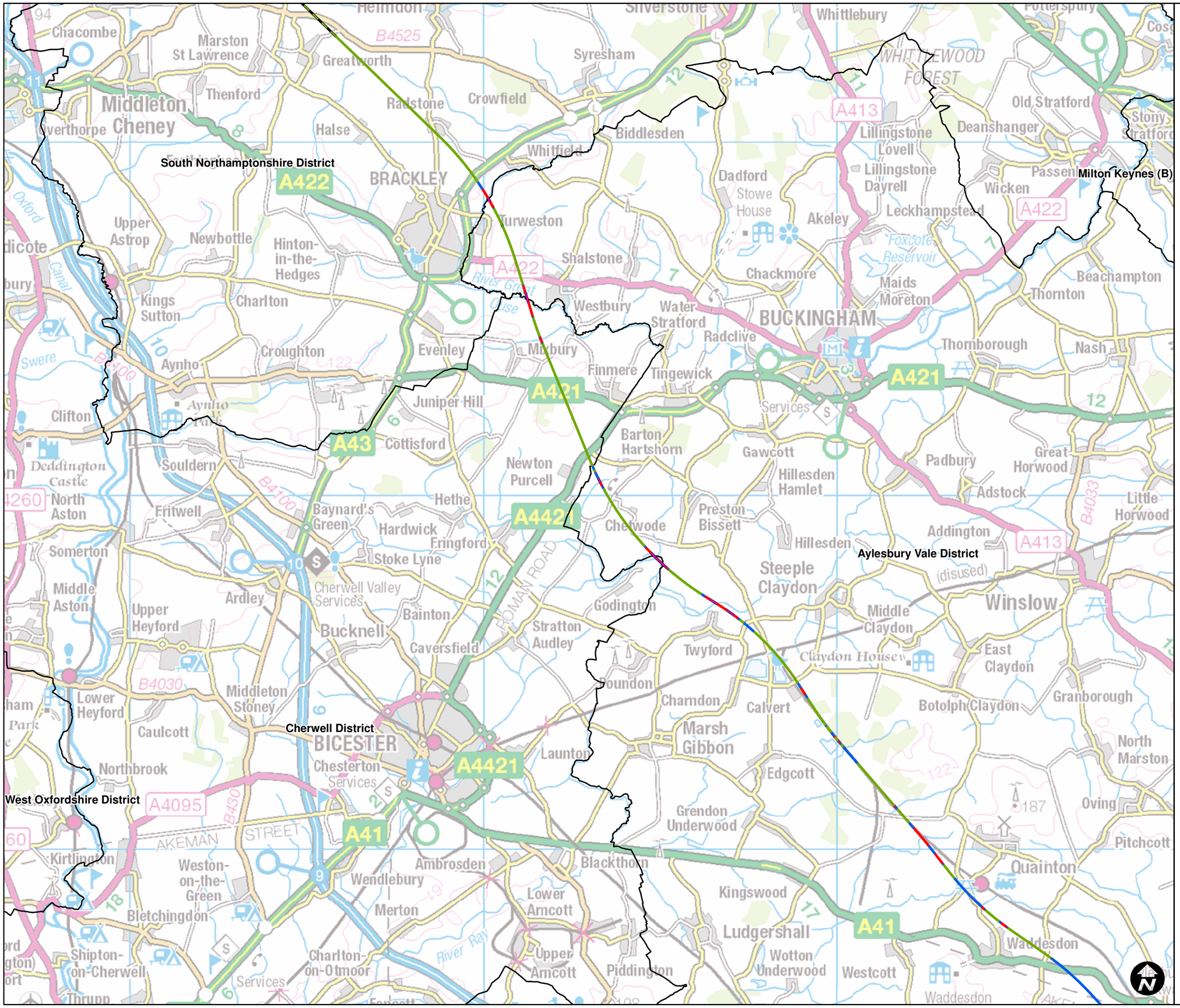

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- Fill
- Green Tunnel
- Retained Cutting
- Retained Fill
- Tunnel
- Viaduct

Issue	Date	By	Chkd	Appd
1	30/03/12	DMc	PJ	CB

Kilometres

0 1.5 3 6

ARUP

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Client

hs2

Job Title
High Speed 2

Key Plan

Drawing Title
HS2 Scope and Methodology Report - Proposed Scheme Route (3of6)

Scale at A3
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Discipline
GIS

Drawing Status	Job No	Issue
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Drawing No
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Legend

Proposed Route

- At Grade
- Cutting
- Fill
- Green Tunnel
- Retained Cutting
- Retained Fill
- Tunnel
- Viaduct

Issue	Date	By	Chkd	Appd
1	30/03/12	DMc	PJ	CB

Kilometres

0 1.5 3 6

ARUP

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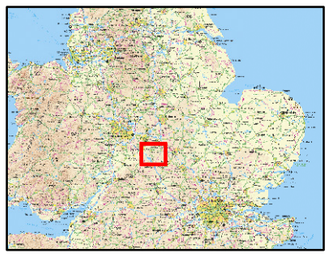
www.arup.com

Client

hs2

Job Title
High Speed 2

Key Plan



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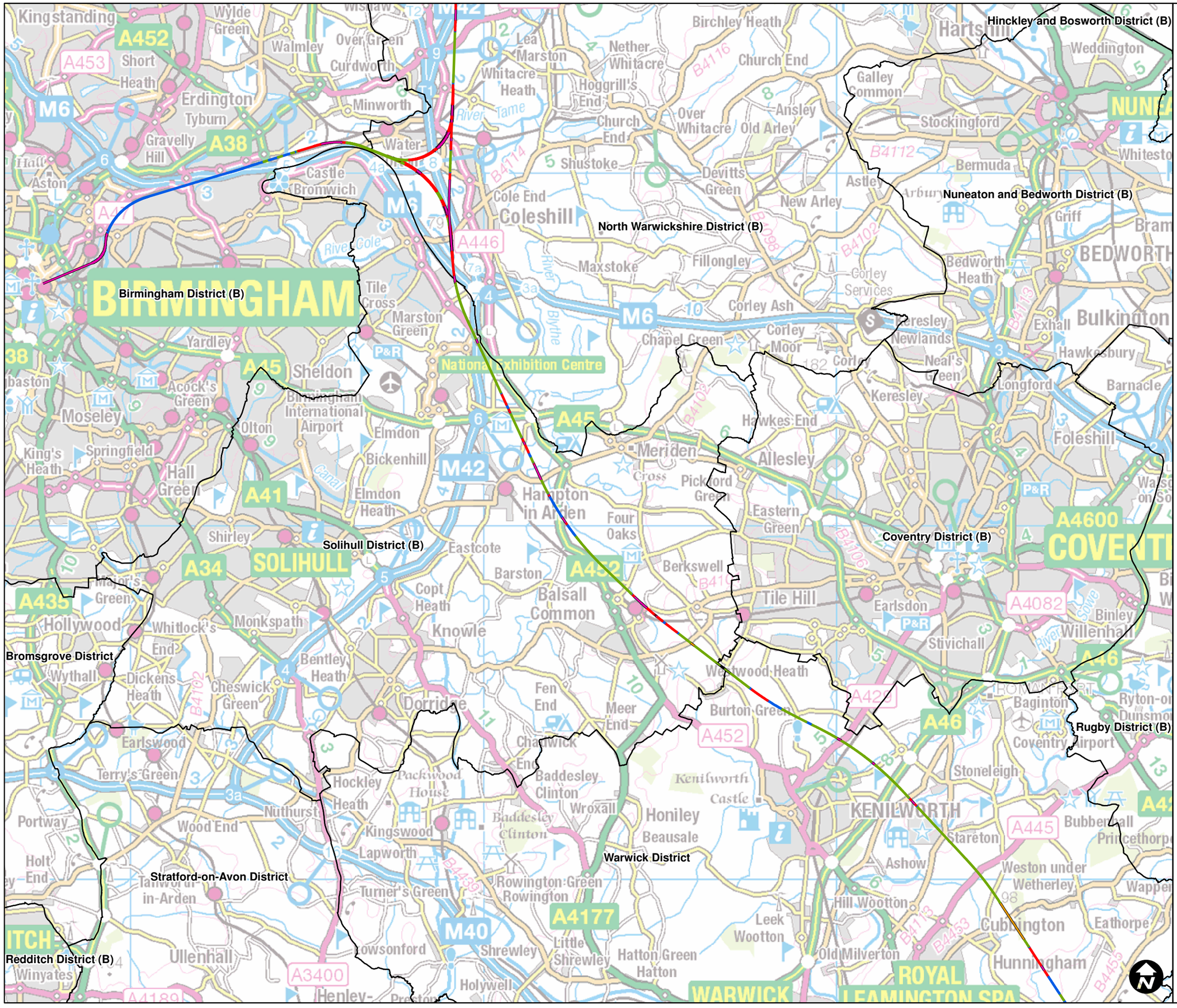

