HS2 London to West Midlands
EIA Scope and Methodology Report

A report to HS2 Ltd by Arup/URS

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Contents

Part A

Executive summary

- This Scope and Methodology Report (SMR) 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) (the 'Proposed Scheme') 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 the Proposed Scheme.

- The EIA is required by European Union Directive[1] and on the assessment of the effects of certain public and private projects on the environment (Directive 2011/92/EU) and Parliament's Private Business Standing Order 27A (SO27A)[2] which require the preparation of an ES to inform the decision-maker of the likely significant effects of the Proposed Scheme on the environment.

- This SMR also sets out the methodology that is proposed for determining the likely environmental impacts and effects; and for assigning values of magnitude and significance to them. It also sets out the approach to the reporting of alternatives in the ES.

- In April 2012, HS2 Ltd consulted on a draft of this SMR (see Annex A for List of Consultees), to enable consultees to comment on the approach proposed. Following consultation, the SMR has been revised, taking into account the comments received where appropriate.

- This SMR sets out, in Part A, the general EIA methodology and scope of assessment, covering temporal, geographic and technical scope; approach to mitigation; cumulative effects; defining significant effects; and notes assumptions in undertaking the EIA. It provides an overview of the main alternatives to be described in the ES, including strategic, route alignment, and design alternatives.

- In Part B of the SMR, the scope and methodology for each environmental topic section is described. The topics addressed are:
  - Agriculture, forestry and soils;
  - Air quality;
  - Climate;
  - Community;
  - Cultural heritage;
  - Ecology;

[1] European Commission (EC), 1985, *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), EC

[2] House of Commons, *Standing Order 27A of the Standing Orders of the House of Commons relating to private business (environmental assessment)*, House of Commons

- Electromagnetic interference;
- Land quality;
- Landscape and visual assessment;
- Socio-economics;
- Sound, noise and vibration;
- Traffic and transport;
- Waste and material resources; and
- Water resources and flood risk assessment.

- An outline of the proposed structure of the ES is set out in Part C of this Report.

1 Introduction

1.1 Purpose of this report

1.1.1 This Report outlines the proposed scope and methodology for the Environmental Impact Assessment (EIA) and subsequent Environmental Statement (ES) for Phase 1 (London to West Midlands) (the 'Proposed Scheme') of the proposed high speed rail network (HS2).

1.1.2 This Scope and Methodology Report (SMR) provides an outline description of the Proposed Scheme and sets out the proposed scope of the environmental effects to be considered during the EIA. For each environmental topic to be covered, issues to be addressed, the distance from the proposed works to be considered (i.e. the spatial scope) and the periods in time when the issues would be assessed (i.e. the temporal scope) are set out. Consideration is given to effects that would arise during construction and operation including temporary, permanent, direct, indirect and cumulative effects.

1.1.3 This SMR also sets out the methodology that is proposed for determining the likely environmental impacts and effects; and for assigning values of magnitude and significance to them. It also sets out the approach to the reporting of alternatives in the ES.

1.1.4 In April 2012, HS2 Ltd consulted on a draft of this SMR (see Annex A for List of Consultees) to enable consultees to comment on the proposed approach.

1.1.5 Following consultation, the SMR has been revised, taking into account the comments received where appropriate.

1.1.6 HS2 Ltd will be consulting on the draft ES (currently expected in Spring 2013). The final ES will be submitted to parliament to accompany the hybrid bill and the public will have the opportunity to comment on it at that stage.

1.1.7 This SMR does not define the project in detail in any location, nor the construction works and ancillary features associated with the project. The afore mentioned details of the Proposed Scheme are currently being developed and will be available for consultation within the draft ES which is currently expected to be consulted upon in Spring 2013.

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 HS2 London to West Midlands Appraisal of Sustainability (AoS)[3], an outline of

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

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 ES.

1.2.2 The annexes to the Report include a list of consultees and a series of maps showing the Proposed Scheme.

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, South Yorkshire and the East Midlands; linked by high speed trains with a capacity to convey up to 18 trains per hour, at speeds of up to 225 miles per hour (mph) (360 kilometres per hour). On some sections of the route speeds would be lower than 225 mph and speeds above 225 mph would not be allowed unless the impacts of operation could be demonstrated to be no worse than assumed for operation at 225 mph. Beyond the dedicated high speed track high speed trains would also connect seamlessly with the existing West Coast Main Line (WCML) and East Coast Main Line (ECML) to serve passengers beyond the HS2 network in Wigan, Liverpool, Lancaster, Preston, Glasgow, York, Darlington, Durham, Newcastle, and Edinburgh.

1.3.2 HS2 would be built in two phases. The Proposed Scheme (Phase 1) would involve construction of a new railway line of approximately 230 kilometres (km) (143 miles) between London and Birmingham by 2026; with a connection to the WCML near Lichfield. Phase 2 would involve lines built from Birmingham to Leeds and Manchester; with construction commencing in or around 2027 and planned to be operational by 2033.

1.3.3 The Proposed Scheme would include a connection to Europe via the Channel Tunnel. On completion of Phase 2, the HS2 network would include a direct link to Heathrow Airport. HS2 trains would be up to 400 metres (m) long with 1,100 seats 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 the HS2 network 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, along with the preferred line of route from London to the West Midlands (i.e. Phase 1); with stations at Euston, Old Oak Common, Birmingham Interchange and Birmingham Curzon Street. Some of the services would continue past Birmingham on the existing rail network (known as classic compatible trains) to serve directly the North West and Scotland, through a connection with the WCML near Lichfield. When running

on the existing rail network, the HS2 classic compatible trains will run at speeds achievable on this network.

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 the Government. HS2 Ltd has now begun to take forward Phase 1 of the project, including the next stage of engineering, design and environmental work. The Government aims to deposit a hybrid bill in Parliament by the end of 2013 to seek the powers to construct and operate the Proposed Scheme. The powers sought are described in Section 1.9 (Hybrid bill powers) of the SMR.

1.3.6 HS2 Ltd is also continuing to work on proposals for Phase 2 (the line of route to Leeds and Manchester), and delivered options on the routes for Phase 2 to the Government in March 2012. A formal consultation on Phase 2 is planned to begin in early 2014, with a final route expected to be chosen by the end of 2014. However, the Government has asked HS2 Ltd to consider how the formal consultation could be brought forward to 2013 and an announcement on this is expected in autumn 2012.

1.4 Regulatory requirements

1.4.1 As the Proposed Scheme will be authorised by a hybrid bill, the objectives of EIA will be pursued through the Parliamentary process. Parliament's Standing Order 27A requires the Project's promoter to prepare and deposit an ES, the contents of which are specified in Standing Order 27A. Standing Order 27A requires the ES to cover the information set out in Part 1 of Schedule 4 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[4]; and so much of the information in Part 2 of that Schedule as is reasonably required to assess the environmental effect of the works and as the Project's promoters can reasonably be expected to compile.

1.4.2 HS2 Ltd will prepare the ES for the Proposed Scheme, in accordance with the requirements of Standing Order 27A and the EIA Directive 2011/92/EU.

1.5 HS2 Phase 1 route description

1.5.1 The following sections provide a summary description of the route of the Proposed Scheme. Annex B of this Report contains a series of route maps. Further detailed maps of the Proposed Scheme are available on the HS2 Ltd consultation website.[5]

[4] Department for Communities and Local Government, 2011 No. 1824, *Town and Country Planning (Environmental Impact Assessment) Regulations 2011,* The Stationery Office

[5] Department for Transport (DfT) and HS2 Ltd; In Your Area; http://highspeedrail.dft.gov.uk/in-your-area

Greater London

1.5.2 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.

1.5.3 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.

1.5.4 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

1.5.5 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.

1.5.6 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 the 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.

1.5.7 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.

1.5.8 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

1.5.9 From Burton Green the line would head north-west to cross the Rugby to Birmingham branch of the 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.

1.5.10 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.

1.5.11 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.

1.5.12 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 In February 2011, the Government published the HS2 London to the West Midlands Appraisal of Sustainability 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. 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 determine the extent to which Phase 1 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.

1.6.2 The AoS considered and compared various route options for Phase 1, taking into account 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. The process is described in full in the AoS.[6]

1.6.3 Almost 55,000 responses to the 2011 public consultation were received, with 36,918 responses including comments addressing matters related to the report. A summary of the responses received is contained within the consultation report High Speed Rail: Investing in Britain's Future, available from the DfT website.[7]

1.6.4 In response to the consultation feedback HS2 Ltd published in January 2012:

- Review of possible refinements to the proposed HS2 London to West Midlands Route[8];
- Review of HS2 London to West Midlands AoS[9]; and
- Review of HS2 London to West Midlands route selection and speed.

1.6.5 The AoS process has been taken into account in developing the SMR for the EIA of the Proposed Scheme. Issues raised during consultation on the AoS have helped to define the scope of the EIA topics, as described in the Consultation section of each topic (see Sections 4 to 17).

[6] Department for Transport (DfT) and HS2 Ltd; High Speed Rail: Investing in Britain's Future – Consultation; HS2 London to the West Midlands Appraisal of Sustainability; http://webarchive.nationalarchives.gov.uk/20111005090740/http://highspeedrail.dft.gov.uk/library/documents/appraisal-sustainability

[7] Department for Transport, February 2011, *High Speed Rail: Investing in Britain's Future Consultation,* DfT

[8] Department for Transport (DfT), 2012, *Review of possible refinements to the proposed HS2 London to West Midlands Route: A Report to Government by HS2 Ltd,* DfT

[9] Department for Transport (DfT), 2012, *Review of HS2 London to West Midlands Appraisal of Sustainability: A Report to Government by HS2 Ltd*, DfT

1.7 Consultation on the Environmental Impact Assessment

1.7.1 Consultation on the draft ES is currently expected in spring 2013 and will give people and organisations the opportunity to comment on the documents.

1.7.2 During preparation of the EIA, ongoing consultation on the scope, methodology and proposed mitigation and nature of resultant impacts within environmental topic areas will occur with the key consultees relevant to those topics.

1.7.3 Engagement with the community and interested organisations will be undertaken throughout the EIA process as it will enable the project to understand local issues and to consider local concerns. This will include engagement with three forums as described below.

Environment Forum

1.7.4 The Environment Forum involves national representatives of environmental statutory authorities and government departments. The forum advises HS2 Ltd on environmental policy for the Proposed Scheme, including project-wide mitigation strategies and principles.

Planning Forums

1.7.5 Planning Forums facilitate discussion between HS2 Ltd and local authority officers on technical matters such as design development, planning issues, environmental impacts and mitigation principles. They provide a focal point to HS2 Ltd's ongoing engagement with local authorities and their communities through HS2 Ltd's area based teams.

Community Forums

1.7.6 The Community Forums will meet to:

- Inform local people about developing HS2 proposals and consultations;
- Consider local issues and discuss potential ways to avoid and mitigate impacts of the Proposed Scheme, such as screening views of the railway, managing noise and reinstating highways; and
- Identify possible community benefits.

1.7.7 These forums provide the formal mechanism for HS2 Ltd's engagement moving towards the deposit of the hybrid bill. They will 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.

1.8 Monitoring of performance against sustainability and environmental goals

1.8.1 As described in Section 1.6 (Previous environmental assessment work on this project), the AoS reported on the extent to which the 2011 consultation 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.

1.8.2 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 to guide the project development teams. These draw upon the knowledge gained through the AoS; and 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.

1.8.3 The EIA will identify the likely significant environmental effects of the Proposed Scheme and determine options for further mitigation. This process is described further in Section 2.3 (Approach to mitigation). The mitigation proposals will include provisions for monitoring the effectiveness of the mitigation to be provided in avoiding or controlling significant environmental effects. For example this would include a Code of Construction Practice; a document that will set out the principles for the management and monitoring of the environmental aspects arising out of construction to ensure that such effects will be managed effectively on site, and would include measures such as sound, noise and water quality monitoring, as necessary.

1.8.4 After construction is complete, HS2 Ltd would provide guidance to ensure that the effectiveness of the mitigation defined in the legislation authorising the Proposed Scheme and in appropriate management, 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 to develop the necessary monitoring and management plans.

1.9 Hybrid bill powers

1.9.1 The Government will deposit a hybrid bill for consideration by Parliament. If passed, it becomes an Act of Parliament conferring powers, including deemed planning permission, 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 Proposed Scheme;
- Powers to protect gas, water, telecommunications and electricity infrastructure which might be affected by the Proposed Scheme; and
- Powers over rights of way.

1.10 EIA Programme

1.10.1 The EIA process commenced in early 2012. The draft SMR report was issued in April 2012 for consultation and it is expected that the draft ES will be published for consultation in Spring 2013. The final ES will be prepared to accompany the hybrid bill in late 2013. The baseline data gathering and EIA processes are programmed to enable the draft ES to describe the significant effects of the project. However, baseline data gathering will continue as appropriate throughout 2013 to supplement where necessary the assessment in the draft ES and ensure that the ES assesses the Proposed Scheme in the form applied for.

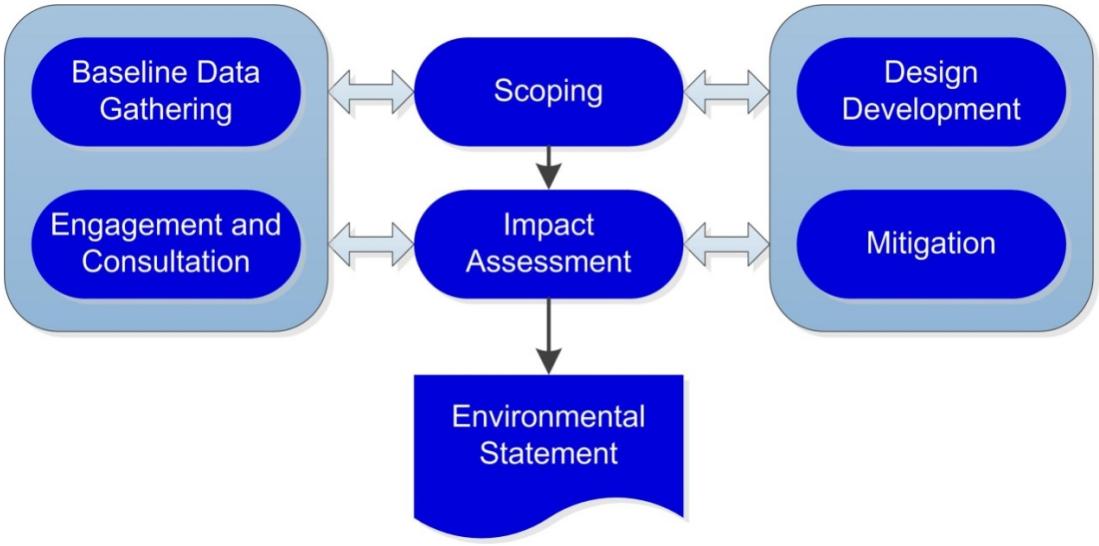
2 EIA methodology

2.1 Introduction

2.1.1 The EIA is the process that leads to the production of the ES to be submitted in support of the hybrid bill. It will be carried out in accordance with applicable legal requirements and with current best practice, and will be carried out in accordance with the requirements of the EIA Directive 2011/92/EU and SO27A.

2.1.2 The EIA process will comprise a number of related activities, as illustrated in Figure 1.

Figure 1 – EIA process diagram



2.1.3 As Figure 1 shows, the main stages in the EIA process comprise:

- Initial EIA scoping to establish the broad scope and methodology of environmental studies to be carried out for each environmental topic and identify the potentially significant environmental effects and, 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 of the area and consultation with groups that have specialist local knowledge;
- 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;

- Establishing the potential for other schemes to be under construction before or during the construction of the Proposed Scheme;
- Consideration of policies, guidelines and legislation and best practice relevant to EIA;
- Assessment of the design of the Proposed Scheme in accordance with the methodology outlined per environmental topic within this Report, to identify the local extent of potential impacts and the practicable design measures to avoid, reduce or otherwise mitigate significant adverse environmental effects;
- Assessment of significant environmental effects after the provision of mitigation, with reference to recognised criteria and using professional judgement in the absence of recognised criteria;
- Engagement and consultation through the Environment, Planning and Community Forums, and more informally where appropriate, throughout the engineering design and assessment process;
- Preparation of the draft ES;
- Public consultation on the draft ES (planned for Spring 2013);
- Further assessment in the light of consultation responses and ongoing design development and baseline surveys; 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 on whether the Proposed Scheme should proceed. The provision of further information to Parliament and further consultation may be required during this legislative process.

2.1.5 In addition to describing the main alternatives considered, broadly, 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 in Section 2.2 (Scope of assessment)]; and
- The effects of the Proposed Scheme in addition to other schemes that are either consented or under construction at that time (but are not included in the projected future baseline, see paragraph 2.1.3) and are identified as having the potential to result in significant cumulative impacts and resultant effects [see Section 2.4 (Cumulative effects)].

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 in the ES.

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 significant adverse effects on the environment during construction and operation. Mitigation measures would be considered and incorporated within the Proposed Scheme wherever appropriate and practicable. The extent and scale of mitigation will be designed to control and minimise significant adverse environmental effects; as well as 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 of the Proposed Scheme.

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), with the intensity and scale of construction along the route varying 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. The effects of services operating prior to the opening of Phase 2 will be addressed in the ES. It is expected that, once Phase 2 is operational, the use of the Phase 1 railway will intensify. Therefore, effects arising from the operational rail traffic on the Phase 1 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).

2.2.4 The ES will describe those elements of Phase 2 such that the relationship between Phase 1 and Phase 2 is understood to enable the impacts on the Phase 1 receptors to be described and assessed.

2.2.5 Effects arising from passenger usage of the Phase 1 railway, such as those that would arise at Euston station and Curzon Street station, and Birmingham and Old Oak Common interchanges, and on journeys to and from these stations/interchanges, would be assessed at both the maximum anticipated use of Phase 1 and of Phase 2.

2.2.6 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.

2.2.7 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 within this section.

Geographic scope

2.2.8 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. In addition to the permanent land take requirements it will also address land taken for construction (both for short and long term periods) and then returned in an agreed condition afterwards. 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.

2.2.9 In addition, the EIA will consider any significant effects caused by effects caused by activities such as:

- HS2 services on the 'classic network' north of Birmingham;
- Consequential changes to rail traffic on other lines, especially on the WCML between London and Birmingham and the Chiltern Line, and disruption at stations/interchanges during construction;
- Passenger access to and from stations and interchanges; and
- Consequential development around stations and interchanges.

2.2.10 Transboundary effects are significant environmental effects caused in other countries (i.e. other than the United Kingdom (UK)). The most likely transboundary effects caused by HS2 are 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

2.2.11 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 of the 2011 EIA Regulations[10] 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.

2.2.12 These aspects have been refined and adapted with reference to current 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:

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

2.2.13 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

[10] HM Government, 2011, *Town and Country Planning (Environmental Impact Assessment) Regulations 2011*, The Stationery Office

that relate to them. Part B of this Report provides further details for each environmental topic regarding the assessment approach to be applied during the EIA.

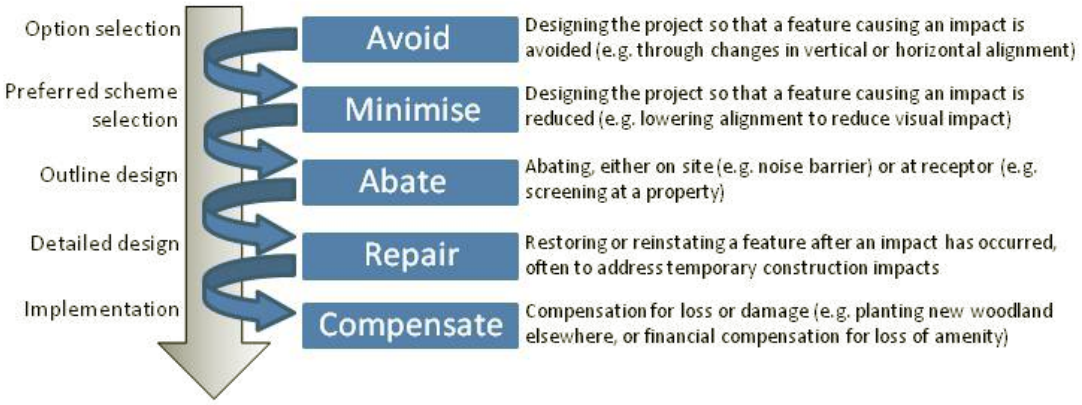
2.2.14 The content of the topics is defined in the topic chapters. They are generally quite broad that amongst them they cover all potential impacts. So for example the impact of lighting during construction and operation is covered under landscape. Likewise the impact of power generation to support the power needs would be included under Climate, but the impact of distribution of the power would fall under Electromagnetic Interference.

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 adverse effects.

2.3.2 Figure 2 (taken from the HS2 London to West Midlands AoS) illustrates the hierarchy that will be used to consider mitigation and compensation measures.

Figure 2 – Mitigation Hierarchy



2.3.3 Mitigation opportunities will continue to be identified during development of the Proposed Scheme prior to the submission of the hybrid bill. The EIA process is iterative, which is likely to enable further refinement of the Proposed Scheme, with the objective of avoiding or reducing significant 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 within the HS2 project teams. 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 - an HS2 Ltd document to set environmental standards which the Proposed Scheme should achieve or endeavour to achieve, thereby structuring and guiding the design;
- Collaborative working between environmental assessment and engineering design teams - to achieve improved design outcomes;
- Community engagement and consultation - to allow local people, environmental organisations and responsible authorities to raise issues and propose design and mitigation changes to be considered within the Proposed Scheme;
- Mitigation report - an HS2 Ltd document that records proposed mitigation along the route and will enable HS2 Ltd to demonstrate the mitigation that it has committed to within the Proposed Scheme. It also acts as a mechanism for gauging the consistency of approach applied along the route; and
- Code of Construction Practice - an HS2 Ltd document to describe the approach to be taken during construction to reduce adverse effects on communities and the environment, including through the use of Local Environmental Plans.