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- Tunnel
- Viaduct

Issue	Date	By	Chkd	Appd
1	30/03/12	DMc	PJ	CB

Kilometres

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Client

hs2

Job Title

High Speed 2

Key Plan

Drawing Title

HS2 Scope and Methodology Report - Proposed Scheme Route (5of6)

Scale at A3

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Discipline

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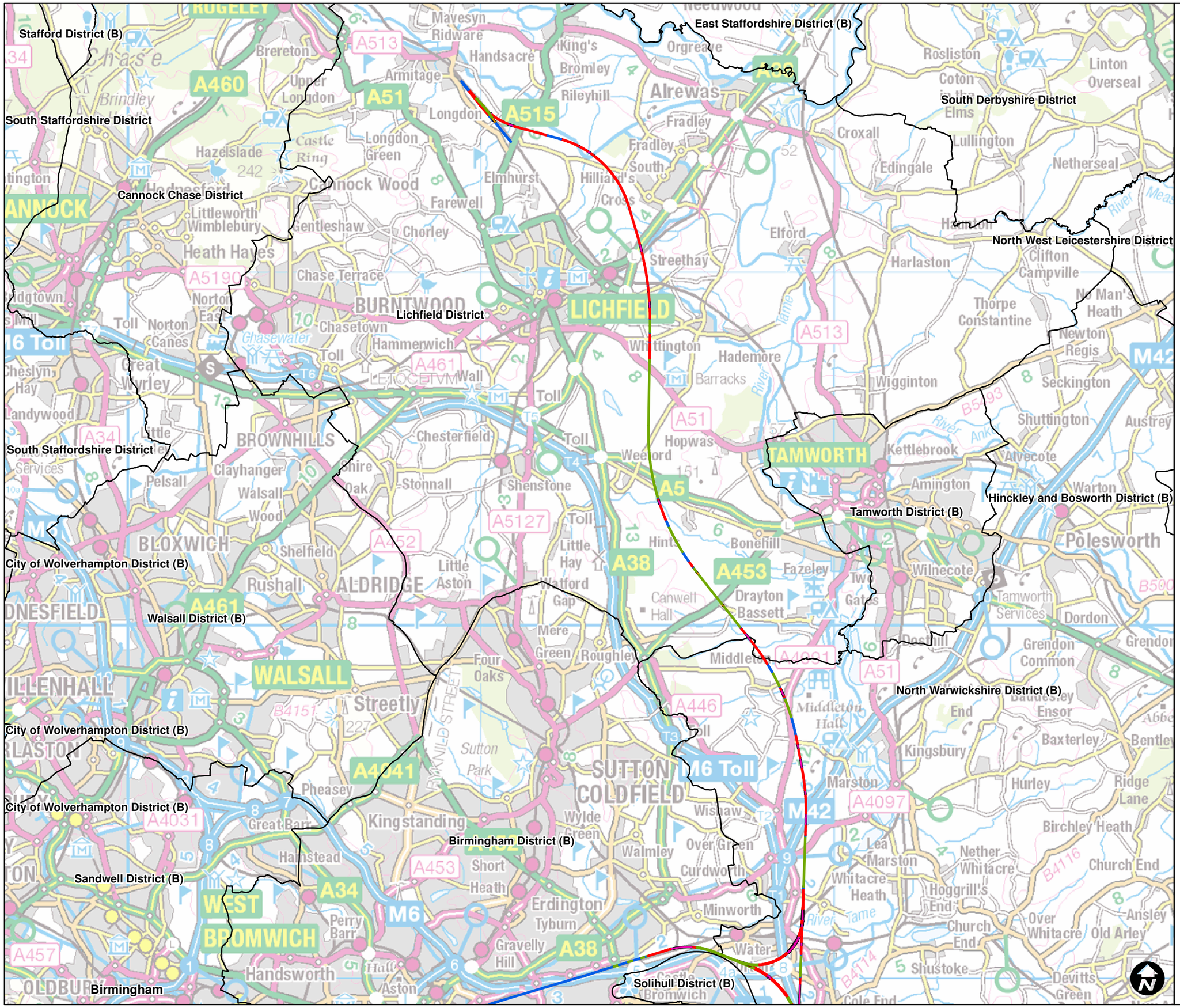

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Proposed Route

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- Fill
- Green Tunnel
- Retained Cutting
- Retained Fill
- Tunnel
- Viaduct

Issue	Date	By	Chkd	Appd
1	30/03/12	DMc	PJ	CB

Kilometres

0 1.5 3 6

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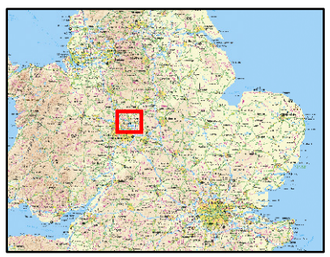
Client

hs2

Job Title
High Speed 2

Key Plan



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Discipline
GIS

Drawing Status
For Information

Job No
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Drawing No
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22 Annex C – List of acronyms

Abbreviations

µg/m^3	Microgram per cubic metre.
AA	Appropriate Assessment
AADT	Annual Average Daily Traffic
ADMS	Atmospheric Dispersion Modelling System
AIR	Air Information Resource
ALARP	As Low As Reasonably Practicable
ALC	Agricultural Land Classification
AONB	Area of Outstanding Natural Beauty
AoS	Appraisal of Sustainability
APIS	Air Pollution Information System
AQMA	Air Quality Management Area
ATO	Automatic Train Operation
ATOC	Association of Train Operating Companies
AURN	Automatic Urban and Rural Network
BAP	Biodiversity Action Plan
BCR	Benefit Cost Ratio
BHS	British Horse Society
BS	British Standards
CAAV	Central Association of Agricultural Land Valuers
CCA	Climate Change Act
CCC	Committee on Climate Change
CDEW	Construction Demolition and Excavation Waste
CHP	Combined Heat and Power
CLA	Country Land and Business Association
CLEA	Contaminated Land Exposure Assessment
CLR	Contaminated Land Report
cm	Centimetre
CO_2	Carbon Dioxide
CoCP	Code of Construction Practice
COP	Code of Practice
CPRE	Campaign for the Protection of Rural England
CRN	Calculation of Railway Noise
CRoW	Countryside and Rights of Way

DART Underground	Dublin Area Rapid Transport Underground
dB	Decibel
DCLG	Department of Communities and Local Government
DDA	Disability Discrimination Act
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
DoS	Degree of Saturation
EA	Environment Agency
EC	European Commission
ECML	East Coast Main Line
EH	English Heritage
EIA	Environmental Impact Assessment
EM	Electromagnetic
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EqIA	Equality Impact Assessment
ERTMS	European Rail Traffic Management System
ES	Environmental Statement
ETCS	European Train Control System
EU	European Union
EU ETS	European Union Emissions Trading System
FRA	Flood Risk Assessment
GHG	Green House Gases
GIS	Geographical Information System
GLA	Greater London Authority
GLVIA	Guidelines for Landscape and Visual Impact Assessment
GPLC	Guiding Principles on Land Contamination
GVA	Gross Value Added
GWML	Great Western Main Line
HCA	Home and Communities Agency
HDV	Heavy Duty Vehicle
HEPPG	Historic Environment Planning Practice Guide
HER	Historic Environment Record
HGV	Heavy Goods Vehicle

HIA	Health Impact Assessment
HRA	Habitat Regulations Assessment
HS1	High Speed One (formerly Channel Tunnel Rail Link – CTRL)
HS2	High Speed Two
HSI	Habitat Suitability Index
IAQM	Institute of Air Quality Management
IAQM.TG	Institute of Air Quality Management Technical Guidance
ICOMOS	International Council on Monuments and Sites
IDB	Internal Drainage Board
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute of Environmental Assessment and Management
IMD	Indices of Multiple Deprivation
IPC	Infrastructure Planning Commission
IPCC	Intergovernmental Panel on Climate Change
JT	Journey time
km	Kilometre
kph	Kilometres per hour
LAeq	Equivalent continuous sound level (noise)
LAQM	Local Air Quality Management
LAQN	London Air Quality Network
LDD	Local Development Document
LDF	Local Development Framework
LEP	Local Enterprise Partnership
LGBCE	Local Government Boundary Commission for England
LiDAR	Light Detection and Ranging
LLAU	Limits of Land to be Acquired or Used
LNR	Local Nature Reserve
LPA	Local Planning Authority
LWM	London to West Midlands
m	Metre
MAFF	Ministry of Agriculture, Fisheries and Food
MML	Midland Main Line
Mt	Million tonnes
NBR	National Buildings Record
NE	Natural England

NEC	National Exhibition Centre
NFU	National Farmers Union
NGO	Non-governmental Organisation
NHS	National Health Service
NIRR	Noise Insulation (Railway) Regulations
NMR	National Monuments Record
NNR	National Nature Reserve
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NPV	Net Present Value
NR	Network Rail
NVC	National Vegetation Classification
OLE	Overhead line equipment
ONS	Office for National Statistics
ORR	Office for Rail Regulation
OS	Ordnance Survey
PDFH	Passenger Demand Forecasting Handbook
PM_{10}	Particulate matter with aerodynamic diameter of less than 10 micrometre
$PM_{2.5}$	Particulate matter with aerodynamic diameter of less than 2.5 micrometres
PPS	Planning Policy Statement
PV	Present Value
PVB	Present Value of Benefits
PVC	Present Value of Costs
QRA	Quantitative Risk Assessment
Ramsar	Site designated under Ramsar Convention
RESTATS	Department of Energy and Climate Change Renewable Energy Statistics
RIGS	Regionally Important Geological and Geomorphological Sites
RPG	Regional Planning Guidance
RSPB	Royal Society for the Protection of Birds
RSSB	Rail Safety and Standards Board
SA	Sustainability Appraisal
SAC	Special Area of Conservation

SAM	Scheduled Ancient Monument
SEA	Strategic Environmental Assessment
SINC	Sites of Importance for Nature Conservation
SPA	Special Protection Area
SPP	Statement of Public Participation
SPZ	Source Protection Zone
SSSI	Sites of Special Scientific Interest
SUDs	Sustainable Drainage System
SWMP	Site Waste Management Plan
TBM	Tunnel Boring Machine
TfL	Transport for London
TIN	Technical Information Note
tph	trains per hour
TSI	Technical Specification for Interoperability
UK	United Kingdom
UK APIS	UK Air Pollution Information System
UKCCRA	UK Climate Change Risk Assessment
UKCP09	UK Climate Projections
VCS	Voluntary and Community Sector
VDV	Vibration Dose Value
VfM	Value for Money
WCML	West Coast Main Line
WebTAG	Web Transport Appraisal Guidance
WEI	Wider economic impact
WFD	Water Framework Directive
WHO	World Health Organisation
WRAP	Waste and Resources Action Programme
ZTV	Zone of Theoretical Visibility