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.

2.4 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 reasonably foreseeable 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 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, 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 (including in a regional context or over the length of the Proposed 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 considered during the EIA. As an example, however, it is expected that the EIA should consider carefully the effects of construction of Phase 2 in the vicinity of receptors of impacts from the Proposed Scheme.

2.4.4 The geographical scope of other 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 for each scheme and for each environmental topic 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.

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 Proposed Scheme 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 or noise 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 ES, 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 impacts will be classified according to whether they are considered to be major, moderate or minor; and beneficial or adverse. 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 change to an environmental resource or receptor;
- Adverse - detrimental or negative change to an environmental resource or receptor;
- Minor - slight, very short term or highly localised impact;
- Moderate - limited impact (by extent, duration or magnitude); 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 The duration of impacts will be categorised as short, medium or long term, where they are not permanent. There is no definition of these terms in EIA practice and it is recognised that the use of the terms would depend on the

viewpoint of the user, especially where the user is subjected to the impact or effect. It is therefore important that in addition to using these descriptors, the EIA also gives an indication of the duration. In general, and given the length of the construction programme, the EIA will consider those impacts that last a matter of months to be 'short term' and those that continue through to the commencement of operations as 'long term'.

2.5.4 Some impacts would arise directly from construction or operation of the Proposed Scheme and others would arise more indirectly from activities associated with the scheme or resulting as a consequence of it. Whether an impact arises directly or indirectly does not affect whether the resulting effects are considered to be significant or not.

2.5.5 Potential variants to the foregoing approach are described as appropriate in the environmental topic sections in Part B of this Report.

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

2.5.7 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 environmental topic section in this Report describes the approach to be taken. In determining whether a resulting effect is significant due consideration will be given to:

- Spatial extent (e.g. local, district, regional, national or international);
- Magnitude;
- Duration (whether short, medium or long term);
- Frequency of occurrence;
- Nature of the effect (whether direct or indirect, permanent or reversible);
- Whether it 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.

2.5.8 Where effects are considered to be significant, the ES will show the geographic (or spatial) level at which they are viewed as significant (for example, at a community level or a regional or national level).

2.5.9 The EIA is being undertaken by a number of consultancies who are considered to be amongst the leaders in their profession in the UK. The leads

for each environmental topic, from the appointed consultancies, meet regularly to discuss the methodology being applied, the issues, impacts and effects arising, and the solutions available. National representatives of environmental statutory authorities and government departments are also involved in these discussions. This approach enables experienced EIA Practitioners to apply expert professional judgement where appropriate on consistent basis.

2.6 Assumptions

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

2.6.2 During the preparation of the EIA there could be some circumstances that result in factors that may limit the information available to inform the assessment process. Any limitations, and the consequences on the completeness or potential accuracy of conclusions, will be described in the relevant environmental topic chapter within the ES.

3 Reporting of alternatives in the ES

3.1.1 This section outlines the background to the Government's decision to proceed with development of a hybrid bill submission for HS2 and outlines the alternatives that will be reported in the ES.

3.1.2 The Government considers that a continuing increase in demand will create a need over the next 20 to 30 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 the 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.

3.1.3 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 the 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 WCML over the coming decades. The strong likelihood is that even by pushing the WCML to the absolute limit, as the alternatives that have been considered do, it 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.

3.1.4 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; rather a new line capable of providing the capacity that is required. It is recognised that 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].

[11] Atkins, February 2011, High Speed Rail Strategic Alternatives Study: Strategic Alternatives to the proposed 'Y' Network

3.1.5 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. The main alternatives that have been considered are reported in the consultation report High Speed Rail: Investing in Britain's Future.

Reporting of alternatives in the ES

3.1.6 The ES will provide an outline of the main alternatives studied by HS2 Ltd and DfT and the main reasons for the choice taking environmental effects into account. The main alternatives to be described will include the following main groups:

Strategic alternatives

3.1.7 In outline, other alternatives described in the report 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 WCML and Chiltern Railway.

Route alignment alternatives

3.1.9 These would include alternatives such as route corridor alternatives between London and the West Midlands, location of the stations, and means of connecting to other rail networks including 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 (along with the Government's preferred route that had been consulted upon.)

Design alternatives on the proposed route

3.1.11 The ES will also describe, 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 stations/interchanges 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.

Part B

4 Agriculture, forestry and soils

4.1 Introduction

4.1.1 This section of the Report covers agriculture, forestry and soils which includes the environmental topic areas of soil, agricultural and forestry land, and farm and farm-based enterprises. In particular, it considers the potential impacts of the loss of land in terms of agricultural land quality, soil resources, local farm businesses and on-farm enterprises, and agri-environment schemes.

4.1.2 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 EIAs.[12] [13]

4.1.3 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).

4.1.4 Policy advises that the economic and other benefits of the best and most versatile agricultural land should be taken into account in decisions on development. Where significant development of agricultural land is demonstrated to be necessary, areas of poorer quality land in Grades 3b, 4 and 5 should be used in preference to higher quality land.

4.1.5 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.

4.2 Establishment of baseline and definition of survey

4.2.1 A description of the baseline environment in relation to the 2011 consultation scheme is contained within the AoS. Section 8.17 of the AoS describes the baseline environment in relation to soil and land resources.

4.2.2 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.[14]

[12] Highways Agency, 2001, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 6 Land Use – Amendment No. 1,* The Stationery Office

[13] Department of Environment (DoE), 1995, *Preparation of Environmental Statements for Planning Projects that require Environmental Impact Assessment: A Good Practice Guide, DoE*

4.2.3 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).

4.2.4 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, however, 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.

4.2.5 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 are also shown on magic.gov.uk.

4.2.6 The approach to the ALC survey of all land to be acquired or used for the Proposed Scheme will be undertaken in two parts. Firstly, an interpretation of published geological, topographical, soil and agro-climatic information will be undertaken in the light of the ALC guidelines. Then the predictive ALC will be augmented with the results of detailed ALC surveys undertaken by MAFF or Department for Environment, Food and Rural Affairs (Defra) and by other recognised sources within or adjacent to the route corridor of the Proposed Scheme. The predictive ALC survey will be augmented by field survey to validate its findings, where required.

4.2.7 The site survey will involve 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 MAFF guidelines to verify or inform the predicted grade of agricultural land.

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

4.2.8 A risk assessment will be prepared to ensure that health and safety hazards relating to the ALC and soil surveys are taken into account. Defra guidance on biosecurity for visits to premises with farm animals will be followed[15].

4.2.9 Information on the existing agricultural use and circumstances of all land to be acquired or used will be obtained primarily from the owners and occupiers of the land. Where land is within a written tenancy, this information will be obtained mostly 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 (i.e. National Farmers Union /Country Land and Business Association and Central Association of Agricultural Valuers) 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.

4.2.10 Where practicable, a representative of the HS2 project design team will attend the interviews alongside the agricultural surveyor. In order to minimise the number of visits to individual farm holdings, specific questions relating to other environmental disciplines (such as Community) may be included within the interview as appropriate.

4.2.11 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 private and commercial equestrian enterprises. Non-agricultural, land-based enterprises will be those within the control of the main occupier of the farm holding.

4.2.12 Information on the presence of any agri-environment schemes (such as Environmental Stewardship) will be obtained from magic.gov.uk, the Natural England website[16] and from individual land owners and occupiers, who will also be asked for details of the nature, requirements and duration of such schemes on the whole farm.

4.2.13 In addition to data collected from land owners and occupiers, information on woodlands affected by the Proposed Scheme will be obtained from the National Forest Inventory.[17]

[15] Department for Environment, Food and Rural Affairs (Defra), 2008, Biosecurity Guidance to Prevent the Spread of Animal Diseases, Defra

[16] Natural England; Our Work; Farming and Land Stewardship; Funding for Land Management; http://www.naturalengland.org.uk/ourwork/farming/funding/default.aspx

[17] The National Forest Inventory; http://www.forestry.gov.uk/inventory

4.3 Consultation

Consultation on the AoS

4.3.1 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.

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

Consultation as part of the EIA process

4.3.3 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 at regional and national levels;
- The Country Land and Business Association at regional and national levels;
- The Central Association of Agricultural Valuers;
- Campaign for the Protection of Rural England ;
- Confor (representing woodland owners and forestry businesses);
- The British Horse Society; and
- Hunting Groups.

4.3.4 At the strategic level, it will be necessary to continue consultation with Defra and Natural England, particularly in respect of 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 within 1km either side of the route alignment of the Proposed Scheme.

4.3.5 The owners and occupiers of land to be acquired or used for the construction and operation of the Proposed Scheme would form the basis of consultation in relation to the undertaking of the EIA.

4.4 Key aspects of the Proposed Scheme for the topic

4.4.1 The key aspects of the Proposed Scheme that will affect agricultural and forestry 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 land 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 and land in agri-environment schemes); 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) and will effect their carbon storage properties;
- 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 (particularly marked with peats and highly organic soils), 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).

4.5 Scope of assessment

Spatial scope

4.5.1 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.

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

Temporal scope

4.5.3 The temporal scope for this topic is outlined in Section 2.2 (Scope of the assessment) of this Report. Agriculture and soil effects will be assessed for the construction period (2017 – 2026) and the year of opening in 2026. The temporal scope will be extended for areas of re-instated agricultural land; typically, agricultural aftercare on restored land lasts for five years following

soil placement in order to ensure that soil structure has stabilised satisfactorily.

Technical scope

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

- The quantity and quality of agricultural and forestry land that would be affected, both temporarily and permanently;
- The nature and use of the agricultural and non-agricultural 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.

4.6 Assessment methodology

Legislation

4.6.1 In 2006, the European Commission adopted a comprehensive '*Thematic Strategy*'[18] specifically dedicated to soil protection which included a proposal for a '*Soil Framework Directive*'[19] to promote the sustainable use of soil and protect soil as a natural resource. However, to date, a European Commission Soil Framework Directive has not been implemented.

4.6.2 Although there remains no specific legislation for the protection of soil and agricultural land, Defra issued the '*Soil Strategy for England – Safeguarding our Soils*'[20] in 2009. The aims of the Strategy have been incorporated into the Natural Environment White Paper: The natural choice: securing the value of nature[21] and set 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.

4.6.3 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.

[18] European Commission (EC), 2006, *Soil Thematic Strategy* (COM (2006) 231), EC
[19] European Commission (EC), 2006, *Proposal for a Soil Framework Directive* (COM (2006) 232), EC
[20] Department for Environment, Food and Rural Affairs (Defra), 2009, *Safeguarding our Soils: A Strategy for England*, Defra
[21] HM Government; 2011, *The Natural Environment White Paper, The natural choice: securing the value of nature*, The Stationery Office

Planning Policy

4.6.4 The National Planning Policy Framework[22] (NPPF) advises at paragraph 109 that the planning system should contribute to and enhance the natural and local environment by, amongst other matters, protecting and enhancing soils.

4.6.5 Paragraph 112 of the NPPF indicates that the economic and other benefits of the best and most versatile agricultural land should be taken into account in development decisions. Where significant development of agricultural land is demonstrated to be necessary, poorer quality land in Grades 3b, 4 and 5 should be used in preference to higher quality land.

4.6.6 There is no guidance in policy with regard to the effects of development proposals on farm holdings, although Natural England's Technical Information Note (TIN) 049[23] 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

4.6.7 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.

4.6.8 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*'[24], Defra's '*Construction Code of Practice for the Sustainable Use of Soils on Construction Sites*'[25] and Defra's '*Guidance for Successful Reclamation of Mineral and Waste Sites'.*[26]

Significance criteria

4.6.9 In order to assess the effects of the Proposed Scheme 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.

[22] Department for Communities and Local Government (DCLG), 2012, *National Planning Policy Framework,* The Stationery Office
[23] Natural England, 2009, *Technical Information Note (TIN) 049, Agricultural Land Classification: protecting the best and most versatile agricultural land*, Natural England
[24] Ministry of Agriculture, Fisheries and Food (MAFF), 2000, *Good Practice Guide for Handling Soils*, MAFF
[25] Defra, 2009, *Construction Code of Practice for the Sustainable Use of Soils on Construction Sites,* Defra
[26] Defra, 2004, *Guidance for Successful Reclamation of Mineral and Waste Sites*, Defra

4.6.10 The significance level attributed to each effect will be assessed based on the magnitude of change due to the Proposed Scheme, the sensitivity of the affected receptor/receiving environment to change, and the relative scarcity or abundance of the resource/receptor in the locality, as well as in a wider context, given that some receptors or features may group or converge in a particular locality.

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

4.6.12 The ALC survey will provide a statement of the 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 Proposed Scheme and the sensitivity of the agricultural land resource will be reflected in its grading. The sustainable reuse of displaced agricultural and non-agricultural soil resources will also be considered and is discussed further in Section 16 (Waste and Material Resources) of this Report.

4.6.13 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 hectares). 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 or special value 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.

4.6.14 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 Proposed Scheme.

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

Construction effects

4.6.16 Construction effects on agricultural and forestry 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.

4.6.17 Other construction effects may include the deposition of dust on sensitive crops, land uses or buildings; disruption to drainage, irrigation and water supply systems; unintentional pollution of soil and watercourses or bodies (used for crop irrigation or livestock drinking water supplies); spread of injurious weeds to adjacent agricultural land from soil and material stockpiles; and construction noise on farm and farm-based enterprises.

Operational effects

4.6.18 Operational effects on agricultural and forestry 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.

4.6.19 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

4.6.20 The construction of the Proposed Scheme, combined with developments that are already taking place or anticipated within the route of the Proposed Scheme, may result in increased pressure on agricultural and forestry 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.

4.7 Assumptions

4.7.1 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 contamination, which is detailed in Section 11 (Land Quality) 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 environmental topics within the ES.

4.7.2 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 Sections 7 (Community) and 13 (Socio-economics) of this Report.

4.7.3 Projections of future climate change on agriculture, forestry and soils will be incorporated in the definition of the future baseline. The methodology for assessing the significance of impacts on climate change adaptation within

the Agriculture, Forestry and Soils topic area will be developed in conjunction with the climate change specialists on the EIA team.

5 Air quality

5.1 Introduction

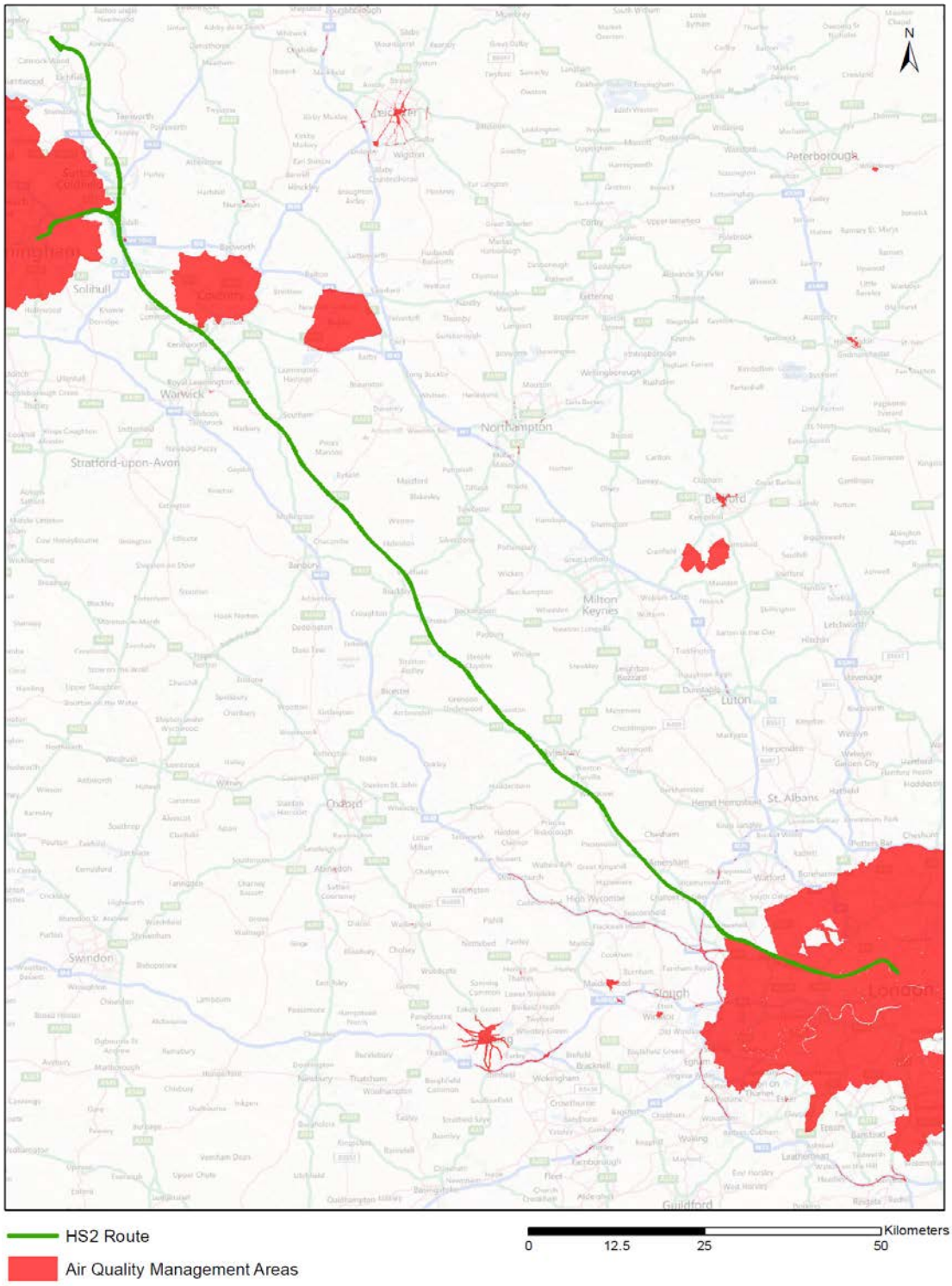
5.1.1 This section of the Report sets out the scope and methodology for assessing the impacts and effects of the Proposed Scheme on air quality during its construction and operation. These activities could result in changes in air quality and therefore need to be assessed in the ES. Air quality changes would occur during construction as a result of the construction activities and associated traffic movements. During 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. In addition, 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 potentially from modal shift. The 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.

5.2 Establishment of baseline and definition of survey

5.2.1 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). The majority 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 AQMAs. Figure 3 shows the Proposed Scheme route map in relation to existing AQMAs.

5.2.2 The vast majority of AQMAs in the UK are designated where NO_2 and 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 process, it is possible that AQMAs that are no longer required are revoked. Similarly, new AQMAs may be declared, or extensions made to existing AQMAs; therefore this will be reviewed throughout the air quality assessment.

Figure 3 HS2 route map in relation to Air Quality Management Areas



5.2.3 Under Part 4, Section 82 of the Environment Act 1995 (Local Air Quality Management)[27], local authorities in the UK are required to review and assess 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 stations/interchanges and along the route alignment of the Proposed Scheme 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 $PM_{2.5}$.

5.2.4 The assessment will review air quality monitoring data available from the national Automatic Urban and Rural Network (AURN) available on Defra's website.[28] 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.[29] The West Midlands Air Quality Group website[30] also contains information relevant to the West Midlands area. It is possible that other local authorities run their own monitoring networks and hold results not available elsewhere, this will be established and dated collected during the baseline assessment.

5.2.5 Further background air pollutant concentration data is available on Defra's Air Information Resource (AIR) website.[31] These data comprise estimated background air pollution data for 2008 and projections for future years for a one square kilometre (km^2) grid for every local authority in the UK.

5.2.6 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 the UK network of protected sites are available from the UK Air Pollution Information System (APIS).[32]

5.2.7 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

[27] Department for Environment, Food and Rural Affairs (Defra), 1995, *The Environment Act 1995*, The Stationery Office
[28] Department for Environment, Food and Rural Affairs (Defra); UK-Air; Monitoring Networks; http://uk-air.defra.gov.uk/networks/
[29] King's College London; Environmental Research Group; London Air; www.londonair.org.uk
30 West Midlands Air Quality Group; http://www.wmair.org
31 Department for Environment, Food and Rural Affairs (Defra); UK-Air; Air Information Resource; http://uk-air.defra.gov.uk
32 Air Pollution Information System; http://www.apis.ac.uk

on vegetation and ecosystems, baseline data for nitrogen oxides (NOx) and nitrogen deposition would be collated.

5.2.8 Additional air quality monitoring data might be required for model verification although it is expected that sufficient data will already be available [see Section 5.7 (Assumptions) of this Report].

5.3 Consultation

Consultation on the AoS

5.3.1 The consultation undertaken during the preparation of the AoS indicated that some consultees provided responses related to the air quality effects of the 2011 consultation scheme. The main points highlighted during this consultation were the direct potential effects of the 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. A summary of the comments are as follows:

- London Borough of Camden responded that the 2011 consultation 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 of works.
- London Borough of Hillingdon's main concern was with regard to potential air quality effects during the operation phase and whether the 2011 consultation 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 modal 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 Airport 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

5.3.2 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.