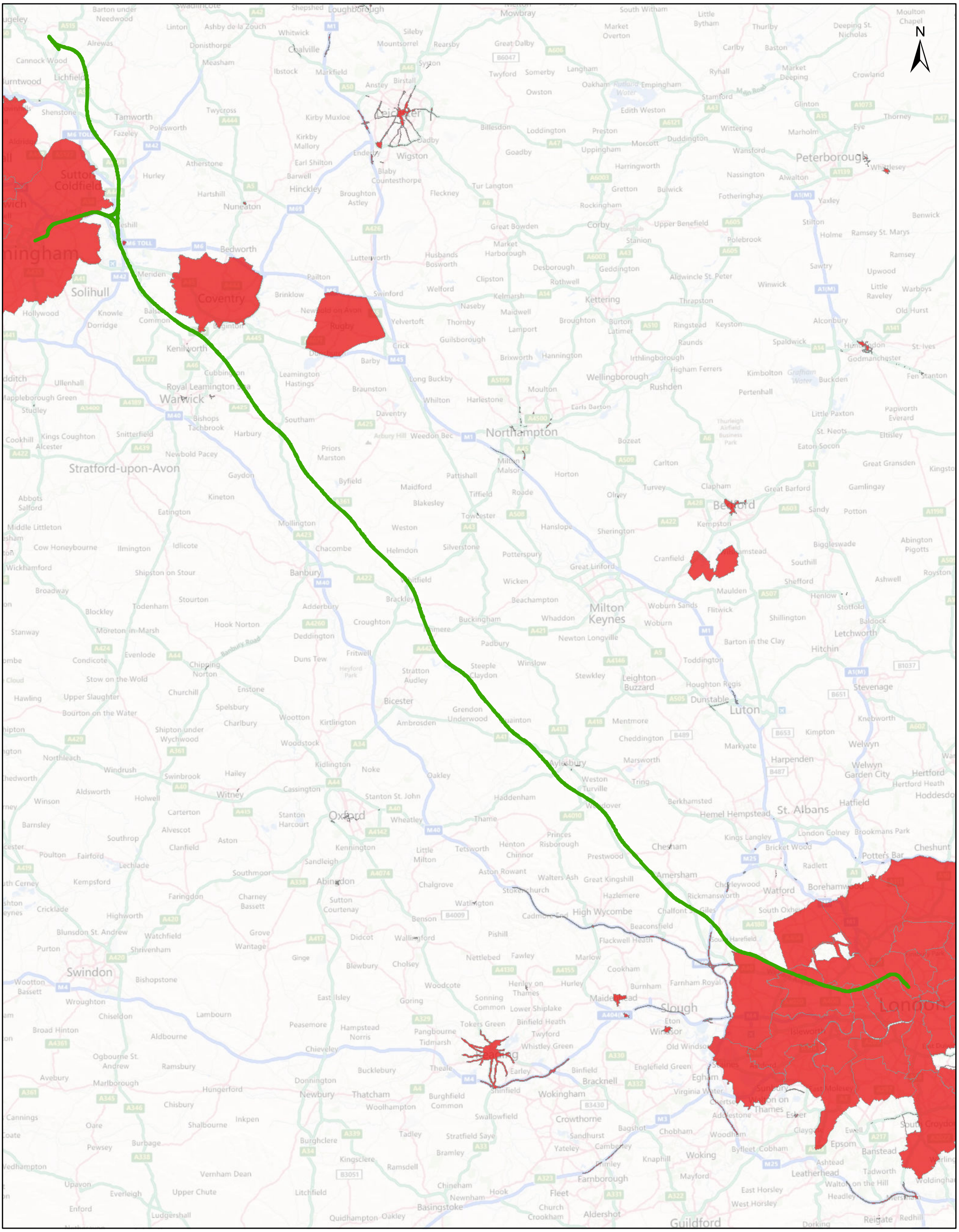
23 Annex D – Air Quality

23 Annex D – Air Quality

This section contains the following information which relates to the HS2 London to West Midlands EIA Scope and Methodology Report, Section 4.0 Air Quality.

- HS2 Proposed Scheme route map in relation to Air Quality Management Areas;
- Environmental Protection UK (EPUK) Guidance: Planning for Air Quality – Assessment of Impact Significance; and
- Institute of Air Quality Management: Guidance on the assessment of the impacts of construction on air quality and the determination of their significance.

HS2 Proposed Scheme route map in relation to Air Quality Management Areas (AQMAs)



1 Environmental Protection UK: Planning for Air Quality – assessment of impact significance

1.1 Background

1.1.1 The Environmental Protection UK (EPUK) guidance[1] provides an approach to determining the significance of impacts resulting from a proposed development on local air quality both for individual receptors and for a whole scheme. The guidance provides a basis on how to describe the significance of the impacts predicted from an air quality modelling study, specifically for the pollutants NO_2 and PM_{10}.

1.1.2 The first step is to identify the descriptor of change in ambient concentrations for NO_2 and PM_{10} according to the percentage change in annual mean concentrations (for both NO_2 and PM_{10}) and change in the forecast number of days greater than 50 $\mu g/m^3$ for PM_{10} (see Table 1 and Table 2 below. The descriptor can then be used to assess the impact significance for the two pollutants in relation to changes in the absolute concentration forecast from the modelling with a proposed development in place (see Table 3 and Table 4).

1.1.3 In terms of overall operational impact, the EPUK Guidance provides an approach for assessing the significance of air quality impacts associated with a given development. This approach suggests factors, listed below, which should be considered, before a suitably qualified professional can determine, with sufficient justification, whether the overall impact of a proposed development should be termed 'insignificant', 'minor', 'moderate' or 'major'.

- Number of people affected by slight, moderate or major air quality impacts and a judgement on the overall balance;
- Where new exposure is being introduced into an existing area of poor air quality, then the number of people exposed to levels above the objective or limit value will be relevant;
- The magnitudes of the changes and the descriptions of the impacts at the receptors;
- Whether or not an exceedence of an objective or limit value is predicted to arise in the study area where none existed before or an exceedence area is substantially increased;
- Whether or not the study area exceeds an objective or limit value and this exceedence is removed or the exceedence area is reduced;
- Uncertainty, including the extent to which worst-case assumptions have been made; and

[1] Environmental Protection UK (EPUK), 2010, *Development Control: Planning for Air Quality (2010 Update).*EPUK

- The extent to which an objective or limit value is exceeded e.g. an annual mean NO_2 of 41 μg/m^3 should attract less significance than an annual mean of 51 μg/m^3.

1.1.4 The EPUK guidance also provides an approach for assessing the significance of the proposals upon air quality, to aid the development management process, by highlighting whether the development has the potential to be a material consideration in the consenting process. This approach uses textual descriptions, contained within a flow chart as shown in Figure 1.

Table 1 - Descriptors for changes in ambient concentrations of NO2 (taken from the EPUK 2010 guidance)

Magnitude of change	**Absolute change in NO2 concentrations (µg/m3)**
Large	Increase/decrease > 4
Medium	Increase/decrease 2 – 4
Small	Increase/decrease 0.4 – 2
Imperceptible	Increase/decrease < 0.4

Table 2 - Descriptors for changes in ambient concentrations of PM10 (taken from the EPUK 2010 guidance)

Magnitude of change	**Equivalent absolute change in PM_{10} concentrations ($\mu g/m^3$)**
Large	Increase/decrease > 4
Medium	Increase/decrease 2 – 4
Small	Increase/decrease 0.4 – 2
Imperceptible	Increase/decrease < 0.4

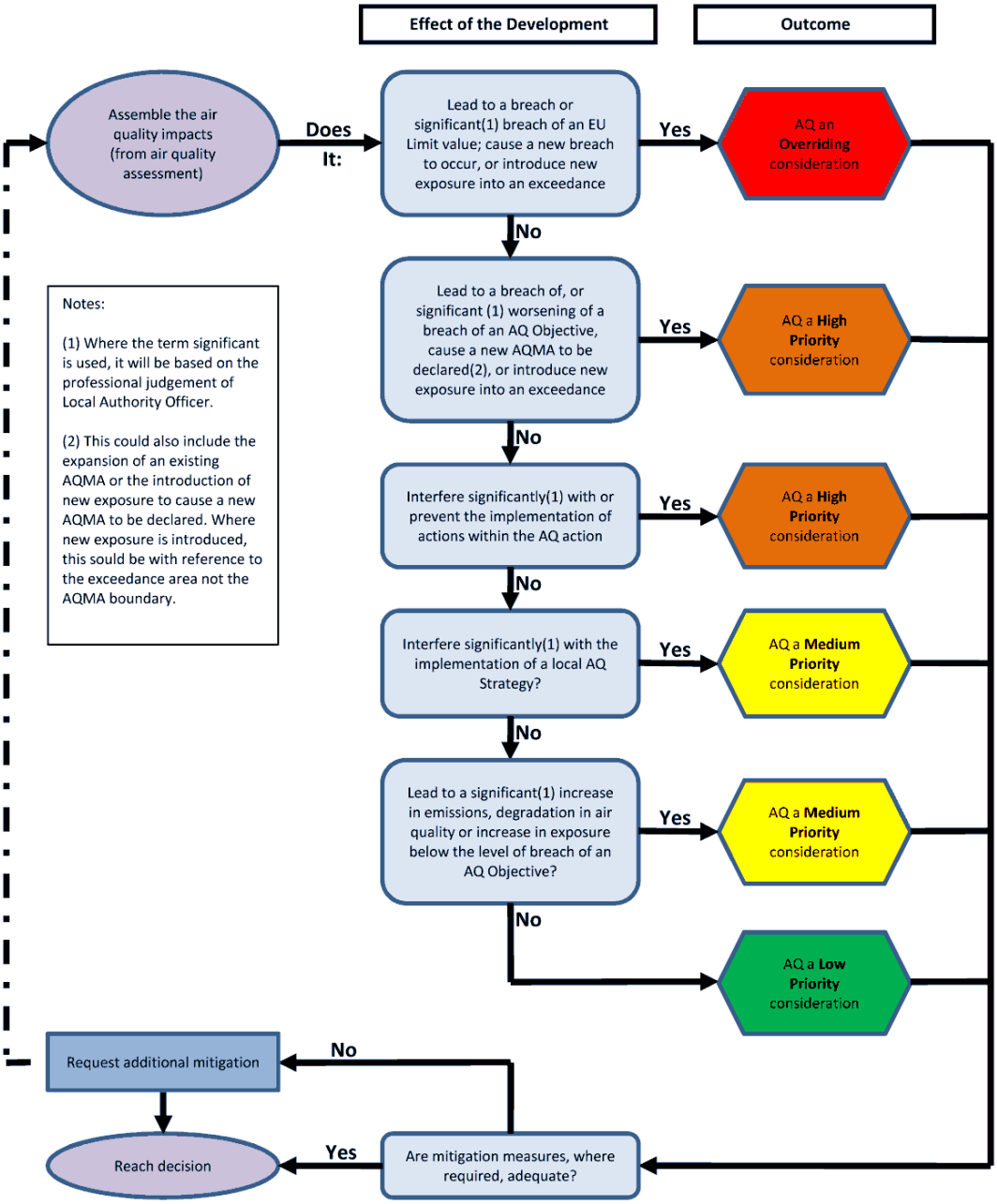
Table 3 - Descriptors for impact significance for annual mean NO2 (taken from the EPUK 2010 guidance)

Absolute concentration in relation to objective/limit value	**Change in concentration**		
	Small	**Medium**	**Large**
Increase with scheme			
Above Objective/Limit Value with scheme (> 40 µg/m^3)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just below Objective/Limit Value with scheme (36-40 µg/m^3)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value with scheme (30-36 µg/m^3)	Negligible	Slight Adverse	Slight Adverse
Well below Objective/Limit Value with scheme (<30 µg/m^3)	Negligible	Negligible	Slight Adverse
Decrease with scheme			
Above Objective/Limit Value without scheme (40 µg/m^3)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just below Objective/Limit Value without scheme (36-40 µg/m^3)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value without scheme (30-36 µg/m^3)	Negligible	Slight Beneficial	Slight Beneficial
Well below Objective/Limit Value without scheme (<30 µg/m^3)	Negligible	Negligible	Slight Beneficial

Table 4 - Descriptors for impact significance for annual mean PM10 (taken from the EPUK 2010 guidance)

Absolute concentration in relation to objective/limit value	**Change in concentration**		
	Small	**Medium**	**Large**
Increase with scheme			
Above Objective/Limit Value with scheme (> 40 μg/m^3)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just below Objective/Limit Value with scheme (36-40 μg/m^3)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value with scheme (30-36 μg/m^3)	Negligible	Slight Adverse	Slight Adverse
Well below Objective/Limit Value with scheme (<30 μg/m^3)	Negligible	Negligible	Slight Adverse
Decrease with scheme			
Above Objective/Limit Value without scheme (40 μg/m^3)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just below Objective/Limit Value without scheme (36-40 μg/m^3)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value without scheme (30-36 μg/m^3)	Negligible	Slight Beneficial	Slight Beneficial
Well below Objective/Limit Value without scheme (<30 μg/m^3)	Negligible	Negligible	Slight Beneficial

Figure 1 - EPUK Steps to assess the significance of impacts of a development proposal



2 Institute of Air Quality Management: Guidance on the assessment of the impacts of construction on air quality and the determination of their significance

2.1.1 The Institute of Air Quality Management (IAQM) guidance[2] was produced in concert with the Greater London Authority (GLA) and gives guidance to development consultants and environmental health officers on how to assess air quality impacts from construction. The guidance provides a method for classifying the significance of effect from construction activities based on 'dust classes' (either high, medium or low) and proximity of the site to the closest receptors. The guidance gives suggested criteria for the classification of dust classes though, understanding that each site will be unique and a purely prescriptive approach to risk assessment would not be appropriate, the importance of professional judgement is stressed throughout.

2.1.2 The guidance considers the potential for dust emissions from the following activities:

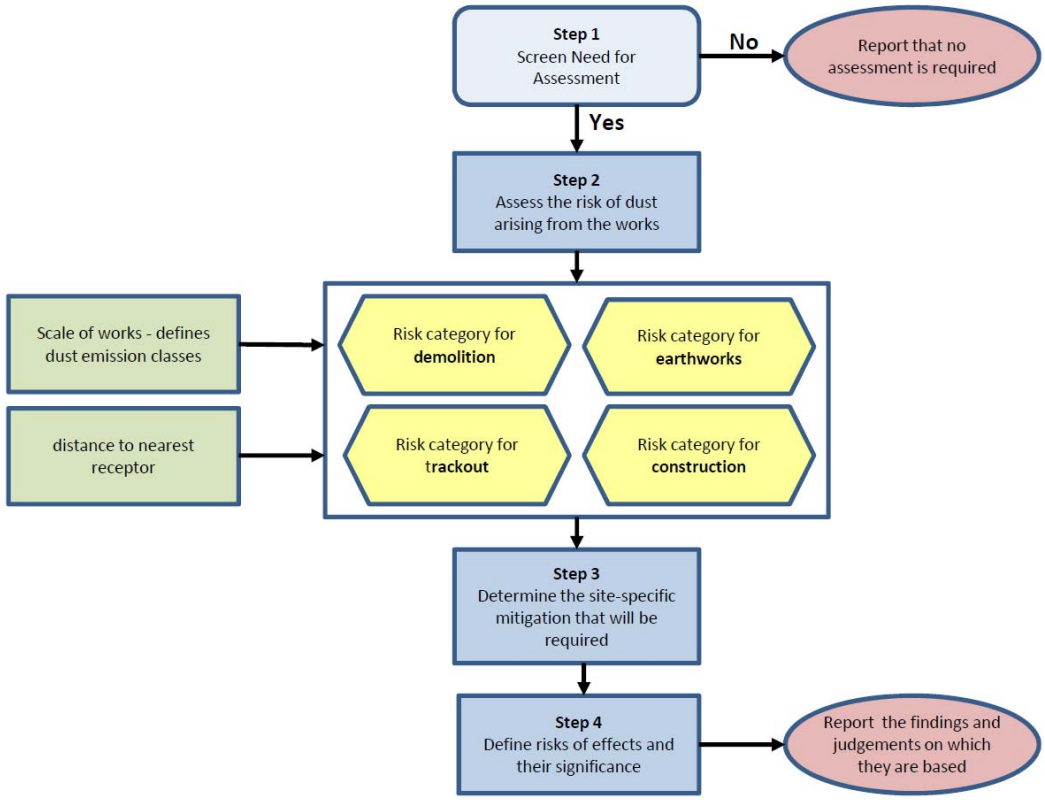
- Demolition;
- Earthworks[3];
- Construction; and
- Trackout[4]
- For each of the above activities, the guidance considers three separate dust effects:
- Annoyance due to dust soiling;
- Harm to ecological receptors; and
- The risk of health effects due to a significant increase in exposure to PM_{10}.