5.3.3 In addition, the Greater London Authority (GLA) will be consulted in relation to the air quality assessment methodology and Natural England with respect to ecological effects of changes in air quality.

5.4 Key aspects of the Proposed Scheme for the topic

5.4.1 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.

5.4.2 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. In addition, some have the potential to cause changes in NOx concentrations at ecologically sensitive habitats. Ozone will not be considered in this assessment as it is formed at a regional level and the expected changes in pollutant emissions are unlikely to have a significant effect on its formation in the atmosphere.

5.4.3 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/interchanges and along the route. In addition, there would be potential air quality effects from emissions from buildings.

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

5.5 Scope of assessment

Spatial scope

5.5.1 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).[33] These criteria will be applied along

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

the length of the route of the Proposed Scheme to identify where further assessment is required, and comprise:

- Road alignment change by 5m 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 change by 10 kph or more; or
- Peak hour traffic speed change by 20 kph or more.

5.5.2 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.[34] These include areas around worksites where there are sensitive receptors within 350m from the construction site boundary and/or within 100m of the routes used by construction vehicles on the public highway and up to 500m from construction site entrances.

5.5.3 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 (Ecology) of this Report.

Temporal scope

5.5.4 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.

5.5.5 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

5.5.6 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. The air quality effects arising from the modal shift will only be assessed in terms of change in regional emissions.

[34] 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

5.6 Assessment methodology

Legislation

5.6.1 The assessment will take into account the following legislation, and any subsequent changes to the legislation:

- Part 4 of the Environment Act 1995;
- The Air Quality (England) (Amendment) Regulations 2002[35];and
- The Air Quality Standards Regulations 2010[36];
- Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe[37]; and
- NPPF, 2012.

Guidance

5.6.2 The assessment will take into account the following guidance:

- Local Air Quality Management Technical Guidance LAQM.TG(09)[38];
- Design Manual for Roads and Bridges. Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 Air Quality, HA207/07;
- Environmental Protection UK (EPUK) Guidance – Development Control: Planning for Air Quality[39];
- IAQM Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance; and
- GLA's Best Practice Guidance: The Control of Dust and Emissions from Construction and Demolition published in 2006 (due to be revised in 2012).[40]

Significance criteria

5.6.3 Air quality limit values and objectives are quality standards for clean air and to protect human health. 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.

5.6.4 Table 1 sets out these European Union (EU) air quality limit values and UK national air quality objectives for the pollutants relevant to this study (NO_2, PM_{10} and $PM_{2.5}$).

[35]Department for Environment, Food and Rural Affairs, 2002, *The Air Quality (England) (Amendment) Regulations 2002*, The Stationery Office
[36] Department for Environment, Food and Rural Affairs, 2010, *The Air Quality Standards Regulations 2010*, The Stationery Office
[37] Official Journal of the European Union, 2008, *Directive 2008/50/EC of the European Parliament and of the Council of the 21 May 2008 on ambient air quality and cleaner air for Europe*, EU
[38] Defra, 2009, *Local Air Quality Management Technical Guidance LAQM.TG(09)*, Defra
[39] Environmental Protection UK, 2010, *Development Control: Planning for Air Quality*, Environmental Protection UK
[40] 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.

Environmental Protection UK: Planning for Air Quality

5.6.5 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 EPUK *Guidance Development Control: Planning for Air Quality*. The Guidance incorporates the latest position of the IAQM on impact significance.

5.6.6 The EPUK Guidance 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}.

5.6.7 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 micrograms (µg) per cubic metre (m^3) for PM_{10} (see Table 2 and Table 3). 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 4 and Table 5).

Table 2 - Descriptors for changes in ambient concentrations of NO_2 (taken from the EPUK 2010 guidance)

Magnitude of change	**Absolute change in NO_2 concentrations (µg/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 changes in ambient concentrations of PM_{10} (taken from the EPUK 2010 guidance)

Magnitude of change	**Equivalent absolute change in PM_{10} concentrations (µg/m^3)**
Large	Increase/decrease > 4
Medium	Increase/decrease 2 – 4
Small	Increase/decrease 0.4 – 2
Imperceptible	Increase/decrease < 0.4

Table 4 - 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 Proposed 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 Proposed 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

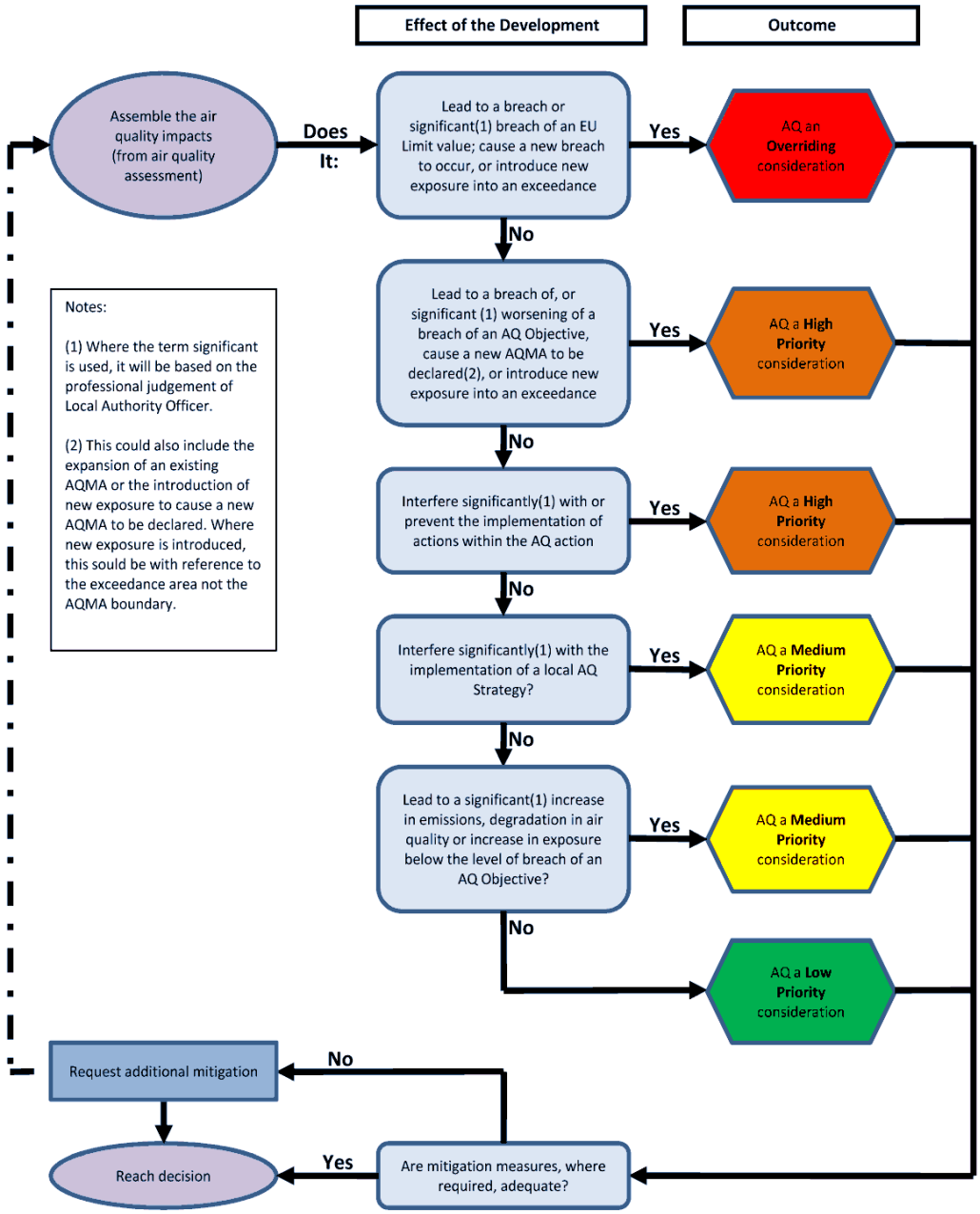
Table 5 - Descriptors for impact significance for annual mean PM10 (taken from the EPUK 2010 guidance)

Absolute concentration in relation to objective/limit value	**Change in concentration**		
	Small	**Medium**	**Large**
Increase with Proposed 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 Proposed 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

5.6.8 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 (see Figure 4). 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
- The extent to which an objective or limit value is exceeded e.g. an annual mean NO_2 of 41 $\mu g/m^3$ should attract less significance than an annual mean of 51 $\mu g/m^3$.

Figure 4 - EPUK Steps to assess the significance of impacts of a development proposal



IAQM: Guidance on the assessment of the impacts of construction on air quality and the determination of their significance

5.6.9 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.

5.6.10 The IAQM guidance was produced in concert with the 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 which are interpreted through professional judgement by air quality specialists.

5.6.11 The guidance considers the potential for dust emissions from the following activities:

- Demolition;
- Earthworks[41];
- Construction; and
- Trackout.[42]

5.6.12 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}.

Construction effects

5.6.13 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.

5.6.14 The assessment will identify where particular mitigation measures are required to address local issues. These mitigation measures will be detailed in the Local Environmental Plans being developed for each community forum area.

[41] Covers the processes of soil stripping, ground-leveling, excavation and land capping.
[42] 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.

5.6.15 The assessment will take into account the distance from the construction activities that may result in atmospheric emissions to the receptors that may experience adverse effects together with local meteorological conditions.

5.6.16 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 paragraph 5.5.1. 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.

5.6.17 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

5.6.18 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 paragraph 5.6.13. 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.

5.6.19 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 the DMRB. Any changes in nitrogen deposition will also be reported in terms of the percentage change relative to the critical load and level for ecosystem protection. Any potential impacts on ecological systems relating to air quality changes will be addressed in the ecological assessment [see Section 9 (Ecology)].

5.6.20 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

5.6.21 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.

5.7 Assumptions

5.7.1 The air quality assessment assumes the following:

- There is available baseline data from the sources mentioned in Section 5.2 (Establishment of baseline and definition of survey);
- Transport information required will be provided in consultation with the Transport Consultants;
- Any significant ecological impacts from changes in pollutant levels will be identified in the Ecology chapter of the ES; and
- There is an adequate level of detail of construction activities at construction sites.

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 UK Climate Change Act 2008[43], Carbon 2050[44] as well as the UK Climate Change Risk Assessment[45] The assessment will determine the net greenhouse gas emissions (GHG) associated with the Proposed Scheme (i.e. any increases associated with the Proposed Scheme less any reductions).

6.1.2 The GHG project protocol[46] 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 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.

6.1.4 Climate Change Adaptation (CCA) will not be addressed in this section; rather it will be addressed in individual topics [for example, Section 17 (Water Resources and Flood Risk Assessment), Section 7 (Community), Section 9 (Ecology) and Section 4 (Agriculture, Forestry and Soils)]. Within the EIA CCA will be considered in relation to determining the impacts the development may have on aspects of the receiving environment (in combination effects of both the project and climate change on the receiving environment).

6.1.5 However, the impacts climate change may have on the development over its operating lifetime (the resilience to CCA of the project) such as design features, construction materials and planned operational or maintenance processes, will be excluded from the EIA.

6.1.6 There are no standard methodologies for addressing climate change adaptation in EIA for high speed rail. A methodology for assessing these impacts for HS2 will be developed for each relevant section of the EIA. They

[43] HM Government, 2008, *Climate Change Act 2008*, The Stationery Office
[44] 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
[45] Defra, 2012, *The UK Climate Change Risk Assessment 2012 Evidence Report*, Defra
[46] World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI), 2003, *The Greenhouse Protocol for Project Accounting,* WBCSD and WRI

will include climate projections/scenarios, baseline information on historic weather conditions and risk assessment methodologies.

6.2 Establishment of baseline and definition of survey

6.2.1 A description of the baseline environment for the 2011 consultation scheme is contained within the AoS. Volume 1, Sections 8.2 and 8.3 of the AoS describes the baseline environment in relation to climatic factors, adaptability and GHGs (further details are provided in Appendix 2 of the AoS). This baseline covers current emissions in the UK, including the UK transport sector and sub sectors. The AoS also reviewed relevant policies.

6.2.2 The baseline GHG assessment will cover the following aspects:

- Changing travel patterns and modal shift;
- Surface access to existing stations/interchanges;
- Projected UK grid power emissions (for example, nuclear versus coal based projection); and
- Assess the impact of planned associated developments. These will be identified through Local Development Frameworks and liaison with the relevant planning department within local authorities.

6.2.3 Baseline transport data will be derived from the HS2 transport model and the transport assessment. The model is expected to report on travel patterns by mode (road and rail) on the route of the Proposed Scheme, and will also consider air travel. Transport efficiency improvements over time will also be considered.

6.2.4 The baseline will not only consider the Proposed Scheme, but also commuter surface access movements to stations/interchanges that connect to the classic network, and how these travel patterns change over time.

6.2.5 Given that the Proposed Scheme will be electrically powered, the assessment will consider various UK grid mix projections for comparison against current factors. According to Defra[47], in 2010 the UK's grid carbon intensity factor was 0.49 kg of carbon dioxide per kWh of electricity consumed. Future UK grid emission factors will be based on reports by the Committee on Climate Change (CCC) and the Department of Energy and Climate Change (DECC).

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 GHG emissions and

[47] Department for Environment, Food and Rural Affairs (Defra) and Department of Energy and Climate Change (DECC), 2012, *GHG Conversion Factors for Company Reporting,* Version 1; http://www.defra.gov.uk/publications/2012/05/30/pb13773-2012-ghg-conversion/

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 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 Proposed Scheme for the topic

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

- Earthworks – includes all excavated material, backfill volumes and any soil treated throughout the construction process. Emissions will arise from the energy used by plant equipment in the extraction of material, as well from logistical operations transporting soil along the route of the Proposed Scheme;
- Land use, land use change and forestry (LULUCF) –includes emissions that are either captured or released, resulting from direct human-induced changes in land use during construction and operation;
- Demolition – to accommodate the Proposed Scheme, demolition and re-development of sites (e.g. local businesses and residential properties) will be required. Emissions associated with the plant equipment energy use will be included in the carbon assessment;
- Construction - Covers the embodied carbon of construction materials used in structures such as stations/interchanges, tunnels, bridges, viaducts, rail lines and supporting infrastructure. This will include the logistical impact of delivering materials to site and removal of waste from

site. Depending on data availability, fuel used by plant equipment during construction (such as tunnel boring machines) will also be included;

- Operation – covers energy consumption of station/interchanges and associated development and infrastructure maintenance 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 aerodynamic factors, passenger loads and speed. The embodied impact of the rolling stock will also be included in the carbon assessment;
- Maintenance – covers the day-to-day upkeep of the railway (track, bridges, tunnels etc) and stations/interchanges as well as the trains. Maintenance activities, similar to construction, involve plant equipment, materials and transport;
- Energy supply - The construction and operational 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[48], the CCC reports[49] [50], and DECC;
- 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; and
- Induced travel – will capture how surface access to existing and new stations/interchanges are expected to change on a daily basis due to the Proposed Scheme. Any extra road travel due to construction related disruptions will be considered depending on transport modelling outputs.

[48] 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

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

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

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 set out in Section 6.4 (Key aspects of the Proposed Scheme for the topic). 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 6.

Table 6 – Scope of GHG assessment

	Construction			**Operation and Maintenance**
	Materials embodied emissions	Logistics emissions	Construction site emissions	
Earthworks	✓	✓	✓	×
LULUCF	n/a	n/a	n/a	n/a
Demolition	×	×	✓	×
Rail tracks	✓	✓	✓	✓
Bridges	✓	✓	✓	✓
Tunnels	✓	✓	✓	✓
Viaducts	✓	✓	✓	✓
Stations/interchanges	✓	✓	✓	✓
Tunnel Boring Machine	✓	×	✓	n/a
Supporting Infrastructure	✓	✓	✓	n/a
Rolling stock	✓	✓	n/a	✓
Workers daily commute	×	✓	×	✓
Additional travel due to disruption from construction	×	✓	×	×
Modal shift	n/a	n/a	n/a	✓
Maintenance	n/a	n/a	n/a	✓
Induced travel	n/a	n/a	n/a	✓
Associated development	✓	✓	✓	✓

6.5.3 For the purpose of this assessment, the following aspects have been scoped out:

- Design stage – existing literature[51] shows that less than 1% of total emissions from high speed rail projects come from the design stage (paper and office energy consumption); and
- Deconstruction – not considered to be appropriate for the Proposed Scheme due to the long design life of the project.

6.6 Assessment methodology

6.6.1 There is no officially recognised methodology for assessing the significance of GHG impact of a large infrastructure project in relation to EIA. However, existing protocols and guidance, such as the GHG Protocol for Project Accounting or ISO14064[52], provide principles and requirements which are directly relevant to the Proposed Scheme. The Institute of Environmental Management and Assessment (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[53] 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[54] [55] on construction materials.

6.6.3 Emissions will be reported in line with the United Nations Framework Convention on Climate Change.[56] Depending on data availability the reporting unit will be in tonnes of carbon dioxide equivalents (tCO_2e) covering the six main GHGs.[57]

6.6.4 The approach used will be to:

- Define emission sources;
- Gather information and appropriate GHG coefficients;
- Calculate GHG emissions; and
- Report GHG emission of the Proposed Scheme over its lifetime in comparison to the baseline.

6.6.5 Construction related emissions will be based on the engineering design drawings and statements covering the key elements of the Proposed

[51] Systra, 2011, *Carbon Footprint of High Speed Rail*, a report of the International Union of Railways, Systra
[52] 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,* BSi
[53] *Department for Environment, Food and Rural Affairs (Defra), 2012, UK Climate Change Risk Assessment: Government Report, The Stationery Office*
[54] Hammond, G.P. and Jones, C.I, 2008, *Inventory of Carbon & Energy (ICE) Version 1.6a,* University of Bath
[55] Hammond, G.P. and Jones, C.I, 2011, *Inventory of Carbon and Energy (ICE) Version 2.0*, University of Bath
[56] United Nations Framework Convention on Climate Change (UNFCCC), *Greenhouse Gas Inventory Data,* http://unfccc.int/ghg_data/items/3800.php
[57] Direct GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), perfluorocarbons (PFCs), hydroflurocarbons (HFCs) and sulphur hexafluoride (SF_6)

Scheme. During design development, carbon reduction measures will be considered.

6.6.6 Bespoke data collection templates will be developed to capture construction related data for the Proposed Scheme. These templates will capture the following information for design elements such as a viaduct or bridge:

- Volume of materials;
- Life span of design element;
- Carbon coefficients;
- Overall GHG emissions of each design element; and
- Functional units (e.g. tonnes of carbon dioxide CO_2 per metre and year of design element).

6.6.7 Construction site emissions relate to fuel and energy use by plant. Information on plant type and usage will be obtained from the Sound, Noise and Vibration (Section 14) assessment which, in the ES, is expected to report on:

- Plant equipment assumptions;
  - Type of equipment;
  - Number of equipment;
  - Percentage on-times for relevant construction periods;
  - Working hours;
- Materials and equipment haul;
- Programme; and
- Site plants.

6.6.8 Sound, noise and vibration information will be combined with published power rating (kW) data of plant equipment by the British Standards Institute (BSI).[58] By combining the percentage of time and duration plant equipment is used, with the power rating of machines, it is possible to estimate total fuel and energy consumption during construction. Fuel consumption will then be converted to GHG emissions.

6.6.9 Transport related emissions will be based on HS2's Demand Model outputs. Outputs from the transport modelling required for the GHG assessment include:

- Surface access: travel to and from each station by modal split, number of trips and average trip distance;
- Classic rail network: change in train movements on the classic network as a result of uptake of services on the Proposed Scheme. If modelling outputs permit, an analysis of the released capacity on the classic network for passenger or freight transport (outputs to be confirmed with transport modellers) will be undertaken;

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

- Modal shift: transfers from air to rail for domestic trips between London and Manchester/ Birmingham/ Glasgow and Leeds. Although there are no flights between London and Birmingham (the route of the Proposed Scheme), there are flights to Manchester, Leeds and other destinations further north. Phase 2 will indirectly impact the modal shift (road and rail) on the Proposed Scheme through, for example, planned increase in services on the London to Birmingham section). The impact that Phase 2 has on the Proposed Scheme will be considered in the assessment;
- Modal shift: transfer from road onto the Proposed Scheme (i.e. between London and Birmingham); and
- Construction transport: transport movements associated with construction activities such as movement of spoil and access to site; and
- Personal transport: any additional transport on existing routes caused by disruption associated with the Proposed Scheme in terms of construction activities and operation.

6.6.10 Operational emissions will cover energy use by stations/interchanges. This will include energy used by station/interchange design elements such as: lighting, lifts and escalators, heating, ventilation and air conditioning, communications.

6.6.11 Rolling stock related emissions will cover both operational and embodied aspects including:

- Weight and material composition of the trains;
- Speed;
- Seat capacity;
- Energy consumptions (kilo-watt hour (kWh) per train km); and
- Load factor (%).

6.7 Assumptions

6.7.1 Predictions of future GHG emissions from the Proposed Scheme and for the baseline will need to make assumptions in relation to the future carbon footprints of power generation and vehicle efficiencies. As such, the assessment will cover a range of predictions which will be set out in the ES.

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 impacts and effects.

7.1.2 Impacts relevant to the community assessment fall broadly within the following categories:

- Demolition/construction, direct land take and impacts on property;
- Intrusion/disturbance to communities and community facilities caused by other environmental impacts.