2.1.3 The methodology takes into account the scale (classed and small, medium or large) to which the above effects are likely to be generated and the distance of the closest receptors in determining suitable mitigation from the GLA guidance[5] should be included in a Construction Environmental Management Plan. The net significance of effect is then determined assuming the mitigation measures are applied satisfactorily. The four assessment steps are

[2] Institute of Air Quality Management (IAQM), 2012, *Guidelines on the assessment of the impacts of construction on air quality and the determination of their significance*, IAQM
[3] Covers the processes of soil stripping, ground-leveling, excavation and land capping.
[4] The unintentional transfer of dust and dirt from construction/demolition sites onto public roads, where it may be deposited and then re-suspended by other vehicles.
[5] Greater London Authority GLA) and London Councils, 2006, *Best Practice Guidance: The control of dust and emissions from construction and demolition.*GLA

summarised in Figure 2 with further descriptions of each step given in the following sections.

Figure 2 - IAQM Construction guidance - steps to perform an assessment



Step 1 - Screen the need for assessment

2.1.4 The first step is the initial screening for the need for an assessment. An assessment is required where there are sensitive receptors within 350 metres (m) of the boundary of the site and/or within 100m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

Step 2 - Assess the risk of dust arising from the works

2.1.5 At this step a description of site and surroundings is given to inform overall significance and professional judgement. The dust emission classes for each of the assessed activities is then determined. The suggested IAQM criteria for this determination are set out in Table 5 for each of the four assessment activities.

Table 5 - Categorisation of dust emission classes

Dust emission class		
Small	**Medium**	**Large**
Demolition		
• total building volume <20,000m^3 • construction material with low potential for dust release (e.g. metal cladding or timber) • demolition activities <10m above ground, demolition during wetter months	• total building volume 20,000m^3 – 50,000m^3 • potentially dusty construction material • demolition activities 10-20m above ground level	• total building volume >50,000m^3 • potentially dusty construction material (e.g. concrete) • on-site crushing and screening, demolition activities >20m above ground level
Earthworks		
• total site area <2,500m^2, soil type with large grain size (e.g. sand) • <5 heavy earth moving vehicles active at any one time • formation of bunds <4 m in height • total material moved <10,000 tonnes • earthworks during wetter months	• total site area 2,500m^2 – 10,000m2, moderately dusty soil type (e.g. silt) • 5-10 heavy earth moving vehicles active at any one time • formation of bunds 4 m - 8m in height • total material moved 20,000 tonnes – 100,000 tonnes	• total site area >10,000m^2 potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size) • >10 heavy earth moving vehicles active at any one time • formation of bunds >8 m in height • total material moved >100,000 tonnes
Construction		
• total building volume <25,000m^3 • construction material with low potential for dust release (e.g. metal cladding or timber)	• total building volume 25,000m^3 – 100,000m^3 • potentially dusty construction material (e.g. concrete) • piling • on-site concrete batching	• total building volume >100,000m^3 • piling • on-site concrete batching • sandblasting
Trackout		

Dust emission class		
Small	**Medium**	**Large**
• <25 Heavy Diesel Vehicles.(HDV) (>3.5t) trips in any one day • surface material with low potential for dust release • unpaved road length <50m	• 25-100 HDV (>3.5t) trips in any one day • moderately dusty surface material (e.g. high clay content) • unpaved road length 50m – 100m;	• >100 HDV (>3.5t) trips in any one day • potentially dusty surface material (e.g. high clay content) • unpaved road length >100m

2.1.6 Once the dust emission class for each of the activities has been determined, the risk category for each of the activities can be found based on the emissions class and the distance to the closest receptor sensitive to dust soiling or PM_{10} exposure, or closest ecological receptor. The risk categorisation matrix for each of the activities is given in Table 6.

Table 6: Risk categorisation from activities

Distance to nearest receptor (m)*		**Dust emission class**		
Dust Soiling and PM_{10}	**Ecological**	**Small**	**Medium**	**Large**
Demolition				
< 20	-	Medium Risk Site	High Risk Site	High Risk Site
20 – 100	< 20	Low Risk Site	Medium Risk Site	High Risk Site
100 – 200	20 – 40	Low Risk Site	Low Risk Site	Medium Risk Site
200 - 350	40 - 100	Negligible	Low Risk Site	Medium Risk Site
Earthworks				
< 20	-	Medium Risk Site	High Risk Site	High Risk Site
20 – 50	-	Low Risk Site	Medium Risk Site	High Risk Site
50 – 100	< 20	Low Risk Site	Medium Risk Site	Medium Risk Site
100 – 200	20 - 40	Negligible	Low Risk Site	Medium Risk Site
200 – 350	40 - 100	Negligible	Low Risk Site	Low Risk Site

Distance to nearest receptor (m)*		Dust emission class		
Dust Soiling and PM_{10}	**Ecological**	**Small**	**Medium**	**Large**
Construction				
< 20	-	Medium Risk Site	High Risk Site	High Risk Site
20 – 50	-	Low Risk Site	Medium Risk Site	High Risk Site
50 – 100	< 20	Low Risk Site	Medium Risk Site	Medium Risk Site
100 – 200	20 - 40	Negligible	Low Risk Site	Medium Risk Site
200 – 350	40 - 100	Negligible	Low Risk Site	Low Risk Site
Trackout				
< 20	-	Medium Risk Site	Medium Risk Site	High Risk Site
20 – 50	-	Low Risk Site	Medium Risk Site	Medium Risk Site
50 – 100	< 20	Negligible	Low Risk Site	Medium Risk Site

*Distances are from emissions sources, or if not known from the site boundary except for trackout where the distance is from the roads used by construction traffic

Step 3 - Determine the site specific mitigation that will be required

2.1.7 Once each of the activities has had a risk rating assigned to it, appropriate mitigation from the GLA guidance is identified for inclusion in a construction plan. Where risk is assigned as negligible, no mitigation measures beyond those required by legislation are required.

Step 4 - Define the risks of effects and their significance

2.1.8 The significance of effects is determined using professional judgement for each of the assessed activities. Examples in the IAQM guidance of criteria for determining sensitivity of the study area are given in Table 7.

Table 7: Examples of factors defining sensitivity of an area

Sensitivity of surrounding area	Examples	
	Human receptors	**Ecological receptors***
Very high	• very densely populated area. • more than 100 dwellings within 20m. • local PM_{10} concentrations exceed the objective. • contaminated buildings present. • very sensitive receptors (e.g. oncology units). • works continuing in one area of the site for more than one year.	European designated site.
High	• densely populated area. • 10-100 dwellings within 20m of site. • local PM_{10} concentrations close to the objective (e.g. annual mean 36-40 $\mu g/m^3$). •commercially sensitive horticultural land within 20m.	Nationally designated site.
Medium	• suburban or edge of town area. • less than 10 receptors within 20m. • local PM_{10} concentrations below the objective (e.g. annual mean 30-36 $\mu g/m^3$).	Locally designated site.
Low	• rural area; industrial area • no receptors within 20m • local PM_{10} concentrations well below the objectives (less than 75%) • wooded area between site and receptors	No designations.

* Only if there are habitats that might be sensitive to dust

2.1.9 The significance of effects with mitigation is then determined based on the risk of the site giving rise to dust effects and the sensitivity of the surrounding area as shown in Table 8.