7.1.3 Community resources and receptors are set out below against the themes of residential property and community infrastructure.

Residential property

7.1.4 This will include private, rented and shared ownership residential dwellings and their surrounding grounds/gardens, student accommodation, extra care/retirement housing, mobile homes (where there are established and recognised locations) and homes used in conjunction with a business or other function.

7.1.5 Receptors include the residents or tenants of properties. They also include employees who permanently reside in a residential property, for example, care givers and janitors.

7.1.6 Impacts on commercial and industrial property will be addressed as part of the socio-economic assessment within the ES. Impacts on farms and farm-based enterprises will be addressed as part of the agriculture, forestry and soils assessment within the ES.

Community infrastructure/organisations

7.1.7 This will include community facilities and infrastructure such as education, health, emergency services, places of worship, sports and recreational facilities, open spaces and public rights of way.

7.1.8 Receptors include users and beneficiaries of resources which can include local residents, organised (community) groups, pupils, patients, congregations and employees who use community infrastructure. Receptors also include owners and organisations running the resources.

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 effect communities (the

socio-economic assessment being focused on economic rather than social impacts and effects). For example, this might include catalytic effects – such as impacts on property prices and blight which will be covered by the socio-economic assessment (as part of the ES) and could have effects on the local community.

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 effects, 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 communities are more dispersed and rural/agricultural 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, and
- Their social vulnerability (i.e. whether they contain or serve a high proportion of vulnerable individuals).

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 include:

- Data collected during the preparation of the AoS, supplemented and updated as appropriate;
- Relevant national datasets such as: Index of Multiple Deprivation Access Domain; Ofsted reports and data; Census data; Office of National Statistics Neighbourhood Statistics; Sports England's participation dataset; Land Registry information; Valuation Office Agency 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, Noise and Vibration (Section 14); Air Quality (Section 5); Socio-Economics (Section 13); Agriculture, Forestry and Soils (Section 4); and Traffic and Transport (Section 15); and
- New studies and/or field surveys where appropriate, for example, relating to open spaces, public rights of way, and effects on community organisations.

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.[59]

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. Relevant organisations include:

- National government departments and statutory organisations;

[59] Department for Transport (DfT), 2011 (Addendum 2012), *High speed rail: Investing in Britain's future consultation summary report: A report to Government by Dialogue by Design*, DfT

- Local and regional government including the GLA, Birmingham City Council, Local Enterprise Partnerships and local authorities on the line of route of the Proposed Scheme;
- Other relevant local non-governmental organisations including, for example, tourism boards; and
- Relevant voluntary and community sector organisations and other special interest groups.

7.3.4 Engagement will be appropriate to each organisation.

7.4 Key aspects of the Proposed Scheme for the topic

7.4.1 The assessment of community effects will consider impacts and effects during both construction and operation of the Proposed Scheme. Impacts can generate the following broadly defined effects on receptors and resources:

- Loss or gain: A loss or gain to a resource or receptor. For example, a decrease in housing stock as a result of demolitions;
- Displacement: The re-location of receptors and resources from one location to another within the study area. For example, people moved from their homes to replacement homes permanently or temporarily;
- Change in amenity: The benefits of enjoyment and wellbeing that receptors gain from a resource in line with its intended function. This is referred to as an amenity value. The amenity value that receptors give to resources may be effected by a combination of factors such as: noise and vibration; air pollution/odours; traffic/congestion; air and water quality; and visual impacts. As such, the amenity assessment will draw on the conclusions from other assessment topics which could lead to impacts on communities; and
- Severance: In the context of this assessment severance is measured by the barriers that pedestrians, equestrians and cyclists face in making their usual journeys, as well as potential isolation and islanding of communities (vehicular journeys will be covered by the Transport Assessment). This includes physical, psychological and social barriers (i.e. non-economic) and the effects of this on local communities. Severance of commercial and industrial buildings and land, and agricultural property and land, are addressed within the scope of assessments presented in Section 13 (Socio-economics) and Section 4 (Agriculture, Forestry and Soils).

7.4.2 In addition, community effects may result from the accumulation 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).

7.4.3 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, hence professional 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.

7.4.4 The work will also consider the wider HS2 business case with a high level overview of second round (catalytic) effects on communities (such as development associated with the Proposed Scheme) noted. These though are not considered to be directly within the scope of this assessment as they will be covered as part of impact assessments for other development proposals.

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 of a suitably qualified EIA practitioner.

Spatial and technical scope

7.5.2 The proposed spatial scope is summarised in Table 7. This scope will be refined as the assessment proceeds (e.g. to ensure consistency with other environmental topics).

Table 7– Impacts and Effects on Resources and Receptors and Spatial Scope

Resource	Impacts	Effects:		Spatial Scope
		Resources	Receptors	
Residential property	Residential property (including gardens) lost to land take	Reduction in housing stock available for people	Displacement of home owners/tenants, inconvenience and loss of their assets	Direct land take by HS2 either for the Proposed Scheme itself or for construction
	Damage to residential property as a result of ground settlement	Repairs needed or value of property diminishes	Inconvenience/ disruption to landlords/owners/ residents	Properties up to 30m from boundary of outer edge of tunnel or excavation works
	Amenity value of residential property is changed	Character or quality of residential properties change as a result, for example due to noise and vibration; traffic/congestion; reduction in	Receptors' enjoyment of resource is changed	Relevant impact area from the edge of the route of the Proposed Scheme is a minimum of 250m in both

Resource	Impacts	Effects:		Spatial Scope
		Resources	Receptors	
		air/water quality; visual impacts		urban and rural areas unless subsequent analysis from other topic areas suggests a greater or lesser extent at specific locations
	Severance of residential properties from other properties and infrastructure	Physical e.g. islanding or isolation of resource	Social and psychological e.g. community ties/integrity is damaged	Anticipated to cover some households up to 1km of route and construction sites and depending upon specific context and proposals[60]
Community Infrastructure, Recreation Infrastructure and Open/Play space	Infrastructure lost to land take	Decline in facilities available for community use or temporary impairment of use	Loss of facilities and benefits for users, workers owners, and groups/organisations	Direct land take by the Proposed Scheme
	Damage to property as a result of ground settlement	Repairs needed or value of property diminishes	Costs of repairs and inconvenience to landlords/owners/tenants/users	Properties up to 30m from boundary of tunnel or excavation works
	Presence of construction workers with consequent requirements	Increased demand from construction workers	Reduced availability for users, workers, owners, and groups/organisations	Distance to relevant infrastructure likely to be significantly used by construction workers
	Amenity value of infrastructure is	Character or quality of cities/towns/neighbourhoods changes	Receptors' enjoyment of resource is changed	Relevant impact area from the edge of the route of the

[60] The distance of the diversion and duration are factors in determining whether or not there is an impact

Resource	Impacts	Effects:		Spatial Scope
		Resources	Receptors	
	changed	as a result of noise and vibration; traffic/congestion; reduction in air/water quality; visual impacts		Proposed Scheme is a minimum of 250m in urban and rural areas unless subsequent analysis from other topic areas suggests a greater or lesser extent at specific locations
	Severance of infrastructure from receptors	Physical e.g. islanding or isolation of resource	Social and psychological e.g. community ties/integrity is damaged	Catchment area of effected resource where it is subject to severance[61]
Existing community organisations	Community activities lost to land take	Loss or impairment of community activities	Loss or impairment of activities	Direct land take by the Proposed Scheme

[61] The distance of the diversion and duration are factors in determining whether or not there is an impact

Resource	Impacts	Effects:		Spatial Scope
		Resources	Receptors	
	Ground settlement and community facilities	Repairs needed or value of property diminishes	Inconvenience to landlords/owners/tenants/users	Properties up to 30m from boundary of tunnels or excavations
	Amenity value of infrastructure is changed resulting in an impact on organisations' operations	Character or quality of organisations' environment changes as a result of noise and vibration; traffic/congestion; reduction in air/water quality; visual impacts	Impact on community organisations	Relevant impact area from the edge of the route of the Proposed Scheme is a minimum of 250m in urban and rural areas unless subsequent analysis from other topic areas suggests a greater or lesser extent at specific locations
	Severance of infrastructure from receptors resulting in an impact on organisations' operations	Physical e.g. islanding or isolation of resource results in change to organisations' environment	Impact on community organisations	Catchment area of effected resource where it is subject to severance[62]

Temporal scope

7.5.3 The temporal scope for this topic is outlined in Section 2.2 (Scope of the assessment) of the Report. Community effects will be assessed for the construction period (including a period of commissioning) (2018 - 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 (Section 13) and Traffic and Transport (Section 15).

7.6 Assessment methodology

[62] The distance of the diversion and duration are factors in determining whether or not there is an impact

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 existing guidance, analysis and methods established for other railway and large infrastructure projects.

Legislation and guidance

7.6.2 Relevant guidance includes:

- Highways Agency Interim Advice Notes[63] and DfT's Transport Analysis Guidance Website (WebTAG)[64]; and
- Industry accepted practice from other EIAs, for example Crossrail and Thames Tunnel.

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 the community resources or receptors.

Determining magnitude of impacts

7.6.4 To determine the magnitude of impact, the nature of the impact (beneficial or adverse) 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.

7.6.5 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 effected); and the duration (short, medium and long-term).

7.6.6 Guideline criteria have been established based on professional judgment and are presented in Table 8.

Table 8 - Community impact magnitude criteria

Impact magnitude	Definition
High	An impact that will be very adverse/beneficial, and very likely to effect large numbers of groups and/or people (with number depending on the local context and nature of the impact), and that will usually continue and effectively constitute a permanent, long-term impact on the baseline conditions

[63] Department for Transport (DfT) and the Highway's Agency, various dates, Interim Advice Notes; http://www.dft.gov.uk/ha/standards/ians/index.htm

[64] Department for Transport (DfT), WebTAG Home, Transport Analysis Guidance; http://www.dft.gov.uk/webtag/ and www.webtag.org.uk

Impact magnitude	Definition
Medium	An impact that is likely to effect a moderate number of groups and/or people (with number depending on the local context and nature of the impact)
Low	An impact that is likely or may effect a small number of groups and/or people (with number depending on the local context and nature of the impact) and/or that usually does not extend beyond the life of the project so that the base case is not effected beyond a short or medium-term duration
Negligible	An impact that is temporary in nature and/or is anticipated to have a slight or no effect on the well-being of groups and/or people

Determining receptor sensitivity

7.6.7 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.

7.6.8 Guideline criteria have been established using professional judgment to determine the sensitivity of the receptors. These are presented in Table 9.

Table 9 - 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

Determining the significance of effects

7.6.9 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.

7.6.10 The approach to determining the significance of community effects is summarised in Table 10.

Table 10 - 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 /beneficial - significant	Moderate adverse /beneficial - significant	Minor adverse /beneficial - not significant	Negligible - not significant
	Low	Moderate adverse/ beneficial - significant	Minor adverse/ beneficial - not significant	Negligible - not significant	Negligible - not significant

7.6.11 Effects are considered to be significant if both impact magnitude and receptor sensitivity is 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.

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

Construction effects

7.6.13 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 (Establishment of baseline and definition of survey);
- Consultations including those outlined in Section 7.3 (Consultation);
- Assessment of impacts and effects against key aspects of the Proposed Scheme as outlined in Section 7.4 (Key aspects of the Proposed Scheme for the topic), covering the scope outlined in Section 7.5 (Scope of assessment) and using the significance criteria outlined in this section; and
- Iterative further assessment of impacts identified through other EIA work, for example in relation to development covered in the Socio-economic Assessment within the ES.

Operational effects

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

Cumulative effects

7.6.15 As outlined in Section 2.4 (Cumulative Effects) of this Report, the EIA will consider the interaction between the Proposed Scheme, HS2 Phase 2 and other consented or completed development which may give rise to significant cumulative effects.

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. Projections of future climate change will also be incorporated in the definition of the future baseline. The methodology for assessing the significance of impacts on climate change adaptation within Community will be developed in conjunction with the climate change specialists on the EIA team.

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, noise and 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 impacts and effects upon heritage assets and the historic environment effected by the construction and operation of the Proposed Scheme.

8.1.2 Heritage assets are defined by the Government in the NPPF Annex 2 Glossary as 'A building, monument, site, place, area or landscape identified as having a degree of significance meriting consideration in planning decisions. Heritage asset includes designated heritage assets and assets identified by the local planning authority (including local listing)'.

8.1.3 Heritage assets include those that are designated under legislation (refer to the NPPF Annex 2 Glossary Designated heritage assets) as well as those that are undesignated assets. Undesignated assets are heritage assets identified as such by local authorities and evidence for these can be obtained through their inclusion within the local Historic Environment Record (HER) (refer to paragraph 15 of English Heritage's Historic Environment Planning Practice Guide, 2010). Undesignated assets may also include those that have been identified but have not been included in the HER. Undesignated heritage assets will also include assets revealed during the course of survey and research undertaken during EIA preparation.

8.1.4 The NPPF Annex 2 Glossary defines the historic environment as: All aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora.

8.1.5 Cultural Heritage is generally and most easily divided into three key areas, as follows:

- Archaeological and palaeo-environmental remains including geological deposits that may contain evidence of the human past;
- Historic landscapes; and
- Historic buildings and the built environment.

8.2 Establishment of baseline and definition of survey

8.2.1 The baseline to be assessed is that which is current as at the time of the publication of the ES.

8.2.2 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, noise and vibration, and landscape. These interfaces will be actively addressed as part of the EIA process to ensure that an integrated assessment is undertaken.

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

8.2.4 Designated assets:

- World Heritage Sites;
- Listed Buildings, Grade I, II* and Grade II;
- Scheduled Monuments;
- Registered Parks and Gardens, including London Squares;
- Conservation Areas;
- Registered Historic Battlefields;
- Registered Commons (insofar as they contribute to historic landscape character); and
- Ancient Woodlands.

8.2.5 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 National Record of the Historic Environment (previously known as National Monuments Record)
    - Archaeological assets of schedulable quality and as identified in the NPPF paragraph 139;
    - Sites or areas predicted or known from desk based or fieldwork study;
    - Palaeo-environmental remains and geological deposits containing evidence for the human past;
    - Known historic settlements including those identified as being of archaeological interest in local planning authority documents;
    - Hedges protected under Hedgerow Regulations (*The Hedgerows Regulations*, 1997[65]) and;

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

- Non-designated historic parks, gardens and battlefields.

8.2.6 Baseline data sources will include:

8.2.7 Existing data

- Details of designated sites held by English Heritage;
- Local authority conservation area appraisal documents and statements (where available) and their mapping
- Records of Ancient Woodland maintained by Natural England, Defra and the Forestry Commission;
- Historic landscape character mapping;
- HER data, held by local planning authorities;
- Aerial photographs;
- Geological mapping and borehole information as held by British Geological Survey;
- Documentary, cartographic and other resources as deposited within local studies libraries, county and national records libraries and archives;
- Readily available published material, building surveys and gazetteers; and
- Data sets held by other bodies, such as British Waterways and the National Trust who have specific data on the assets for which they have a responsibility.

8.2.8 Data collected during the EIA process

- Data from preliminary works such as boreholes or test pits;
- Data from a programme of non-intrusive survey;
- Data from light detection and ranging (LiDAR) aerial survey;
- Data from intrusive techniques, for example trial trenching and building survey;
- Data in respect of the zone of theoretical visibility (ZTV) as identified by the Landscape and Visual Assessment [see Section 12 (Landscape and Visual Assessment)]; and
- Data obtained through site visit and walkover survey from public land, or from private land where access has been previously arranged and approved.

8.2.9 The requirement for and scope of non-intrusive and intrusive survey including building survey, is to be developed and agreed in consultation with English Heritage and other appropriate bodies including Local Authority Conservation Officers and Archaeological Officers (subject to land access). In determining the need and scope for such survey a character area, risk based approach will be adopted. This approach will use the evidence collected during the EIA process regarding the historic environment to predict the likelihood of the discovery of previously unknown heritage assets, particularly below ground archaeological sites. In developing the heritage baseline and assessing the impact and effects of the Proposed Scheme, character areas (as opposed to point specific assets) will be defined and used

to identify patterns of discovery, identify the risk of previously unknown archaeological remains to determine the type of field evaluation.

Study Area

8.2.10 The definition of the study area for heritage assets will vary between the metropolitan urban and country sections of the Proposed Scheme. The study area in urban London and Birmingham will comprise the entire land take required for construction (including permanent and temporary works), plus 250m either side of the full extent of the land take. In the Country South and Country North rural sections, the study area will encompass the entire land take plus 500m either side of the full extent of the land take. In addition for the appraisal of the setting of heritage assets, including historic landscapes, the study area will be defined by the ZTV, for both rural and urban sections of the route. The extent of the ZTV will be identified by the Landscape, and Visual Assessment within the ES.

London and West Midlands Metropolitan areas

8.2.11 The London Metropolitan section of the Proposed Scheme includes the London Euston and Old Oak Common stations/interchanges. It passes through predominantly urban areas and lies within the GLA administrative area. Substantial parts of this route will be in tunnel, therefore the potential for ground settlement will 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 heritage assets and their setting.

8.2.12 The West Midlands section of the Proposed Scheme passes through the suburban and urban areas of Solihull and Birmingham and includes the infrastructure maintenance depot at Washwood Heath, a 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 heritage assets and their setting.

8.2.13 This section of the Proposed Scheme also passes through areas of a more rural character where there is potential for impacts to occur both to the setting of heritage assets and to historic landscape character areas.

8.2.14 To identify those heritage assets whose fabric may be affected, the urban study area including the full extent of the landtake for the Proposed Scheme plus 250m each side, will be established. Field visits will be carried out to all heritage assets (where access is permitted) within this study area.

8.2.15 Field visits within the study area will comprise field inspection to identify heritage assets and to examine the character and form of the historic urban landscape. The purpose of the survey will be to verify the baseline research, assess the nature and condition of known heritage assets and identify previously unidentified assets which may be affected by the Proposed Scheme. These activities will provide an understanding of the characteristics

of the landscape and the assets that are contained within it and their contribution to the overall historic landscape/urban landscape within the defined ZTV area.

8.2.16 The study area will be defined by the extent of the ZTV to be identified by the Landscape, Townscape and Visual Assessment within the ES. Within the ZTV area, the setting of all assets will be considered.

Country south and country north

8.2.17 The Country South section of the Proposed Scheme passes through a number of rural counties. Much of the Proposed Scheme will be in either tunnel or cutting, with some sections elevated on viaduct or embankment.

8.2.18 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, with substantial sections at grade.

8.2.19 To identify those heritage assets whose fabric may be effected, a study area which includes the full extent of the landtake for the Proposed Scheme plus 500m to each side of the route will be established. Field visits will be carried out to all heritage assets (where access is permitted) within this study area.

8.2.20 Field visits within the study area will comprise field inspection to identify heritage assets and to examine the character and form of the historic landscape. The purpose of the survey will be to verify the baseline research, assess the nature and condition of known heritage assets and identify previously unidentified assets which may be affected by the Proposed Scheme. These activities will provide an understanding of the characteristics of the landscape and the assets that are contained within it and their contribution to the overall historic landscape within the defined ZTV area.

8.2.21 The study area will be defined by the extent of the ZTV to be identified by the Landscape, Townscape and Visual Assessment within the ES. Within the ZTV area, the setting of all assets will be considered.

8.3 Consultation

Consultation on the AoS

8.3.1 A large number of consultation responses were received regarding the AoS in respect of heritage assets. 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.

8.3.2 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 route is inadequate to assess impacts upon setting. As a consequence of this response, and to provide a robust basis for

defining the area of survey, it is proposed that survey for analysis and assessment of the setting of assets will be determined primarily by the extent of ZTV defined for the area of assessment of visual impact [see Section 12 (Landscape and Visual Assessment)]. It is however, acknowledged that other factors such as noise and light impacts may extend beyond the ZTV, and these will be assessed within the respective chapters of the ES.

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

8.3.4 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 the NPPF, is based on the significance/value of assets. A set of significance based criteria (refer to the NPPF Annex 2, Glossary) is therefore proposed as set out in Table 11.

8.3.5 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 of those of Grade I or Grade II* such as at Hartwell.

8.3.6 In respect of the London Metropolitan area of the 2011 consultation scheme, the London Borough of Camden issued a consultation response opposing the scheme for reasons including the potential impact on built heritage assets, particularly around Euston station. The 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.

8.3.7 The proposed scope and methodology of assessment allows all of these issues to be identified and addressed as part of the EIA.

Consultation as part of the EIA process

8.3.8 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.

8.3.9 Consultation with local planning authorities along the route of the Proposed Scheme, including the Community Forums, will continue throughout the EIA

process. This will ensure that consultation comments are appropriately considered.

8.3.10 Other key consultees for the topic will include the Local Authority Archaeological Officers (or 'Curators') or their equivalents for Hertfordshire, Buckinghamshire, Oxfordshire, Northamptonshire, Warwickshire, Birmingham and Staffordshire. In London, this role is performed by English Heritage's Greater London Archaeology Advisory Service. Local Authority Conservation Officers and, in London, English Heritage Historic Building Officers will also be key consultees.

8.3.11 It will be necessary to consult English Heritage's 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 the Proposed Scheme.

8.4 Key aspects of the Proposed Scheme for the topic

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

- Construction works which require the physical excavation of, demolition or removal of, or alteration to heritage assets;
- Settlement of heritage assets resulting from tunnelling, deep excavations or construction of retaining walls;
- Impacts upon the setting of heritage assets;
- Loss of coherence or legibility of heritage assets, such as through severance;
- Temporary setting effects on designated or other heritage 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 at some locations where tranquillity may be a consideration;
- Vibration effects upon heritage assets during both construction and operation; and
- Protection of heritage assets during construction activities.