Table 8: Significance of effects for each activity with mitigation

Sensitivity of surrounding area	Risk of site giving risk to dust effects		
	High	**Medium**	**Low**
Very high	Slight adverse	Slight adverse	Negligible
High	Slight adverse	Negligible	Negligible
Medium	Negligible	Negligible	Negligible
Low	Negligible	Negligible	Negligible

2.1.10 A summary table is then given for each of the activities and the three dust effects; dust soiling effects, ecological effects and PM_{10} effects. An overall level of significance is then assigned to the scheme.

24 Glossary of terms

Glossary

Air quality exceedence	A period of time (defined for each standard) where the concentration is higher than that set out in the Standard.
Air quality limit values	Legally binding EU parameters that must not be exceeded. They are set for individual pollutants and are made up of a concentration value, an averaging time over which it is to be measured, the number of exceedences allowed per year, if any, and a date by which it must be achieved
Air Quality Management Area (AQMA)	Air Quality Management Area. Designated under the Local Air Quality Management regime for areas currently, or forecast, to exceed National Air Quality Strategy objectives.
Air quality objective	The target date on which exceedences of a Standard must not exceed a specified number.
Air quality standard	Concentrations recorded over a given time period, which are considered to be acceptable in terms of what is scientifically known about the effects of each pollutant on health and on the environment.
Air quality target values	Values used in some EU Directives and are set out in the same way as limit values. They are to be attained where possible by taking all necessary measures not entailing disproportionate costs.
ALARP Rule	As low as reasonably practicable – A rule which involves weighing a risk against the time and money needed to control it.
Ambient	Totally encompassing sound at a given location and time, usually composed of sound from many sources both near and far.
Ancient Woodland	Land that has been continually wooded since at least 1600.
Appraisal of Sustainability (AoS)	Appraisal of impact of plans or policies from environmental, economic and social perspective and against objectives of sustainable development.

Appropriate Assessment (AA)	An assessment of the effect of a plan or project on the Natura 2000 network of European sites of nature conservation significance, as required under the Habitats Directive.
Aquifer	A below ground, water bearing layer of soil or rock.
Area of Outstanding Natural Beauty (AONB)	Area designated under section 82 of the Countryside and Rights of Way Act 2000 for the purpose of conserving and enhancing its natural beauty.
Auger	An auger is a drilling device, or drill bit, that usually includes a rotating helical screw blade called a "flighting" to act as a screw conveyor to remove the drilled out material. The rotation of the blade causes the material to move out of the hole being drilled.
Baseline	Existing environmental conditions present on, or near a site, against which future changes can be measured or predicted.
Biodiversity Action Plan	A Biodiversity Action Plan (BAP) is an internationally recognised programme addressing threatened species and habitats and is designed to protect and restore biological systems. The original impetus for these plans derives from the 1992 Convention on Biological Diversity.
Birmingham Interchange Station	Interchange station on the proposed route which would allow access to Birmingham International railway station, the National Exhibition Centre and Birmingham Airport.
Borehole	A deep hole bored into the ground as part of intrusive investigations typically to test depth and quality of groundwater.
Built Heritage	A heritage asset that is a structure or building visible above the land surface.
Buried Heritage	A heritage asset that remains buried beneath the land surface and which may include earthworks.
Captive	High speed trains designed to European legislation on interoperability, which may only operate on new HS2 infrastructure.

Classic compatible	High speed trains designed to European legislation on interoperability and also to be capable of operating services to destinations north of HS2 through connections with the existing GB rail network.
Code of Construction Practice	The code of Construction Practice sets out the standards and procedures to which a Developer or Contractor must adhere to when undertaking construction of major projects thus managing the environmental impacts. It also identifies the main responsibilities and requirements of Developers and Contractors in constructing their projects.
Committee on Climate Change	Established under the CCA, the Committee on Climate Change is an independent advisory body tasked with helping the UK Government set and meet carbon budgets and adapt to climate change.
Conservation	The preservation or enhancement of a species or building/structure.
Conservation Area	An area designated under section 69 of the Planning (Listed Buildings and Conservation Areas) Act 1990 as being of special architectural or historic interest the character or appearance of which it is desirable to preserve or enhance.
Conurbation	A region comprising a number of cities, large towns and other urban areas that, through population growth and physical expansion, have merged to form one continuous urban and industrially developed area.
Crossrail	A new east-west railway linking Maidenhead and Heathrow Airport in the West via tunnels under Central London to Shenfield and Abbey Wood in the East.
Crossrail interchange	Proposed interchange station in Old Oak Common, in outer London providing access to Crossrail and other rail services including the Great Western Main Line.
Department for Transport (DfT)	Government department responsible for transport policy in the UK (where not devolved).

Directive	European Commission Directives impose legal obligations on European Member States. They are binding as to the results to be achieved, but allow individual states the right to decide the form and methods used to achieve the resuits. An example of this is the EC Air Quality Framework Directive 96/62 that is brought into legal effect in the UK by the Air Quality (England) Regulations (2000).
Displacement	The extent to which the benefits of a project are offset by reductions of output or employment elsewhere.
Dust	Defined as all particulate matter up to 75 micrometre in diameter (according to BS6069) and comprising both suspended and deposited dust.
EMC Zones	A bounded area in which specific levels of EM energy exist. It follows that some EMC zones contain higher levels of EM energy that others. In the railway environment the zone containing most energy in these EMC zones exists on the trackside of the railway (where traction power is returned to the running rails) and close to traction or non-traction power distribution equipment.
English Heritage	The Government's statutory advisor on the historic environment. Officially known as Historic Buildings and Monuments Commission for England, English Heritage is an executive Non-Departmental Public Body sponsored by the Department for Culture, Media and Sport, with principal powers and responsibilities are set out in the National Heritage Act (1983).
Environmental Impact Assessment (EIA)	Assessment of environmental effects of certain public and private projects under Directive 2011/92/EU.
Environmental Statement (ES)	The formal document or suite of documents reporting the requisite environmental information in respect of a project in accordance with EC Directive 2011/92/EU. Includes all such information that is reasonably required to assess the environmental effects of a development.

European Union Emissions Trading System	The European Union Emissions Trading System or European Union Emissions Trading Proposed Scheme is a cap-and-trade greenhouse gas emissions framework, designed to result in emissions reductions across multiple countries.
Floodplain	Land adjacent to a watercourse over which water flows, or would flow but for defences in place, in times of flood.
Grade I building	A listed building of exceptional interest, sometimes considered to be internationally important.
Grade II* building	A listed building of particular importance, of more than special interest.
Grade II building	Nationally important buildings that are of special interest.
Green Tunnel	Where earth is built up around and over a section of the rail line to reduce its environmental impacts.
Greenhouse Gases	Gases that trap thermal radiation in the atmosphere; examples include: carbon dioxide, water vapour, methane and nitrous oxide.
Groundwater	Water associated with soil or rocks below the ground surface but is usually taken to mean water in the saturated zone.
Groundwater Source Protection Zone	A defined area within which groundwater is extracted for potable water supply. The area is defined by the Environment Agency on the basis of the length of time taken for groundwater to migrate from the potable source.
Habitat	The living place of an organism characterised by Its physical or biotic properties.
Habitat Suitability Index (HSI)	An HSI is a numerical index evaluating habitat quality and quantity for a particular species, where a value of 1 represents optimum habitat and 0, habitat of no value. The HSI for great crested newt incorporates 10 suitability indices, all of which are factors know to affect this species.