8.5 Scope of assessment

8.5.1 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 to be presented in the ES.

8.5.2 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.

8.5.3 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. These can also affect the availability of land for future research in cases where archaeological sites may be buried by earth bunding.

8.5.4 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 (by definition) involve the permanent loss of, or harm to a heritage asset including its setting.

8.5.5 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. Such developments may also have permanent effects as identified in paragraph 8.5.4.

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

Spatial scope

8.5.7 Within both the rural and metropolitan sections of the Proposed Scheme, an area of survey as defined by the ZTV will be set. Within the area of survey, designated and undesignated heritage assets will be identified and assessed in accordance with the methodology defined in Section 8.2 (Establishment of baseline and definition of survey). This will allow for identification and assessment of setting and other impacts to assets.

8.5.8 Further detailed assessment of Proposed Scheme impacts will be carried forward only for those heritage assets where the Proposed Scheme would impact upon the physical characteristics and setting of the asset, such that significance (archaeological, architectural, artistic or historic) would be effected. It is acknowledged that setting could be effected by other scheme factors including but not limited to light and noise; and these will be

considered as part of the assessment process. An outline of the characteristics of the historic landscape zones, through which the route of the Proposed Scheme passes, is provided in Section 8.2 (Establishment of baseline and definition of survey).

Temporal scope

8.5.9 The assessment will consider both temporary and permanent impacts on heritage assets and their setting. The assessment will identify impacts which are temporary in nature for example impacts on setting derived from construction-related sites. It is however recognised that these impacts may be permanent for some classes of assets, for instance buried archaeological assets.

8.5.10 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

8.5.11 The fabric and setting of all heritage assets will be considered, as described in 'Spatial scope' above. Further detailed assessment of Proposed Scheme impacts will be carried forward only for those assets where the Proposed Scheme would impact upon the setting or fabric of the asset such that significance (archaeological, architectural, artistic or historic) would be affected.

8.6 Assessment methodology

Legislation and guidance

8.6.1 Policy in respect of heritage assets is set out in the NPPF (Section 12 Conserving and enhancing the historic environment).

8.6.2 There is no specific national guidance on the methodology for the preparation of impact assessments for heritage assets. However, DMRB (Volume 11: Environmental Assessment) provides an approach for the assessment of impacts arising from highway schemes; and Section 3, Part 2 (HA 2008/07) covers Cultural Heritage including historic landscape (Annex 7).

8.6.3 In May 2010, the International Council on Monuments and Sites (ICOMOS) issued draft guidance on Heritage Impact Assessments for Cultural World Heritage Properties[66]. Though specifically addressing World Heritage Sites and development impact on their Outstanding Universal Value, the document provides an approach to assessment and evaluation of impact.

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

8.6.4 In May 2011, English Heritage published its guidance '*Seeing History in the View*' (2011a)[67]. This guidance, which deals specifically with assessing impact upon heritage views and multiple assets, contains an approach to baseline analysis and the assessment of impact; with a series of tables to assist 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 (2011b)[68].

8.6.5 Additional guidance in respect of the Historic Environment is set out in the English Heritage Historic Environment Practice Guide of March 2010 which remains current notwithstanding the introduction of the NPPF which replaced Planning Policy Statement 5 (PPS5): Planning for the Historic Environment in March 2012.[69]

Approach

8.6.6 The methodology set out in the above legislation and guidance is summarised as follows:

- Identify the baseline heritage assets (defined as all data collected from a range of desk based sources and as appropriate, surveys) and their setting;
- Assess the significance/value of the baseline assets and their settings;
- Identify and define the magnitude of impact and the severity of the effects;
- Identify mitigation required and it methodology in terms of spatial extent and techniques to be deployed; and
- Assess the development impact and its effect on the significance of the asset taking into consideration any mitigation proposed.

Significance Criteria

8.6.7 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' (the NPPF 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 local authority designation, though determined through legislation) 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

[67] English Heritage, 2011a, *Seeing History In The View; A Method For Assessing Heritage Significance Within Views*, English Heritage
[68] English Heritage, 2011b, *The Setting Of Heritage Assets, English Heritage Guidance*, English Heritage
[69] Communities and Local Government (CLG), 2010, *Planning Policy Statement 5 (PPS5): Planning for the historic Environment*, The Stationary Office

(2008)].[70] Non-designated heritage assets may exhibit equivalent values to those which have been granted statutory protection.

8.6.8 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).

8.6.9 Taking these criteria into account, each identified baseline heritage asset will be assigned a level of significance in accordance with a five-point scale as shown in Table 11.

Table 11 - 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 Registered battlefields Undesignated archaeological assets of schedulable quality and importance Undesignated buildings, monuments, sites or landscapes that can be shown to have 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 and Gardens Sites of high archaeological resource value as identified through consultation Locally listed buildings as recorded on a local authority list Undesignated buildings, monuments, sites or landscapes that can be shown to have important qualities in their fabric or historical association Registered Common Land Historic Hedgerows Historic Townscapes with historic integrity in that the assets that constitute their make-up are clearly legible
Low	Undesignated buildings, monuments, sites or landscapes of local importance and of modest quality Locally important historic or archaeological sites, sites with a local value for education or cultural appreciation Assets that are so badly damaged that too little remains to

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

Significance (value)	Asset Categories
	justify inclusion into a higher grade Parks and gardens of local interest
Not Significant	Assets identified as being of no historic, evidential, aesthetic or communal interest Assets whose values are compromised by poor preservation or survival or of contextual associations to justify inclusion into a higher grade

Magnitude of impact

8.6.10 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 or long-term, permanent or temporary and can be positive or negative.

8.6.11 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 setting is set out by English Heritage (2011a).

8.6.12 The magnitude of an impact can vary from 'high' to 'no change' as set out in Table 12, and can be beneficial or adverse.

Table 12 - 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 effecting significance, resulting in changes in our ability to understand and appreciate the resource and its historical context and setting
Medium	Change such that the significance of the asset is affected. Changes such that the setting of the asset is noticeably different, effecting 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 that do not affect the significance of the asset or our appreciation of it

Significance of effects

8.6.13 Only those heritage assets where there is a potential for impact, as determined following a review and analysis of available data including site visits, will be assessed. Assessment of the significance of effects will take into consideration mitigation associated with the Proposed Scheme, for example landscape planting, ecological compensation and noise barriers. It should be recognised that some mitigation measures can themselves be a source of impact.

8.6.14 The assessment of the level of overall significance of the effect, taking into consideration mitigation, is determined by cross referencing the significance value of the asset (Table 11) and the magnitude of impact (Table 12), as shown in Table 13.

8.6.15 Major and moderate impacts may be considered to be significant effects. The assessment of overall effect can be either adverse or beneficial.

Table 13 - 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	Negligible	Minor/ Negligible	Minor	Moderate
Not Significant	Neutral	Negligible	Negligible	Negligible	Negligible

Construction effects

8.6.16 Construction effects will be assessed following the general EIA assessment process including the establishment of the baseline, consultations, assessment of impacts and effects against key aspects of the Proposed Scheme, the scope of the assessment and using the significance criteria outlined in this section. Further assessment of impacts identified through other EIA work, for example the assessments for sound, noise and vibration, landscape and visual, and ecology will be undertaken.

Operational effects

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

Cumulative effects

8.6.18 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 along the route of the Proposed Scheme, 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 (Cumulative effects) of this Report.

8.7 Assumptions

8.7.1 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, the National Record of the Historic Environment), records of designated sites (including the National Heritage list for England); and that collections of historic maps and other sources held by external record offices (such as local studies libraries, county and national archives) will be available.

8.7.2 The assessment within this section considers heritage assets from the perspective of the historic environment. The value of heritage assets – such as historic buildings, archaeological earthworks and deposits, elements of historic landscape survival - from amenity, ecological and landscape points of view is considered in Section 7 (Community), Section 9 (Ecology) and Section 12 (Landscape and Visual Assessment) of this Report, respectively. Effects on geology and geomorphology are considered in Section 11 (Land Quality), while effects on sound, noise and vibration are considered in Section 14 (Sound, Noise and Vibration).

9 Ecology

9.1 Introduction

9.1.1 This section of the Report sets out the scope for the ecology component of the EIA of the Proposed Scheme.

9.1.2 It describes the methodologies that will be used to identify the potential for impacts and 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.

9.2 Establishment of baseline and definition of survey

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

9.2.2 Existing biological data for the route of the Proposed Scheme will be obtained from relevant Biological Records Centres and from national and local specialist data sources, such as Bat Groups. The data to be collated will include:

- Statutory designated sites within 10km of the route[71];
- 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 from the route to ensure that a complete baseline for the assessment is gathered); and
- Priority or otherwise notable habitats or features within 500m of the route.

9.2.3 Other relevant sources of ecological data such as national and local Biodiversity Action Plans, ancient woodland inventories[72], existing Phase 1 habitat surveys and Habitat Biodiversity Audits, Biodiversity Opportunity Mapping and Green Infrastructure studies will be consulted.

9.2.4 In addition, existing ecological data available from other sources, such as ESs associated with other relevant developments or Nature Reserve monitoring records, will be consulted where available.

9.2.5 As with the area of search for the desk study, 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 and ecological connectivity of the landscape, and the

[71] Desk study searches encompass corridors either side of the centreline of the proposed route.
[72] It is noted that some ancient woodland may be omitted from ancient woodland inventories, for a number of reasons including the size of the woodland block.

ecological receptor. In rural sections, the survey corridor for some species, such as Great Crested Newt, could extend up to 500m either side of the route[73]; 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 by an ecologist as to the potential for the presence of protected or otherwise notable species, further detailed specialist surveys will be undertaken where possible.

9.2.7 Specialist surveys will include:

- Detailed botanical surveys (including National Vegetation Classification);
- Surveys of invasive non-native species;
- River Habitat Surveys and River Corridor Surveys;
- Hedgerow surveys;
- Ditch surveys;
- Pond surveys;
- Amphibian Habitat Suitability Index (HSI) surveys of water bodies;
- Amphibian surveys of water bodies;
- Reptile surveys;
- Breeding bird surveys;
- Wintering and passage 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[74] species are thought to be present, additional surveys will be agreed with Natural England);
- Otter surveys;
- Water vole surveys;
- Terrestrial invertebrate surveys;
- Aquatic macro-invertebrate surveys;
- White-clawed crayfish surveys; and
- Fish surveys.

9.2.8 Further details on the survey methodologies will be set out in the ES. The methods set out in this Report follow recognised methodologies (deviating only where considered appropriate); and have been determined in consultation with Natural England.

9.2.9 The desk study and field surveys, aided by consultation, will support the identification of sites and features of value. In addition, the assessment will identify landscape-scale ecological features, such as linear features (e.g.

[73] Such surveys will extend 500m beyond the outer limit of the area of land required for permanent and temporary works.
[74] Council Directive 92/43/EEC On the conservation of natural habitats and of wild fauna and flora. Annex II – species requiring designation of Special Areas of Conservation

hedgerows, watercourses, and disused railway lines) that have additional value in providing habitat connectivity and potential migration corridors.

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;
- Local planning authorities;
- 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).

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, Butterfly Conservation, the Forestry Commission, the Woodland Trust and the Deer Initiative.

9.3.5 In addition, at a local level, other organisations and individuals 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 Proposed 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. Loss or degradation of ecological corridors and networks, with a resulting decline in 'habitat connectivity', is recognised as an issue. 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 of species, populations and habitats. Some habitats, such as ancient woodland, are recognised as being essentially irreplaceable and where such habitats are affected, mitigation is not practicable, with a focus, instead, on avoidance or compensation measures.

9.4.2 Disturbance as a result of sound, noise, 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, and from changes in water levels or flows.

9.4.3 In addition, there is the potential for the Proposed Scheme to have beneficial effects, for example as a consequence of habitat creation designed to extend and link fragments of semi-natural habitat.

9.4.4 Key potential ecological impacts are listed in Section 9.6 (Assessment methodology).

9.5 Scope of assessment

Temporal scope

9.5.1 The main construction works for the Proposed Scheme are anticipated to take place between 2017 and 2026. The assessment of construction effects will relate to the construction programme set out in the ES. Effects arising from the operation of the Proposed Scheme will be assessed taking account of the services that are expected when HS2 reaches maximum capacity (anticipated to be up to 18 trains per hour at peak times in each direction) (i.e. both Phase 1 and Phase 2 are operational).

9.5.2 The baseline for the 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 future scenarios described

in paragraph 9.5.1, this will be made clear in the ES[75]. In particular, the assessment will consider the influence of other factors, such as climate change and how those might affect the baseline conditions.

Geographic scope

9.5.3 The geographic scope of the ecological assessment will be defined by the potential area of ecological impact. More details are provided in Section 9.2 (Establishment of baseline and definition of survey). In summary, the area of search for existing information will extend up to and potentially beyond 10km from the route of the Proposed Scheme. Field survey will be less extensive, varying according to the species and/ or habitat under study and the potential area of impact.

9.5.4 The geographic scope will include not only the physical extent of the works, including land-take associated with construction sites, road improvements and off-site works, but also indirect or secondary effects such as changes to rail traffic on other lines, consequential development around stations/interchanges, temporary and permanent changes in road traffic etc.

Technical scope

9.5.5 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. It will include all species and habitats of nature conservation value, not only those listed in Section 9.2 (Establishment of baseline and definition of survey) as requiring targeted survey; thus, for example, brown hare, deer, veteran trees and wood pasture/parkland habitat will all be included in the assessment.

9.5.6 The assessment will include effects on individual sites or receptors, and the cumulative effects of the works on the ecology of the length of the Proposed Scheme [see Section 9.6 (Assessment methodology)]. It will also consider the effects on landscape-scale ecological features, including habitat connectivity.

9.5.7 Impacts on relevant European designated sites will be described within the ES. Technical studies relating specifically to Habitats Regulation Assessment will be presented in a separate, standalone document, since such assessment requires a distinct methodology. The HRA will not form part of the ES, but the conclusions of the HRA would be incorporated within the Ecology Chapter of the ES.

9.6 Assessment methodology

9.6.1 The impact assessment methodology for the Proposed Scheme follows the standard method for ecology as set out by the Institute of Ecology and

[75] In addition, there will be a need for a programme of repeating and updating ecological surveys to continue beyond the deposition of the hybrid bill, up to the point of site clearance, with monitoring beyond that time.

Environmental Management (IEEM) in their Guidelines for Ecological Impact Assessment (2006)[76]. It is also influenced by the principles in DfT's DMRB Volume 11 (Ecology and Nature Conservation) and Interim Advice Note 130/10 (Ecology and Nature Conservation: Criteria for Impact Assessment).[77]

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)[78];
- The Conservation of Habitats and Species Regulations 2010 (Amended 2012)[79];
- Protection of Badgers Act 1992[80];
- The Hedgerows Regulations 1997[81];
- Countryside and Rights of Way Act 2000[82]; and
- Natural Environment and Rural Communities Act 2006.[83]

Guidance

9.6.3 The assessment also takes into account relevant guidance set out in national, regional and local planning policy and other guidance, such as:

- NPPF (2012);
- Government Circular: Biodiversity and geological conservation – statutory obligations and their impact within the planning system[84];
- Natural Environment White Paper - The Natural Choice: securing the value of nature (2011);
- Making Space for Nature: A Review of England's Wildlife Sites and Ecological Network (2010; the 'Lawton Report')[85]; and
- Biodiversity 2020: A strategy for England's wildlife and ecosystem services (2011).[86]

[76] Institute of Ecology and Environmental Management (IEEM), 2006, *Guidelines for Ecological Impact Assessment*, IEEM
[77] Department for Transport (DfT), 2010, *Interim Advice Note 130/10, Ecology and Nature Conservation: Criteria for Impact Assessment,* DfT
[78] HM Government, 1981, *The Wildlife and Countryside Act 1981* (as amended), The Stationery Office
[79] Defra, 2010, *The Conservation of Habitats and Species Regulations (Amended 2012)*, Defra
[80] HM Government, 1992, *The Protection of Badgers Act*, The Stationery Office
[81] HM Government, 1997, *The Hedgerows Regulations 1997,* The Stationery Office
[82] HM Government, 2000, *Countryside and Rights of Way Act 2000,* The Stationery Office
[83] HM Government, 2006, *Natural Environment and Rural Communities Act 2006,* The Stationery Office
[84] Office of the Deputy Prime Minister (ODPM) and Defra, 2005, ODPM Circular 06/2005 and Defra Circular 01/05, *Government Circular: Biodiversity and geological conservation – statutory obligations and their impact within the planning system*, ODPM
[85] Defra, 2010, *Making Space for Nature: A Review of England's Wildlife Sites and Ecological Network*, Defra
[86] Defra, 2011, *Biodiversity 2020: A strategy for England's wildlife and ecosystem services,* Defra

9.6.4 As well as taking account of nature conservation policies in Local Development Frameworks, the assessment will consider other local plans such as The Chilterns AONB Management Plan 2008 – 2013: A Framework for Action.[87]

Significance criteria

9.6.5 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.

9.6.6 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".[88] A site or ecosystem that achieves this level of integrity is described as being at favourable condition.

9.6.7 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.

9.6.8 Relevant information on policy relating to the conservation status of species and habitats will be identified through reference to Biodiversity Action Plans, published conservation notes (where available) from Natural England, and relevant local planning policies.

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

9.6.10 It is important that there is a consistent approach to the definition of significance across the different environmental topics reported in the ES. Significant ecological effects on receptors at different geographical scales will therefore be related to the overall significance categories used by other environmental topic areas. This process will also ensure that the overall

[87] The Chilterns Conservation Board, 2007, *Chilterns Area of Outstanding Natural Beauty Management Plan 2008-2013: A Framework for Action*, The Chilterns Conservation Board

[88] Office of the Deputy Prime Minister (ODPM) and Defra, 2005, ODPM Circular 06/2005 and Defra Circular 01/05, *Government Circular: Biodiversity and geological conservation – statutory obligations and their impact within the planning system*, ODPM

assessment focuses on the key significant ecological issues. 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.

Construction effects

9.6.11 Potential impacts resulting from construction activities include:

- Temporary and permanent land-take;
- Severance of ecological corridors and networks, resulting in a reduction in habitat connectivity;
- Fragmentation of habitats and sites;
- 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;
- Hydrological effects, from changes in water levels and/or flows;
- Changes in management, often resulting in habitat degradation; and
- Introduction and spread of non-native invasive species.

9.6.12 The Proposed Scheme also offers opportunities for creation and enhancement of habitats. There are opportunities to restore, reconnect and to 're-naturalise' terrestrial and aquatic habitat, the value of which may be limited by existing modification. Both the landscape and drainage designs of the Proposed Scheme will be influenced by ecological opportunities, for example, through careful design of balancing ponds to promote biodiversity, or creation of more natural watercourses. Ensuring that the landscaping and habitat creation associated with the Proposed Scheme has a nature conservation legacy is reflected in the Environmental Design Aims.

Operational effects

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

- Barrier effects (to movement of fauna);
- Mortality from collision;
- Noise and visual disturbance;
- Disturbance from lighting;
- Accidental pollution; and
- Introduction and spread of non-native invasive species.

Cumulative effects

9.6.14 Cumulative effects are those that result from a combination of a number of individual effects. In the context of the ecological assessment of the Proposed Scheme, these will include:

- The combined ecological effect on a single receptor of a number of individual environmental impacts, e.g. land-take, noise and airborne dust, arising from the Proposed Scheme;
- The cumulative effects of localised ecological impacts along the length of the railway, for example the potential of cumulative loss of certain habitat types; and
- Interaction between ecological effects arising from the Proposed Scheme and those from other relevant projects and plans (both on single receptors and along the length of the route of the Proposed Scheme).

9.7 Assumptions

9.7.1 The Ecology chapter of the ES will include a section to explain any assumptions made in undertaking the ecological 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 – such as trees, ancient woodlands, historic hedgerows and nature reserves - from social/recreational, heritage and landscape points of view is considered in Section 7 (Community), Section 8 (Cultural Heritage) and Section 12 (Landscape and Visual Assessment) of this Report, respectively. Effects on geology and geomorphology are considered in Section 11 (Land Quality).

10 Electromagnetic interference

10.1 Introduction

10.1.1 This section of the Report covers the impacts and effects of the Proposed Scheme on Electromagnetic Interference (EMI), including Electro Magnetic Compatibility (EMC).

10.1.2 EMI is disturbance that affects an electrical system due to magnetic and electric fields, 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 that may have an effect on third parties will be generated by either the traction power supply system or the traction units. Emissions from the signalling and communication systems, electrical and mechanical systems, generally only affect the internal railway operating system. In addition, equipment located within the infrastructure maintenance depot 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). 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.

10.1.5 The Proposed Scheme (particularity its nature as an electrified railway) is not unique, hence, there exists data from HS1 for example, that can be used to illustrate the minimal effects of EMI to the environment.

10.1.6 EMC is an issue that can normally be mitigated though the application of EMC industry accepted practice during design and installation.

10.1.7 Electromagnetic Field (EMF) limits are to be specified through the future EMF Directive, anticipated to be published during 2013. Currently, the limits provided by the International Commission on Non-Ionizing Radiation Protection[89] (ICNIRP) are applicable and can be used during design and installation.

10.1.8 The ICNIRP guidelines also require that the electromagnetic field exposure to workers and the general public be addressed.

[89] International Commission on Non-Ionising Radiation Protection (ICNIRP), 1998, *ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz),* Health Physics 74 (4):494-522

10.1.9 Many of the effects caused by EMI will be eliminated or reduced to acceptable standards during the design and installation period of the Proposed Scheme. Designs for which are covered by British and European Standards and industry accepted practice.

10.2 Establishment of baseline and definition of survey

10.2.1 A description of the baseline environment for the 2011 consultation scheme is contained within Section 8 of the AoS (Main Report).

10.2.2 In constructing and operating the Proposed Scheme, there will be key interface issues that require evaluation and management. 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 upon by its surroundings, which will differ throughout the length of the route of the Proposed Scheme.

10.2.3 Where the Proposed Scheme is adjacent to an existing railway corridor, there will be a significant interface with the existing railway networks. Although the existing infrastructure may have systems and procedures to mitigate the effects of EMI, it is possible that the introduction of the Proposed Scheme's infrastructure may have an adverse effect on the existing railway infrastructure. Similarly, the existing railway infrastructure may have an effect on the Proposed Scheme (both infrastructure and rolling stock).

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

10.2.5 For the areas not adjacent to existing railway, the Proposed Scheme's 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 communication systems.

10.2.6 The Proposed Scheme's rolling stock could be a major source of EMC issues and therefore it is necessary that the rolling stock specification is compatible with the operational limits of the infrastructure and the Technical Specification for Interoperability (TSI). The main impact of EMI resulting from the rolling stock is on the railway infrastructure itself.

10.3 Consultation

Consultation on the AoS

10.3.1 Electromagnetic interference was not considered as part of the AoS in relation to the 2011 consultation scheme.

Consultation as part of the EIA process

10.3.2 In producing the hazard log a list of interested parties will be developed including:

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

10.4 Key aspects of the Proposed 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; and
- 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/interchanges, infrastructure maintenance depots, ventilation shafts and other line side equipment, traction depots and rolling stock, both existing and proposed].

10.4.2 The main source of EMI will be the traction power system, as electromagnetic emissions are caused by the current flowing in an electrical system. The higher currents found in high voltage distribution have the potential to create larger electromagnetic fields, the strength of which diminish rapidly with the distance from the source.

10.5 Scope of assessment

10.5.1 A desk study will be undertaken to identify potential sources of EMI that exist or may be produced during both the construction and operational phases of the Proposed Scheme. The list will identify the potential risk and

the potential impact and effect, and form part of a hazard log. The desk-based study will also identify establishments where people are potentially at risk from the electromagnetic fields produced by the Proposed Scheme's 25 kilo Volts (kV) electrification traction power and its rolling stock.

10.5.2 The assessment will identify potentially sensitive receptor sites within a 20m corridor either side of the centreline of the nearest track within the Proposed Scheme, or from proposed power equipment (e.g. overhead lines and traction substations).

10.5.3 Once each receptor site has been identified, a risk assessment will be undertaken to categorise the perceived level of risk and to identify the potential mitigation for each receptor site.

10.5.4 The risk assessment will assess the impact of electromagnetic fields and EMC effects on nearby equipment, installations and people.

10.5.5 The EMI, EMC and EMF assessment will use existing data, particularity that of electrified railways, in undertaking the evaluation.

10.6 Assessment methodology

Legislation and guidance

10.6.1 The following standards are relevant:

- British Standard (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;
- 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;
- BS IEC 60000-2-7:1998 Electromagnetic compatibility (EMC). Low frequency magnetic fields in various environments; and
- ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz) (1998).

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. 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 10m from the centreline of the nearest track rails or from non-traction power equipment (i.e. cables transformers or switchgear). BS EN 50121-4:2006 (Signalling and Telecommunication Apparatus) and BS EN 50121-5:2006 (Fixed Power Supply Installations) will be applied in this zone. The emission and immunity levels are provided in the BS. BS EN 50121-4:2006 (Signalling and Telecommunication Apparatus) 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: 2005 (Generic

standards - 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 BSs. Any safety critical equipment located in this zone would also apply to these BSs.

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: 2007 (Generic standard - Immunity for residential, commercial and light industrial environments) and BS EN 61000-6-3: 2007 (Generic standards - Emissions for residential, commercial and light industrial environments), will be applied in this zone. The emission and immunity levels are given in these BSs.

10.6.7 For emissions effecting people outside the 20m zone, ICNIRP guidelines will be followed.

10.6.8 Where risk is identified, calculations will be undertaken to assess the impact of EMC. Industry accepted 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.

10.6.9 In creating the hazard log, the impact and risk levels will be established thereby identifying key areas for assessment. Base-line measurements will be taken to ensure that the existing environment is compliant with the relevant BSs. Preliminary calculations will be used to identify the potential impact of the Proposed Scheme's infrastructure, using industry standards and industry accepted practice.

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 with the relevant BSs individually will produce a cumulative effect once installed as part of a wider system, such as traction substations. 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, however this is usually confined to the effect on equipment within the railway boundary.

10.7 Assumptions

10.7.1 The following assumptions are made:

- No site visits will be conducted, rather a desk-based study will be undertaken;
- No modelling or detailed calculations will be undertaken;
- Where information is not available, professional judgement will be used to reach a conclusion. It may be possible, subject to review, to use information from other recent and similar railway construction projects such as HS1;
- The compilation of information from which to assess the baseline measurements will be dependent on the availability of recorded information; and
- In accordance with good safety management principles, it is assumed that risks due to EMI will be reduced using the '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, which was considered within the AoS within the wider topic of 'Sustainable Consumption and Production'.

Land Contamination

11.1.2 Land and groundwater along the route of the Proposed Scheme 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). Contamination may be in topsoils, soil, deeper geology or as ground gases. Construction of the Proposed Scheme will require earthworks, cut and cover and bored tunnelling, deep foundations, temporary and permanent 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 would need to be assessed and mitigated.

11.1.3 The Land Quality chapter of the 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 will need to be considered in order to remediate significant areas of contamination. It will also present a review of measures to prevent or mitigate land contamination arising from the construction and operational stages of the project.

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 sources or pathways by which contamination can spread; and where there is a significant risk of this happening, to consider mitigation measures to prevent it. HS2 Ltd will be responsible for dealing with contamination on any land it acquires.

11.1.5 The Land Quality chapter will have significant interaction with the Water Resources and Flood Risk Assessment and Waste and Materials chapters of the ES.

Geological and Mining/Mineral Features

11.1.6 Along the route of the Proposed Scheme 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 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 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 2011 consultation scheme would cross 16 old landfill sites, thereby giving rise to an opportunity to re-use currently disused land. This would also apply to other derelict areas of contaminated land.

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

- Data collected for the AoS;
- Analysis of the results of previous investigations carried out in the immediate area of the Proposed Scheme;
- Historical Ordnance Survey mapping;
- Published geological and hydrogeological mapping/information;
- 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:

- Environment Agency;
- Water Companies;
- British Geological Survey; and
- County councils and district councils.

11.2.4 Much of the data is also held on commercial environmental databases. Site inspections will be used to supplement the documentary study data obtained.

11.2.5 Generally, a width of 250m either side of the Proposed Scheme, and land required for construction of stations/interchanges, depots, construction/storage sites 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. The 250m width may be widened where evidence suggests that it is required. Groundwater resources over a much larger area will be considered for the Water Resources study and will be available for assessment of groundwater contamination effects.

11.2.6 A risk based approach in accordance with Defra and the Environment Agency guidance will be taken to identifying contamination which may have a significant impact upon the construction of the Proposed Scheme. Following a review of desk study data, the AoS and site inspections, where the identified past uses of land indicate a high risk of previous significant contamination and potential risk to receptors, intrusive investigations may be carried out (where practicable) at the same time as 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 *Model Procedures for the Management of Land Contamination: Contaminated Land Report 11*[90] and BS10175: 2011[91] and based on a developed conceptual site model (see paragraph 11.6.2).

11.2.7 With regards to other sites of geological interest, information will be obtained from Natural England, the British geological Society, 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 Environment Agency 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 and Geology Trusts (if RIGS are affected);
- Network Rail;
- Landfill and mineral abstraction companies;
- Coal Authority;
- Local authorities (primarily Environmental Health Officers and Contaminated Land Officers); and
- Water companies.

[90] Defra and the Environment Agency, 2004, *Model Procedures for the Management of Land Contamination: Contaminated Land Report 11*, Environment Agency

[91] British Standards Institute (BSi), 2001, 10175 *Investigation of potentially contaminated sites. Code of practice*, BSi

11.4 Key aspects of the Proposed 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 and groundwater may be present as a result of historical activities at a particular location or as a result of current operations.

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 necessarily be accessible to the public.

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. Potential sterilisation of resources could affect both coal mining and mineral resources.

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. The construction of the railway will entail bringing materials on to site (such as fuel) which if spilt or leaked could result in land or groundwater contamination. Impairment and sterilisation of geological and mining/mineral resources will likewise be addressed.

11.5.2 Although the maintenance of the railway once it is operational will be required to be in compliance with appropriate environmental legislation in

order to prevent land, surface water or groundwater contamination, the major operational sources of contamination will be reviewed and appropriate mitigation measures proposed. In addition, during the operational period, monitoring works (such as for groundwater) may continue in order to demonstrate the effectiveness of any remedial works.

11.6 Assessment methodology

Legislation

11.6.1 Part 2A of the Environmental Protection Act 1990 (as amended)[92] provides a statutory definition of contaminated land:

11.6.2 *"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

11.6.3 In the guidance[93] that accompanies the Environmental Protection Act 1990, there is advice on what constitutes significant harm and what constitutes a significant possibility. The following reports provide further guidance on the risk assessment process, and introduce the Contaminated Land Exposure Assessment (CLEA) model:

- *Model Procedures for the Management of Land Contamination: Contaminated Land Report 11* (Defra and the Environment Agency);
- *Guidance on the legal definition of contaminated land*[94];
- *Human Health Toxicological Assessment of Contaminants in Soil*[95];
- *Updated Technical Background to the CLEA Model*[96]; and
- *Guiding Principles on Land Contamination*[97].

11.6.4 The impacts associated with contaminated land are generally assessed by means of a source/hazard-pathway-receptor methodology in accordance with *Model Procedures for the Management of Land Contamination: Contaminated Land Report 11* and BS10175: 2001, where the following definitions apply:

- *Source:* contamination that has the potential to cause adverse impacts to a receptor;

[92] HM Government, 1990*, Environmental Protection Act 1990*, The Stationery Office
[93] HM Government, 2012, *Environmental Protection Act 1990, Part 2A: Contaminated Land Statutory Guidance*, The Stationery Office
[94] Department of Environment, Food and Rural Affairs (Defra), 2008, *Guidance on the legal definition of contaminated land*, Defra
[95] Environment Agency, 2008, *Science Report – SC050021/SR2 - Human Health Toxicological Assessment of Contaminants in Soil*, Environment Agency
[96] Environment Agency, 2008, *Science Report – SC050021/SR3 - Updated Technical Background to the CLEA Model*, Environment Agency
[97] Environment Agency, 2010, *Guiding Principles on Land Contamination*, Environment Agency

- *Receptor:* a target that may be affected by contamination; examples include human occupants or 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

11.6.5 The previously described 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 onsite or off site source), potential sensitive receptors and potential pathways through which the former may affect the latter (a contaminant linkage).

11.6.6 The sensitivity of potential receptors can be described qualitatively according to the categories shown in Table 14. However, the distance criteria quoted 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).

Table 14 - Criteria for assessing receptor sensitivity[98]

Receptor sensitivity/ Value of Resource	Receptor/ Resource
High	Residential areas, schools and playing fields within 50m of groundwater disturbed by construction Nearby water bodies of high quality and/or route on Principal Aquifer Nationally designated areas e.g. SSSI Major mining or mineral resource areas
Moderate	Residential areas, schools and playing fields within 250m of ground disturbed by 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

11.6.7 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 which will be put in place prior to the construction phase.

11.6.8 The magnitude of potential scheme impacts regarding contamination issues will be assessed using a four-point scale as shown in Table 15.

[98] Based on the Highways Agency, 2008, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 2 Environmental Impact Assessment, Part 5 Assessment and Management of Environmental Effects*, The Stationery Office

Table 15 - Impact magnitude criteria[99]

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.

11.6.9 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.

11.6.10 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.

11.6.11 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.

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

[99] Based on the Highways Agency, 2008, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 2 Environmental Impact Assessment, Part 5 Assessment and Management of Environmental Effects*, The Stationery Office

11.6.13 Table 16 summarises the criteria for assessing effect significance.

Table 16 - Significance of effects criteria[100]

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.

Construction effects

11.6.14 The impact of existing land contamination will become manifest 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.

11.6.15 Remediation of contaminated land, and other construction activities, can lead to a number of secondary effects such as potential issues of dust migration and surface water impairment during the remediation and construction processes. Any such effects would be controlled through use of the Code of Construction Practice.

11.6.16 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

11.6.17 The major operational sources of contamination will be reviewed and appropriate mitigation measures proposed. In addition, during the operational period, monitoring works (such as for groundwater) may continue in order to demonstrate the effectiveness of any remedial works

[100] Generally based on the Highways Agency, 2008, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 2 Environmental Impact Assessment, Part 5 Assessment and Management of Environmental Effects*, The Stationery Office

Cumulative effects

11.6.18 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.

11.6.19 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 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 (Air Quality) of this Report.

11.7.2 Land contamination has the potential to affect groundwater resources. There will be significant inter-action between the Land Quality and Water Resources assessments in order to determine the potential effects on the quality of groundwater from any contaminated land. Wider issues of groundwater and surface water resources are contained within Section 17 (Water Resources and Flood Risk Assessment) of this Report.

11.7.3 Land contamination has the potential to affect ecological resources. Other ecological issues are contained in Section 9 (Ecology) of this Report.

11.7.4 Remediation of contamination can lead to a requirement for disposal of contaminated materials. Issues of onsite treatment and re-use of contaminated materials will be dealt with in the Land Quality assessment whereas issues of the disposal of contaminated soils off site are dealt with in Section 16 (Waste and Material Resources) of this Report.

12 Landscape and visual assessment

12.1 Introduction

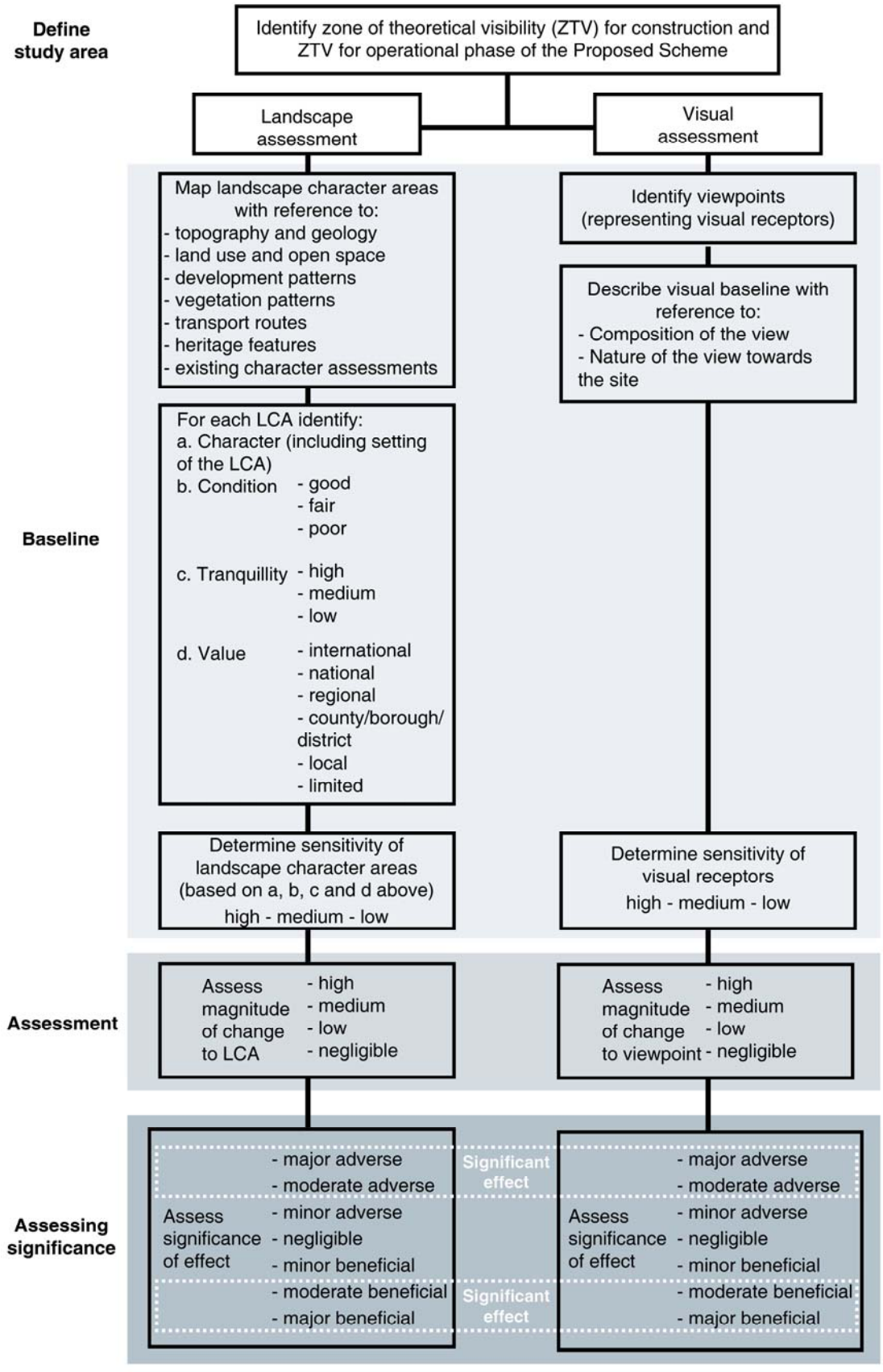
12.1.1 This section of the Report sets out the methodology for assessing the likely significant effects of the Proposed Scheme on landscape and visual receptors.

12.1.2 The topic specific methodology presented in this section builds upon the general assessment methodology summarised in Section 2 (EIA Methodology) of this Report. This has been developed to take account of the range of likely significant environmental effects on the landscape 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. To avoid the use of interchangeable terms (such as townscape), the term landscape has been used throughout.

12.1.4 The process for the landscape and visual assessment is illustrated in Figure 5. Each stage of the assessment process is then described in more detail through the following sections.

Figure 5 - Assessment process for the landscape and visual assessment



12.2 Establishment of baseline and definition of survey

12.2.1 A description of the baseline environment in relation to the 2011 consultation scheme is contained within the AoS (Volume 1, Section 8); particularly, Section 8.4 provides a description of the baseline environment in relation to landscape and visual receptors, with further details provided in Appendices 2, 3 and 5.

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

- The landscape 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 AONB;
- The rural, suburban and urban landscapes of Solihull District and Birmingham; and
- The rural and agricultural landscape of Warwickshire and Staffordshire north of Birmingham, where the Proposed Scheme joins the WCML north of Lichfield.

12.2.3 The landscape character of the study area [see Section 12.5 (Scope of assessment – Spatial scope)] and the nature of existing views will be established through desk based research and field survey.

12.2.4 The landscape and visual surveys will be carried out by Chartered Landscape Architects experienced in EIA. Assessments made will be verified by at least two other Chartered Landscaped Architects experienced in EIA. Survey work will be carried out in both the summer and winter, in order for seasonal change to be considered in the assessment. The survey work will be carried out in a methodical order as follows:

- Verification of the zone of theoretical visibility (ZTV) i.e. the study area [see Section 12.5 (Scope of assessment - Spatial Scope)];
- Definition of the landscape character areas (see paragraphs 12.2.7 and 12.2.8);
- Assessment of the condition, tranquillity and value of each of the character areas (see paragraphs 12.2.9 to 12.2.12);
- Establishment of the sensitivity of each of the character areas (see paragraph 12.2.14);
- Definition of visual receptors (viewpoints) within the ZTV (see paragraph 12.2.15);
- Definition of the type and nature of the view from each viewpoint (see paragraph 12.2.17); and
- Determination of the magnitude of change for each character area (see paragraph 12.6.2) and visual receptor (see paragraph 12.6.9).

12.2.5 The field study will include a comprehensive photographic record carried out in both the summer and winter, to illustrate each character area and viewpoint (see paragraphs 12.2.15 to 12.2.18).

Landscape baseline

12.2.6 The landscape baseline 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, including statutory and non-statutory designations relevant to the landscape and visual assessment (for example AONB and Areas of Great Landscape Value);
- Development patterns and scale, including age, massing and density of buildings, levels of enclosure, skyline characteristics, building materials and landmark features;
- Vegetation patterns and extents;
- Transport routes and Public Rights of Way, National Trails and other routes to include roads, railways, cycleways, bridleways, footpaths, historic green lanes and drovers roads and waterways;
- Heritage features, including conservation areas, listed buildings, registered parks and gardens and other historic components; and
- Existing landscape character assessments and/or local green infrastructure strategies or plans prepared by authorities, including the latest available National Character Assessment and Profiles from Natural England.

Landscape character assessment

12.2.7 The landscape baseline elements will be used to prepare a character area assessment covering the full extent of the study areas. Landscape character areas are defined as areas with broadly homogenous characteristics. The identification of character areas will be influenced by published character assessments, including those prepared at national, county and district scales. If these are sub-divided to create units of character appropriate to the scale of the Proposed Scheme, this will be clearly set out in the ES.