Heritage Asset	A building, monument, site, place, area or landscape positively identified as having a degree of significance meriting consideration in planning decisions. Heritage assets are the valued components of the historic environment. They include designated heritage assets and assets identified by the local planning authority during the process of decision-making or through the plan-making process (including local listing).
High Speed One (HS1)	The Channel Tunnel Rail Link from St Pancras International station to the Channel Tunnel.
High Speed Two Limited (HS2 Ltd)	The company set up by the Government to develop proposals for a new high speed railway line between London and the West Midlands and to consider the case for new high speed rail services linking London, northern England and Scotland.
Hybrid bill	Public bill which affects a particular private interest in a manner different from the private interest of other persons or bodies of the same category or class.
Hydrogeology	The study of geological factors relating to the Earth's water.
Infrastructure maintenance depot	Base for maintenance of infrastructure associated with the proposed high speed rail line, including track, signalling equipment, cuttings and embankments.
In-situ preservation	Preserving archaeological remains In the natural, original or appropriate position.
Institute of Environmental Management and Assessment	Professional membership organisation for environmental practitioners.
Intergovernmental Panel on Climate Change	A scientific intergovernmental body, tasked with the production of assessments of our overall understanding of the scientific, environmental, technical and socio-economic risks from and likely responses required to climate change.

Intrusive Investigation	An in-depth investigation involving further sampling and analysis, such as the gathering of samples from the ground, walls, ceilings for the detection of contamination, asbestos and or archaeological remains.
Listed Buildings	Buildings of special architectural or historic interest listed by the Secretary of State for Culture, Media and Sport on the advice of English Heritage. Buildings are graded to indicate their relative importance.
Mitigation	The measures put forward to prevent, reduce and where possible, offset any adverse effects on the environment.
National Farmers Union	Member organisation/industry association for Welsh and English farmers.
National Trust	A UK conservation charity protecting historic places and green spaces and opening up for everyone.
National Vegetation Classification (NVC)	The National Vegetation Classification (NVC) is a comprehensive classification and description of the plant communities of Britain.
Natural Area	Natural Areas are sub-divisions of England, defined by Natural England, each with a characteristic association of wildlife and natural features. They provide a way of interpreting the ecological variations of the country in terms of natural features, illustrating the distinctions between one area and another. Each Natural Area has a unique identity resulting from the interaction of wildlife, landforms, geology, land use and human impact. Natural Areas have been formally defined as ‘biogeographic zones which reflect the geological foundation, the natural systems and processes and the wildlife in different parts of England, and provide a framework for setting objectives for nature conservation' (Biodiversity: The UK Steering Group Report, HMSO, 1995).
Natural England	The Government’s advisor on the natural environment who provides practical advice, grounded in science, on how best to safeguard England’s natural wealth for the benefit of everyone.

Net	After all deductions have been made.
NO_2	Nitrogen Dioxide. Road transport and the burning of fossil fuels for power are the main sources of Nitrogen dioxide. In addition to being a green house gas it also contributes to photochemical smog formation. It is an irritant to the respiratory system.
Non-governmental Organisation	Legally constituted organisation, which is independent of government. It is ordinarily non-profit and may be organised at a local, national or international level.
NOx	Nitrogen Oxides. NOX is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. NOX is typically comprised largely of nitric oxide (NO) and nitrogen dioxide (NO2). Many of the nitrogen oxides are colourless and odourless, although NO2 can often be seen as a reddish-brown layer over many urban areas when present alongside particulates. NOX form when fuel is burned at high temperatures, as in a combustion process. Consequently, these emissions occur almost exclusively from the combustion of fossil fuels for industry and transport, and form the burning of biomass.
Particulate matter	Discrete particles in ambient air, sizes ranging between nanometres (nm, billionths of a metre) to tens of micrometres (µm, millionths of a metre).
Pathways	The routes by which impacts are transmitted through air, water, soils or plants and organisms to their receptors.
Phase 1	Phase 1 of the proposed Y network - a high speed railway between London and the West Midlands with a connection via the West Coast Main Line at conventional speeds to the North West and Scotland and to the Channel Tunnel via HS1. Phase 1 includes four high speed rail stations at London Euston, Old Oak Common (West London), Birmingham Airport (Birmingham Interchange) and Birmingham (Curzon Street).

Phase 1 habitat survey	The Phase 1 habitat classification and associated field survey technique provides a relatively rapid system to record semi-natural vegetation and other wildlife habitats. Each habitat type/feature is defined by way of a brief description and is allocated a specific name, an alpha-numeric code, and unique mapping colour. The system has been widely used and continues to act as the standard 'phase 1' technique for habitat survey across the UK.
Phase 2	Phase 2 of the proposed Y network - extending the high speed railway beyond the West Midlands to Manchester and Leeds with connections at conventional speeds via the West Coast and East Coast Main Lines and a direct link at high speed to Heathrow Airport.
Priority habitats and species	The UK Biodiversity Action Plan published in 1994 sets out a programme for conserving biodiversity in the UK. The UK BAP has published lists of species and habitats that are conservation priorities because of their rarity and rate of decline. A review of the UK BAP priority list in 2007 led to the identification of 1,150 species and 65 habitats that meet the BAP criteria at UK level. Priorities for England have been published under Section 41 of the NERC Act 2006.
Proposed Scheme	Proposals for a high speed railway between London and the West Midlands announced by Government in *High Speed Rail: Investing in Britain's Future – Decisions and Next Steps* (January 2012).
Public Realm	The space between and within buildings that are publicly accessible, including streets, squares, forecourts, parks and open spaces.
Receptor	A component of the natural, created or built environment such as human being, water, air, a building, or a plant that is affected by an impact.
Registered Historic Parks and Gardens	A national record of the historic parks and gardens, which make a rich and varied contribution to the landscape and should be treated with care.

Residual Impacts	Those impacts of the development that cannot be mitigated following implementation of mitigation proposals.
Riparian Area	The interface between land and a river or stream.
Risk Assessment	An assessment of the likelihood and severity of an occurrence.
River Corridor Survey	Field mapping vegetation and physical features along the watercourse corridor using standard symbols, with cross-sections of channel form.
River Habitat Survey	A method designed to characterise and assess, in broad terms, the physical structure of watercourses.
Rolling Stock Depot	Depot used to service and maintain trains operating on the proposed route.
Scheduled Monument	Important sites and monuments are given legal protection by being placed on a schedule by English Heritage.
Scoping	An initial stage in determining the nature and potential scale of environmental impacts arising as a result of a development, and an assessment of what further studies are required to establish their significance.
Setting (Heritage Asset)	The surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral.
Site of Special Scientific Interest (SSSI)	Area of land notified by Natural England under section 28 of the Wildlife and Countryside Act 1981 as being of special interest by reason of its flora, fauna or geological or physiological features.
Strategic Environmental Assessment	Environmental assessment of certain plans or programmes under Directive 2001/42/EC
Threshold	A level of effect above which an assessment will be taken of whether any changes to procedures need to be made.
Topography	The natural or artificial features, level and surface form of the ground surface.

Transport for London (TfL)	TfL was created in 2000 and is the integrated body responsible for London's transport system.
Tunnel boring machine	A machine that excavates tunnels – commonly called a 'mole'.
UK Climate Change Risk Assessment	Research into the anticipated impacts of climate change on the UK and its economy.
UK Climate Projections	Information on the projected evolution of climate change in the UK explored through three possible scenarios: High, Medium and Low greenhouse gas emissions levels.
West Coast Main Line (WCML)	Intercity railway route in the UK connecting London, Birmingham, Manchester, Liverpool and Glasgow.