12.2.8 The character of each landscape character area would be described, influenced by existing documentation including local authority character assessments, historic landscape character assessments and Conservation Area character appraisals where available.

Condition

12.2.9 The condition of each character area will 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.

12.2.10 Professional judgements by landscape architects on the condition of the character areas will be based on the physical state of the landscape, including its intactness and the state of repair of individual features and elements.

Tranquillity

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

- Land use;
- Level of seclusion or isolation, including perception of nature;
- Extent and type of enclosure by surrounding land uses;
- Level of screening afforded by vegetation, ground level change or boundary treatments;
- Levels and types of vehicular traffic within, or close to the character area;
- Levels of pedestrian traffic within, or close to the character area;
- Level of light pollution; 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, medium or low.

Landscape value

12.2.13 An assessment will be made of the likely scale at which the character areas are valued. This will 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 17. These criteria are based on guidance provided by the Landscape Institute.[101]

Table 17 - Landscape value

Scale of landscape value	Where 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

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

Scale of landscape value	Where the character area is:
	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
Regional	Located within green belt, Metropolitan Open Land or a regional scale park Considered a distinctive component of the region's character, experienced by a large proportion of its population
County/ Borough/District	Designated open space within the local authority Unitary Development Plan or Local Development Framework Designated as a Conservation Area Experienced by a significant proportion of the county's, 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 value to the local community or residents

Sensitivity criteria

12.2.14 With reference to condition, tranquillity and landscape value, the sensitivity of the character areas to the nature of the Proposed Scheme will 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, including published character assessments which attribute sensitivity to landscape character areas. 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 Table 18.

Table 18 - Landscape sensitivity

Sensitivity	Where the character area:
High	Is valued at the international, national, regional or borough/district scale Is predominantly characterised by landscape 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 Is well maintained and in a good condition
Medium	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 landscape Is of a fair condition
Low	Has limited landscape value Has few or no distinctive components, or components that detract from the overall character of the site

Sensitivity	Where the character area:
	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 landscape, and opportunities for an improvement in character Is in a poor condition

Visual baseline

Selection of viewpoints

12.2.15 Viewpoints would be selected to allow an assessment of effects [see Section 12.6 (Assessment methodology)] from receptors within the study area. Individual residential, hotel, healthcare, employment and educational receptors will be identified and those with the same or similar view grouped together. Representational viewpoints will be identified for recreational, transport and active sports receptors.

12.2.16 All viewpoints will be agreed with the community forums, local planning authorities and other relevant stakeholders, for example English Heritage, the National Trust, Natural England and the Chilterns Conservation Board.

12.2.17 Photos taken during both winter and summer periods will be included in the ES for each viewpoint. The composition of the view will be described, including foreground and background characteristics, the nature of the view towards the land to be acquired or used for the Proposed Development, that which obstructs the view (if anything) and whether a view is panoramic, framed, glimpsed or sequential.

12.2.18 The view at night will be described in cases where significant effects arising from lighting during construction or operation are likely.

Sensitivity

12.2.19 Within the study area, visual receptor types will be mapped by category according to the hierarchy shown in Table 19, based on people's level of interaction with the landscape. These categories are based on best practice guidance from the Landscape Institute.

Table 19 - Visual sensitivity

Sensitivity	Level of interaction with the landscape
High	Occupiers of residential properties Recreational users or tourists whose attention may be focussed on

Sensitivity	Level of interaction with the landscape
	the landscape Designated or protected views
Medium	People travelling through the landscape 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 and visual receptors were raised during consultation on the AoS, with reference also made to the AONB and other valued landscapes (including both designated and non-designated areas).[102]

12.3.2 Any new large infrastructure project, especially road and railway routes could have effects on landscape 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 effects and respond to other environmental concerns. This approach has included evolving the 2011 consultation scheme such that lower viaducts and embankments are used, along with the extensive use of cuttings 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 by following the existing contours of the land or along existing transport corridors where possible. In addition, natural screening of the railway will 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. The planting of these would be carefully considered to ensure they are appropriate to the character of the surrounding landscape.

12.3.4 The Chiltern Hills escarpment crosses a direct line between London and the West Midlands, much of which is designated as an AONB. Specific concerns were raised during consultation on the 2011 consultation scheme and the AoS relating to the AONB, asking whether it was appropriate for such a development to have effects on the landscape designation and associated features. Reference was made to policy and regulations in this respect. However, changes to the route following consultation ensured that in the AONB, 7.5 miles would be in tunnel and 3 miles would be hidden in deep

[102] Department for Transport (DfT), 2012, *Review of HS2 London to West Midlands Appraisal of Sustainability: A Report to Government by HS2 Ltd*, DfT

cutting, meaning that only 1.5 miles of the route would be visible in the Chilterns.

Consultation as part of the EIA process

12.3.5 Consultees for this chapter of the ES will include (but not be limited to) local planning authorities, county councils, the GLA, Natural England, English Heritage, the National Trust, the Environment Agency, the Forestry Commission, the Chilterns Conservation Board and other groups with appropriate technical knowledge.

12.4 Key aspects of the Proposed Scheme for the topic

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

- Construction sites (including vehicles, construction lighting);
- Site compounds and storage areas, including temporary fencing and signage;
- Earthworks (including temporary stockpiles or earth bunds for screening);
- Construction of buildings, structures and electrical apparatus;
- Demolition and vegetation clearance;
- Construction traffic, including movement of excavated materials and movements on public roads; and
- Infrastructure and utility diversions.

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

- The track and track bed;
- Traffic (including trains and maintenance vehicles), and 'arcing' from trains;
- The overhead line equipment (OLE), lighting, communication masts and signage;
- Tunnel portals and ventilation shafts;
- Viaducts and bridges (including both road and pedestrian);
- Demolitions;
- Earthworks including cuttings, embankments, cut and cover "green tunnels" 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/interchanges and infrastructure maintenance depots, and associated development such as road widening, junction changes and increased traffic; and
- Associated developments, such as utility and permanent road diversions/upgrading.

12.5 Scope of assessment

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

- Guidelines for Landscape and Visual Impact Assessment Landscape (2nd Edition), Landscape Institute and IEMA; and
- DMRB, Volume 11 Section 3 Part 5: Landscape Effects (1993).

12.5.2 There is no legislation or prescriptive guidance for undertaking landscape and visual assessments. Therefore, the methodology that has been developed for this assessment seeks to make reference to relevant guidance from both of the above documents, whilst also accommodating relevant developments in the assessment outlined in the Guidelines for Landscape and Visual Impact Assessment (GLVIA)[103] (3rd Edition Consultation Draft, 2012) (for example, through avoiding judgements on landscape quality).

Spatial scope

12.5.3 The landscape 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.

12.5.4 The landscape assessment area would be defined by the maximum extent of all character areas located partially or entirely within the ZTV except in those locations where the Proposed Scheme during construction or operation would be barely perceptible. The visual assessment area would be defined by the maximum extents of the ZTV except in those locations where the Proposed Scheme during construction or operation would be barely perceptible.

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

12.5.6 Aspects of landscape and visual assessment are important to consider in respect of the setting of historic buildings and landscapes. The methodology

[103] Landscape Institute, 2012, *Guidelines for Landscape and Visual Impact Assessment* (3rd Edition Consultation Draft), Landscape Institute

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 character and on visual receptors. Section 8 (Cultural Heritage) of this Report 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

12.5.7 The landscape 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 may give rise to effects on character. Effects may be direct (whereby landscape 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).

Landscape assessment methodology

Determining magnitude of change

12.6.2 The likely nature and magnitude of changes to individual landscape components and characteristics are described together with the consequential effect on landscape character. Factors that would be considered in assessing the magnitude of change to the character areas surrounding the site are summarised in Table 20. These criteria are based on guidance provided by the Landscape Institute.

Table 20 - Landscape magnitude of change

Impact magnitude	Definition
High	Total loss of or major alteration to key characteristics of the character and/or setting of the character area

Impact magnitude	Definition
	Addition of new features or components that substantially alter the character and/or setting of the character area Introduction of elements that markedly alter the tranquillity of the character area
Medium	Partial loss or alteration to one or more key characteristics of the character and/or setting of the character area Addition of new features or components that form prominent elements of the character and/or 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 character and/or setting of the character area Addition of new features or components that form largely inconspicuous elements of the existing character and/or 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 character and/or setting of the character area Addition of new features or components that do not influence the overall character and/or setting of the character area, or are entirely characteristic of the existing setting Introduction of elements that make no perceptible change to the tranquillity of the character area

Determining significance of effects

12.6.3 Determination of the significance of an effect requires the application of impartial 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 effects are noted in Table 21. 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 21 - Landscape 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
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
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

Visual assessment methodology

12.6.4 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.

12.6.5 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.

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

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

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

Determining magnitude of change

12.6.9 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 22, based on guidance from the Landscape Institute.

Table 22 - 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
Medium	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

Impact magnitude	Definition
Low	Minor loss of or alteration to one or more characteristics of the view from a receptor Addition of new features or landscape 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
Negligible	Very minor loss or alteration of inconspicuous characteristics of the view from a receptor Addition of new features or landscape 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

12.6.10 Determination of the significance of an effect requires the impartial 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 23. 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 23 - 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

Significance of effect	Description The proposed development would result in:
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

12.6.11 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, Local Development Frameworks 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).

12.6.12 Verifiable photomontages would be produced for construction, operation year 1, operation year 15 and operation year 60 as required.

Cumulative effects assessment

12.6.13 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.

12.6.14 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.

12.6.15 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.

12.7 Assumptions

12.7.1 The assessment is based on professional judgement and takes into account both the adverse and beneficial contribution that new development can have upon the existing landscape character and on the visual resource of surrounding receptors.

12.7.2 During the baseline survey there may be some areas which are inaccessible (such as private land, commercial premises and residential buildings). In these instances, professional judgement will be used to approximate the likely views from these locations. Where viewpoints are selected to reflect the visibility of the site from tall residential properties, a photo will be included from public land in close proximity to the property, taken at ground level, and a commentary included as to the likely appearance of the view from a higher elevation. In line with industry accepted guidance, in these instances, no photomontages will be included from an elevated perspective.

12.7.3 The ZTVs will be generated using LiDAR topographic data (where available) or Ordnance Survey Landform Profile data. It is acknowledged that changes in the assessment area through new development and/or demolition will not necessarily be picked up by this model. However, professional judgement will be used to verify the ZTVs on site as far as possible.

13 Socio-economics

13.1 Introduction

13.1.1 This section of the Report sets out the methodology for the socio-economic assessment, which focuses on identifying significant economic and employment effects during the construction and operational phases of the Proposed Scheme. The need for a socio-economic assessment results from the potential for the Proposed Scheme to generate impacts on:

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

13.1.2 The socio-economic assessment will feed into the community assessment chapter of the ES, for example, increases in property prices arising from catalytic effects may give rise to changes in access to housing. The assessment will also draw upon other assessments where relevant, such as agriculture, forestry and soils in relation to farm-based businesses. Specifically the socio-economic 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).

13.1.3 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 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. Benefits to the national economy arise through the circulation of monies over a wide area, which may not have directly observable or significance consequences in the context of EIA.

13.2 Establishment of baseline and definition of survey

Characteristics of communities

13.2.1 The need to minimise negative socio-economic effects has influenced the design development of the Proposed Scheme, 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.

13.2.2 However, the route passes through, and will potentially effect, a diverse range of communities. 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

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

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

13.2.5 Baseline information will be presented against comparable performance statistics for areas associated with communities where impacts are being assessed, known as benchmark areas. Benchmark areas will include a local catchment, the host district and wider areas or a county where appropriate. The baseline for the benchmark areas 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 of the Proposed Scheme.

13.2.6 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 and investigations into the character and nature of businesses in the area.

13.3 Consultation

Consultation on the AoS

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

13.3.2 A wider consultation process was also undertaken in relation to the 2011 Consultation Scheme 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. 4,163 respondents expressed doubt about the forecasted economic benefits including the reliability of the assumptions underpinning the figure, with some stating that only a few places will benefit and some may lose economic activity[104]. 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 the construction and operational phases would not see any benefits.

13.3.3 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

13.3.4 Relevant formal and other stakeholders will be contacted as part of the EIA process, including:

- Local authorities with territory along the route of the Proposed Scheme as well as territories associated with proposed stations/ interchanges, junctions and infrastructure maintenance 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.

[104] Department for Transport (DfT), 2011 (Addendum 2012), *High speed rail: Investing in Britain's future consultation summary report: A report to Government by Dialogue by Design*, DfT

13.4 Key aspects of the Proposed Scheme for the topic

13.4.1 Relevant aspects of the Proposed 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/interchanges;
- 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 WCML and any other lines affected by the Proposed Scheme;
- The economic and land use effects of changes in accessibility;
- Catalytic effects on planned and anticipated development; and
- Wider catalytic effects[105] and city regeneration.[106]

13.5 Scope of assessment

Spatial scope

13.5.1 The spatial scope of the assessment will vary according to the type of resource or receptor (see Table 24).

Table 24 – Socio-economic assessment: resources, receptors and spatial scope

Resource	Impacts	Effects:		Spatial scope
		On resources	On receptors	
Existing businesses and organisations – land take and amenity impacts	Businesses (non-community) lost to land take	Loss or impairment of business activities	Change in employment and skills mix	Direct land take by the Proposed Scheme
	Community activities lost to land take	Loss or impairment of community activities	Change in employment and skills mix	Direct land take by the Proposed Scheme
	Ground settlement and businesses (non community)	Repairs needed or value of property diminishes	Costs of repairs and inconvenience to landlords/owners/tenants/users	Properties up to 30m from boundary of tunnels or excavations
	Amenity value of infrastructure (used for employment purposes) is changed resulting in an impact on businesses and organisations'	Character or quality of businesses and organisations' environment changes as a result of noise; traffic/congestion, vibration; pollution;	Impact on (non-community) businesses	Relevant impact area from the edge of the Proposed Scheme is a minimum 250m in both urban and rural areas unless
			Change in employment and skills mix	

[105] The creation of station infrastructure may attract other investment activity – either to use its services directly or to exploit associated infrastructure. For example, firms may locate in close proximity to a station to use their services and/or in response to the changed investment climate and perceptions of the area.

[106] Regeneration is subset of wider catalytic effects where, for example, a station development encourages the development of a site which also delivers regeneration benefits where these are defined as such by local policy.

Resource	Impacts	Effects:		Spatial scope
		On resources	On receptors	
	operations	air/water quality; visual impacts		subsequent analysis from other topic areas suggests a greater or lesser extent at specific locations
	Severance of infrastructure (used for employment purposes) from receptors resulting in an impact on businesses and organisations' operations	Physical e.g. Islanding or isolation of resource results in change to business and organisations' environment	Impact on (non-community) businesses	All or part of the catchment area of affected resource where it is subject to severance[107]
			Change in employment and skills mix	
Employment associated with construction	Direct employment opportunities associated with the construction phase	Demand for construction sector services	Demand for construction sector jobs and change in opportunities for local employment	Travel to Work Area of construction sites for daily commute workforce and UK wide for migrant workers
	Indirect impacts on the economy of the construction phase	Indirect impacts on other construction sector projects, multiplier impacts on the wider economy	Demand for construction sector jobs and change in opportunities for local employment	UK
Employment associated with operations	Direct employment opportunities associated with the operational phase	Demand for operational phase services	Demand for operational phase associated jobs and change in opportunities for local employment	Travel to Work Areas associated with the stations and depots during the operational phase employment locations
	Indirect impacts on the economy of the operational phase	Indirect impacts on sectors of the economy, multiplier impacts on the wider economy	Change in employment and skills and change in opportunities for local employment	Induced effects are most likely to occur within the Greater London and the West Midlands where the operational workforce is located. Indirect (supplier based) effects are likely to occur within the UK

Temporal scope

13.5.2 The temporal scope is outlined in Section 2.2 (Scope of assessment) of this Report. Socio-economic impacts will generally be assessed for the construction period (2018 – 2026) and operational capacity (based on operational services of, at peak, 18 trains per hour) in 2033. Impacts will also be assessed in the future against scenarios reflecting different service

[107] The distance of the diversion and duration are factors in determining whether or not there is an impact.

intensities. For socio-economic impacts, 10 years following completion is considered an appropriate timescale[108] for the 'future' assessment.

Uncertainty

13.5.3 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.

13.6 Assessment methodology

13.6.1 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 conditions and those as a result of the Proposed Scheme.

Legislation and guidance

13.6.2 The available guidance on socio-economic assessment sets out the overarching principles, including the assessment of gross and net impacts and recognition of the wider economic impacts of transport schemes. The HCA employment densities guide[109] will be used where necessary to estimate employment in identified floorspace where it is not practical to undertake a direct survey. Other relevant guidance includes:

- *Treasury Green Book*: Appraisal and Evaluation in Central Government[110];
- DfT WebTAG guidance (on wider economic effects of transport);
- English Partnerships (2008) *Additionality Guide, A standard approach to Assessing Additional Effects of Projects*[111]*;* and
- Good practice from other infrastructure project EIAs, for example, Crossrail and Thames Tunnel.

Significance criteria

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

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

[108] Department for Business, Innovation and Skills (BIS), 2009, *Regional Development Agency (RDA) Evaluation: Practical Guidance on Implementing the Impact Evaluation Framework,* BIS. 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.

[109] Homes and Communities Agency, Office of Project & Programme Advice & Training and Drivers Jonas Deloitte, 2010, *Employment Densities Guide*, 2nd Edition, HCA.

[110] HM Treasury, 2003, *The Green Book: Appraisal and Evaluation in Central Government*, The Stationery Office

[111] English Partnerships, 2008, *Additionality Guide, A standard approach to Assessing Additional Effects of Projects* (3rd Edition), English Partnerships

Determining magnitude of impacts

13.6.4 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 of occurrence;
- The scope for incorporated environmental design features or mitigation; and
- Value of the resource.

13.6.5 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 industry accepted practice (see Table 25).

Table 25 - Socio-economic impact magnitude criteria

Impact magnitude	Definition
High	An impact that will be very adverse/beneficial, and very likely to effect large numbers of businesses and/or people (with number depending on the local context and nature of the impact), and that will usually continue and effectively constitute a permanent, long-term impact on the baseline conditions
Moderate	An impact that is likely to effect a moderate number of businesses and/or people (with number depending on the local context and nature of the impact)
Low	An impact that is likely or may effect a small number of businesses and/or people (with number depending on the local context and nature of the impact) and/or that usually does not extend beyond the life of the project so that the baseline is not affected beyond a short or medium-term duration
Negligible	An impact that is temporary in nature and/or is anticipated to have a slight or no effect on the well-being of businesses and/or people

Determining receptor sensitivity

13.6.6 Guideline criteria have been established using professional judgement and existing industry accepted practice to determine the sensitivity of the receptors (see Table 26).

Table 26 - 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

13.6.7 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 industry accepted practice.

13.6.8 The approach to determining significance is summarised in Table 27.

Table 27 - 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 - significant	Minor adverse - not significant	Negligible - not significant	Negligible - not significant

13.6.9 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.

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

Construction effects

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

- Establishment of the baseline with definition and collection of relevant data and information as outlined in Section 13.2 (Establishment of baseline and definition of survey);
- Consultations including those outlined in Section 13.3 (Consultation);
- Assessment of impacts and effects against key aspects of the Proposed Scheme as outlined in Section 13.4 (Key aspects of the Proposed Scheme for the topic), covering the scope outlined in Section 13.5 (Scope of assessment) and using the significance criteria outlined in Table 27; and
- Iterative further assessment of impacts identified through other environmental topics as part of the EIA.

Operational effects

13.6.12 The same process will be used for assessment of operational effects as outlined for construction effects above in paragraph 13.6.11.

Cumulative effects

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

13.7 Assumptions

13.7.1 Key assumptions include:

- Construction labour productivity underpinning the construction labour demand curve remains constant over the life of the Proposed Scheme (e.g. no major changes in technology and method of work that lead to changes in the skills mix, etc); and
- 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).

14 Sound, noise and vibration

14.1 Introduction

14.1.1 This section of the Report presents the proposed approach to assessing sound, noise and vibration impacts and effects. It has been divided into two parts, the first dealing with ground-borne sound, noise and vibration and the second dealing with airborne sound and noise.

14.1.2 The terms sound and noise are used in this section. 'Sound' is the neutral term used to describe the fluctuating pressure waves in the air that stimulate the sense of hearing. Noise is often defined as unwanted sound. The term sound is used in this scope and methodology for two reasons. Firstly, during consultation in 2011, communities along HS2's line of route requested that the 'sound quality' in their local area be taken into consideration when assessing the affects of HS2. Secondly, the Noise Policy Statement for England[112] notes "… sound only becomes noise ... when it exists in the wrong place or at the wrong time such that it causes or contributes to some harmful or otherwise unwanted effect, like annoyance or sleep disturbance". Therefore the term sound is used here until the assessment methodology evaluates that there is a potential adverse effect on a receptor, at which stage the term noise is used. Mitigation is therefore noise mitigation.

14.2 Ground-borne sound and vibration

Introduction

14.2.1 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.

14.2.2 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).

14.2.3 The assessment will cover all noise and vibration sensitive receptors (e.g. occupied buildings), including where appropriate 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.

[112] Department for the Environment, Food and Rural Affairs (Defra), 2010, *Noise Policy Statement for England*, Defra

Establishment of baseline and definition of survey requirements

Ground-borne sound

14.2.4 Absolute criteria, rather than sound change criteria, apply for ground-borne sound for four main reasons, as follows:

- 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).

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

Ground-borne vibration

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

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

Consultation

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

14.2.9 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 ES.

14.2.10 Responses to the consultation undertaken in 2011 on the AoS (and in relation to the 2011 consultation scheme) 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 Proposed Scheme for the topic

14.2.11 The key aspects for ground-borne sound and vibration are the following generic types of potential significant adverse effect that could occur without mitigation:

- 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).

14.2.12 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.

14.2.13 During construction of the Proposed Scheme, 'best practicable means' will be used to control and mitigate temporary construction noise and vibration effects consistent with legislation and best practice. 'Best practicable means' will include consideration of working methods, working hours, selection of plant, logistical planning physical barriers and proactive community engagement. The framework for determining such mitigation on a site-by-site basis will be set out in the Code of Construction Practice.

14.2.14 For the operational railway, significant ground-borne noise and vibration effects may be reduced or removed through, for example, the performance specification and design of the rolling stock and infrastructure (especially the track system).

Scope of assessment

14.2.15 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. These will be compared, as necessary, with the future baseline in 2026 (without the Proposed Scheme).

14.2.16 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 United States (US) Federal Railroad Administration

guidance[113] and Federal Transit Administration guidance[114] 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) - whichever is the greater of either 85m from the centreline of the track or nearest construction activity or the area within which impacts from ground-borne sound and/or vibration from the Proposed Scheme are forecast; 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, sound recording / broadcast studios, large auditoria / theatres or concert halls - 200m from centreline of the track or nearest construction activity.

14.2.17 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 Table 31).

Assessment methodology

Legislation and guidance

14.2.18 Relevant legislation includes the Control of Pollution Act 1974[115], the Environmental Protection Act 1990, the Noise and Statutory Nuisance Act 1993[116] and the Land Compensation Act 1973[117] (all as amended).

14.2.19 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 53[118] and TRL Report 429[119], and guidance in BS5228-2.[120]

14.2.20 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

[113] U.S. Department of Transportation and the Federal Railroad Administration (Office of Railroad Development), 2005, *High-Speed Ground Transportation Noise and Vibration Impact Assessment,* Federal Railroad Administration
[114] U.S. Department of Transportation and the Federal Transport Administration, 2006, *Transit Noise and Vibration Impact Assessment Guidance Manual,* Federal Transit Administration
[115] HM Government, 1974, *Control of Pollution Act 1974*, The Stationery Office
[116] HM Government, 1993, *Noise and Statutory Nuisance Act*, The Stationery Office
[117] HM Government, 1973, *Land Compensation Act 1973*, The Stationery Office
[118] Transport Research Laboratory (TRL), 1986, *TRL Report 53: Ground vibration caused by civil engineering works,* TRL
[119] Transport Research Laboratory (TRL), 2000, *TRL Report 429: Groundborne vibration caused by mechanised construction works,* TRL
[120] British Standards Institute (BSi), 2009, BS 5228-2 *Code of Practice for Noise and Vibration Control on Open Construction Sites - Part 2: Vibration,* BSi

calculation method developed and validated initially for the design and construction of HS1.[121] The method is empirical, developed from thousands of measurements, is fully consistent with ISO 14837[122], 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

14.2.21 There are no relevant national or international standards setting criteria for ground-borne sound. The impact criteria set out in Table 28 and Table 29 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.

Table 28 - Ground-borne sound impact criteria for residential receptors

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

Table 29 - Ground-borne sound impact criteria for non-residential receptors

Category of Building	Impact criterion dB L_{pASmax}
Theatres/large auditoria and concert halls	25
Sound recording/broadcast studios	30
Places of meeting for religious worship/courts/cinema /lecture theatres/museums/small auditoria or halls	35
Offices/schools/colleges/hospitals/hotels/libraries	40

[121] Greer R, J., 1999, *Methods for Predicting Groundborne Noise and Vibration from Trains in Tunnels*, Proceedings of the LARIF and IoA Conference

[122] International Standards Organisation (ISO), 2005, *14837 Mechanical vibration – Ground-borne noise and vibration arising from rail systems – Part 1: General Guidance,* ISO

Ground-borne vibration: buildings - construction and operation

14.2.22 The impact criteria for building damage are based upon guidance within BS7385: Part 2.[123] The standard differentiates between transient and continuous vibration (refer to the footnotes within Table 30). For transient vibration the standard notes that the risk of cosmetic damage to residential buildings starts at a Peak Particle Velocity (PPV) of 15 millimetres per second (mm/s) at 4 hertz (Hz). 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%.

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

14.2.23 Guidance on the impact of vibration on people in buildings is presented in BS6472: 2008.[124] Part 1 of the standard assesses the impact of vibration using the Vibration Dose Value (VDV). This is an 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.

14.2.24 Vibration from the operation of the permanent railway and all construction will be assessed using the criteria presented in Table 30.

Table 30 - Vibration impact criteria for buildings[125]

Category of building	Impact criterion: (Peak Particle Velocity - PPV - at building foundation)	
	Transient[126] vibration	Continuous[127] vibration
Potentially vulnerable buildings[128]	≥6 mm/s	≥3 mm/s
Structurally sound buildings	≥12 mm/s	≥6 mm/s

14.2.25 The change criteria presented in Table 31 have been developed using the guidance in BS6472 and are consistent with those applied to other projects such as HS1 and Crossrail.

14.2.26 In the majority of locations along the Proposed Scheme, no existing appreciable level of vibration exists and therefore an absolute criterion is

[123] British Standards Institute (BSi), 1993, 7385-2 *Evaluation and measurement for vibration in buildings – Guide to damage levels from groundborne vibration*, BSi
[124] British Standards Institute (BSi), 2008, 6472 *Guide to evaluation of human exposure to vibration in buildings Parts 1 and 2,* BSi
[125] Conservative criteria which there is no risk of cosmetic damage.
[126] Transient vibration relative to building response such as impulsive vibration from percussive piling.
[127] Continuous vibration relative to building response such as vibrating rollers.
[128] 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 (e.g. 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.

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.

Table 31 - Vibration impact criteria for the disturbance (annoyance) of occupants and building users

Impact classification	In the absence of appreciable existing levels of vibration[129] [130]		Appreciable existing levels of vibration[131]
	VDV $m/s^{1.75}$ Daytime (0700-2300)	VDV $m/s^{1.75}$ 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	> 0.4	>100

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

14.2.27 As noted in ISO 14837-1, 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

14.2.28 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 Table 31 to indicate whether the change could result in a potential impact.

Significance criteria - residential receptors

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

- The type of effect being considered;
- The magnitude of the impacts and available dose-response information;

[129] Highest impact category used, daytime or night–time.
[130] Determined at the worst location on a normally loaded floor (usually the centre of the floor).
[131] Where there is an appreciable existing level of vibration and daytime and night-time vibration dose vales (VDVs) exceed $0.2ms^{-1.75}$ and $0.1ms^{-1.75}$ respectively.

- The number and grouping of impacts;
- The potential combined impacts of airborne sound, ground-borne sound and ground-borne vibration;
- Any unique features of the Proposed Scheme's sound or vibration impacts in the area being considered (which may require secondary acoustic indicators/criteria);
- 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

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

- The type of effect being considered;
- 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;
- Any unique features of the Proposed Scheme's sound or vibration impacts in the area being considered (which may require secondary acoustic indicators/criteria);
- The frequency and duration over which temporary construction impacts may occur; and
- The effectiveness of mitigation through design or other means.

Cumulative Effects

14.2.31 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 (EIA Methodology) 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.

14.2.32 Community, ecological or heritage effects arising from impacts and effects identified for ground-borne noise and vibration will be considered and reported in the relevant chapter of the ES.

Assumptions

14.2.33 Assumptions, relevant to scope and methodology, for the ground-borne sound and vibration assessment include:

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

- Maintenance specifications.

14.3 Airborne sound

Introduction

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

14.3.2 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.

14.3.3 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.

14.3.4 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

14.3.5 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 Proposed Scheme will be developed and refined in three stages.

14.3.6 Initially, existing data will be gathered to form the 'desk top' baseline (Baseline 1). 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 ES.

14.3.7 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

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

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

14.3.10 Responses to consultation on the 2011 consultation scheme raised the following recurring matters in respect of the acoustic assessment presented in the AoS. The manner in which each matter will be considered as part of the EIA, is as follows:

- Potential effects associated with vehicle movements and spoil disposal: *The potential indirect effect of such movements is being assessed as part of the EIA* (e.g. refer to paragraph 14.3.11);
- Concern that the equivalent continuous sound (L_{pAeq}) indicator 'averages out' the impact associated with intermittent train sound: *The LpAeq indicator is a proven and widely established indicator of community annoyance for railway sound and is therefore used in all relevant legislation, standards and guidelines. The EIA is also considering the maximum sound level for a train pass-by consistent with the assessment and design of HS1;*
- A request to present contour maps: *Contour maps will be included within the ES;*
- The need to consider pantograph sound particularly in respect of the height of the source above ground compared to the height of noise barriers: *Pantograph aerodynamic sound is being explicitly calculated and used as part of the determination of mitigation requirements as set out in this Report* (refer to paragraph 14.3.20);
- That the assumed 3 dB reduction in train sound emission levels (compared to current high speed trains) may not be reasonable: *A reduction of 3 dB in train sound emission level is recommended in the High Speed Technical Specification for Interoperability and has been demonstrated to be reasonable in the AoS. Any residual uncertainty is being considered in the EIA;* and
- The need to assess sound levels in terms of the long term expected usage of the Proposed Scheme: *Potential noise and vibration effects are being assessed using the highest traffic forecast during the first 15 years of operation* (refer to paragraphs 14.2.15 and 14.3.14).

Key aspects of the Proposed Scheme for the topic

14.3.11 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, utility works and track works. These activities would be supported from local work compounds close to the structure or 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, other line side equipment and maintenance; and
    - Indirect effects could be caused by long term changes to road and rail traffic pattern on the existing networks.

14.3.12 During construction of the Proposed Scheme, 'best practicable means' will be used to control and mitigate temporary construction noise effects consistent with legislation and best practice. 'Best practicable means' will include consideration of working methods, working hours, selection of plant, logistical planning, physical barriers and proactive community engagement. The framework for determining such mitigation on a site-by-site basis will be set out in the Code of Construction Practice.

14.3.13 Significant adverse noise effects from the operational railway may be reduced or removed through, for example, the performance specification and design of the rolling stock, infrastructure and noise barriers.

Scope of assessment

14.3.14 Temporal scope - the Proposed Scheme will be assessed in the short term at the year of opening; and in the long term with the highest rail traffic patterns forecast for the first 15 years of operation. These will be compared, as necessary, with the future baseline in 2026 (without the Proposed Scheme).

14.3.15 Spatial scope for direct effects - for a mitigated Proposed 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 Railroad Administration Guidance for high speed rail:

- Construction (from BS5228-1) - 300m from any construction activity or the area within which sound levels from the Proposed Scheme are forecast to give rise to potential impacts, whichever is the greater; and
- Operational Proposed Scheme - 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 give rise to potential impacts, whichever is the greater.

14.3.16 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 the Proposed Scheme would be likely to cause a change in the baseline sound level ($L_{pAeq,T}$) exceeding 1 dB during either the day (07:00 to 23:00) or night time periods (23:00 to 07:00).

Assessment methodology

Legislation and Guidance

14.3.17 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[132]) and the European Communities Act 1972[133] (including the Environmental Noise (England) Regulations 2006[134]) (all as amended) and the NPPF including the Noise Policy Statement for England 2010.

14.3.18 Relevant guidance and standards include, in part, the Transport Analysis Guidance[135], the Mayor of London's Ambient Noise Strategy[136] and as identified in each of the following sections.

14.3.19 The airborne sound generated by construction activities will be calculated using the method set out in BS5228-1.

14.3.20 The airborne sound generated by rail operations associated with the Proposed Scheme, both mainlines and connecting chords, and classic lines will be calculated using the calculation method developed and validated initially for the environmental assessment, and then the design, of HS1[137]. The method is empirical, developed from over a thousand measurements. The method has been further tested and verified since HS1; and calculates maximum sound levels for each train, as well as equivalent continuous sound levels. The method has been further refined for the Proposed Scheme to allow for aerodynamic sound sources at speeds over 300 kph.

14.3.21 The Calculation of Road Traffic Noise (CRTN) 1988[138] will be used to predict the airborne sound from road traffic with the spatial scope [see section 15 (Traffic and Transport)].

[132] HM Government, 1996, *The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996*, The Stationery Office; and HM Government, 1998, *The Noise Insulation (Amendment) Regulations 1988*, The Stationery Office
[133] HM Government, 1972, *European Communities Act 1972*, The Stationery Office
[134] These are the transposition in to English legislation of the Environmental Noise Directive 2002/49/EC as amended. HM Government, 2006 (Amendment 2010), *The Environmental Noise (England) Regulations 2006*, The Stationery Office
[135] Department for Transport (DfT), 2011, *Transport Analysis Guidance (TAG), Unit 3.3.2 The Noise Sub-Objective*, DfT
[136] Greater London Authority (GLA), 2004, *Sounder City, The Mayor of London's Ambient Noise Strategy*, GLA
[137] Williams P, R et al., 1991, *Validation of the AEL Methodology for the Calculation of Train Noise*, Proceedings of the POLMET Conference 1991
[138] Department of Transport (Welsh Office), 1988, *Calculation of Road Traffic Noise*, HMSO

14.3.22 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[139]). Plant is generally not finalised until the detailed design phase. As such, where insufficient information is available on plant to be used, limits will be set based on baseline sound data.

14.3.23 The number and location of properties estimated to qualify under the Noise Insulation Regulations will be reported.

Impact criteria - direct impacts

Airborne sound – construction

14.3.24 The construction sound assessment categories for the Proposed Scheme are presented in Table 32. These are based upon the experience from other major infrastructure projects and BS5228-1. The criteria are guided by the prevailing baseline ambient sound levels in the locale of the receptor.

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

Table 32 - 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 LpAeq,T	>70 dB LpAeq,T	>75 dB LpAeq,T
Evenings and weekends: T=1hr Weekdays 19.00–23.00, Saturdays 13.00-23.00, Sundays 07.00-23.00	>55 dB LpAeq,T	>60 dB LpAeq,T	>65 dB LpAeq,T
Night: T=1hr Every day 23.00-07.00	>45 dB LpAeq,T	>50 dB LpAeq,T	>55 dB LpAeq,T

Notes:

All sound levels are defined at the façade of the receptor

Assessment Category A: impact criteria to use when baseline ambient sound levels (rounded to the nearest 5 dB) are less than these values;
Assessment Category B: impact criteria to use when baseline ambient sound levels (rounded to the nearest 5 dB) are the same as category A values; and
Assessment Category C: impact criteria 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 Assessment 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 construction LpAeq,T sound level for the period is greater than the ambient noise level.

Airborne sound – operational train movements

14.3.25 The magnitude of an impact arising from a change in sound level due to the Proposed Scheme (road or rail, temporary or permanent, direct or indirect sources) will be quantified using the semantic scale in Table 33.

Table 33: Airborne sound from operational train movements - impact criteria[140]

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

14.3.26 For residential receptors, direct long term operational sound impacts (positive and negative) will be identified where at the façade of the receptor the Proposed Scheme causes:

- A change in the day or night equivalent continuous sound level as defined in Table 33; or
- A maximum sound level (L_{pAFmax}) of 85 dB or greater; and
- Absolute sound levels that are above the values of 50 dB $L_{pAeq,16hr}$ during the daytime or 40 dB $L_{pAeq,8hr}$ at night.

Airborne sound – operational static sources

14.3.27 Static sources include a range of permanent works associated with the Proposed Scheme, such as fixed plant at stations and depots, line side equipment, tunnel ventilation shafts, tunnel pressure relief shafts.

14.3.28 Sound from static sources will be evaluated by comparing the rating level against background levels following the principles set out in BS4142.[141] 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.

14.3.29 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 34.

[140] Based on the Highways Agency, 2011, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 7 Noise and Vibration document HD213/11*

[141] British Standards Institute (BSi), 1997, BS4142 *Method for rating industrial noise affecting mixed residential and industrial areas,* BSi

Table 34 - 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

14.3.30 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 a potential significant effect unless the area being considered is currently exposed to high levels of sound (refer to paragraph 14.3.31), in which case, a change of 1 dB or greater may be taken as an indicator of potential significance.

Significance Criteria - residential receptors

14.3.31 For residential receptors, significant effects will be determined for any source from the Proposed Scheme by taking account of the following factors:

- Type of effect being considered;
- The number and grouping of receptors subject to impacts[142];
- The magnitude of the impacts and available dose-response information;
- The existing sound environment in terms of the absolute level [143] and the character of the existing soundscape;
- Any unique features of the Proposed Scheme's sound or impacts in the area being considered (which may require secondary acoustic indicators / criteria);
- 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.

[142] Evaluated using the impact criteria set out earlier in this section.

[143] *As one example*: for operational rail sound, greater weight will be given to a sound level change between 1 dB and 3 dB if the area is already exposed to high levels of noise. High levels of noise exposure will be evaluated having regard to the criteria contained in the *Noise Insulation (Railway and Other Guided Transport Systems) Regulations 1996*, and the Noise Action Plans in England (Defra 2012) for 'First Priority Locations' and 'Important Areas'.

Significance Criteria - non-residential receptors and land uses

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

- The type of effect being considered;
- 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, effected;
- The magnitude of the forecast impact;
- The potential combined impacts of sound and vibration;
- Any unique features of the Proposed Scheme's sound or impacts in the area being considered (which may require secondary acoustic indicators / criteria);
- 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

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

- The type of effect being considered;
- The criteria set out in the Noise Action Plans in England for 'Quiet Areas'[144];
- Tranquillity indicators (for land use) - refer also to Section 12 (Landscape and Visual Assessment) of this Report;
- Any unique features of the Proposed Scheme's sound or impacts in the area being considered (which may require secondary acoustic indicators / criteria);
- The duration over which temporary construction impacts may occur; and
- The effectiveness of mitigation through design or other means.

Cumulative Effects

14.3.34 Community, ecological or heritage effects arising from impacts and effects identified for airborne sound will be considered and reported in the relevant chapter of the ES.

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

[144] Department for Environment, Food and Rural Affairs (Defra); Environmental Noise; Noise Action Plans; http://www.defra.gov.uk/environment/quality/noise/environmental-noise/action-plans/

14.3.36 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 2.4 (Cumulative effects) of this Report. The results of these assessments will be used to qualitatively assess potentially significant cumulative 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

14.3.37 Assumptions, relevant to scope and methodology, for the airborne sound assessment include:

- Design assumptions (e.g. train specification, revenue service speeds and timetables);
- Maintenance specifications; and
- Sound emission limits as set by the Technical Specification for Interoperability as amended.[145] [146]

[145] 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

[146] 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

15 Traffic and transport

15.1 Introduction

15.1.1 The traffic and transport assessment will present an assessment of the impacts on pedestrians, cyclists, equestrians, mobility impaired people, highways, public transport, stations and interchanges and depots. It will cover the impacts that are likely to occur during both the construction and operational periods of the Proposed Scheme.

15.1.2 The Proposed Scheme is a transport project and therefore by its very nature will affect existing transport networks. A transport assessment including transport modelling is being undertaken which will inform the traffic and transport chapter of the ES. The development of the transport model may result in refinements to the proposed scope and criteria described in this section of the Report.

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/closures/diversions/widening/alterations (including stopping and passing places)/junction improvements/diversion of rights of way;
- Changed access to properties and places of work;
- 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, parking, taxi parking/ operation, and delivery and servicing;
- Changes to bus routes and stop locations; and
- Changed journey times and distances, and changes in amenity and ambience, for vulnerable road users and waterway users.

15.2 Establishment of baseline and definition of survey

15.2.1 Traffic data, traffic surveys and modelling will be undertaken to inform the transport models along the route of the Proposed Scheme. These transport models will also be used to provide information to determine the baseline for the traffic and transport assessment within the ES.

15.2.2 The future baseline will include consideration of the growth in travel demand, including the changes arising from other 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 2011 scheme as part of the AoS include:

- Whether the highway and public transport networks around the stations and interchanges could cope with the additional demands that would be placed upon them;
- The need to minimise potential disruption and disturbance during the construction of the Proposed Scheme, including tunnels and viaducts;
- Concern that footpaths and rights of way would become inaccessible or be closed, and that some waterways would be negatively affected; and
- 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.

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:

- DfT;
- Highways Agency;
- Network Rail;
- Transport for London;
- Centro;
- Metropolitan, county, district and parish councils;
- London boroughs;
- Local enterprise partnerships;
- Rail Passengers Council;
- Disabled Persons Transport Advisory Committee;
- Office of Rail Regulator; and
- Emergency Services.

15.4 Key aspects of the Proposed 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/interchanges at Birmingham Curzon street, Birmingham International interchange, Old Oak Common and Euston stations;
- Stabling, infrastructure maintenance and rolling stock depots;
- Interfaces with other public transport and highway networks including changes to existing, new and improved infrastructure and services;
- Rights of way and users (pedestrians, cyclists etc.); and

- All construction including tunnelling, tunnel portals and vent shafts, lorry routes and points of access, haul routes and construction sites.

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 and operational impacts being assessed.

Spatial scope – construction

15.5.2 The assessment will focus on traffic and transport issues resulting from land taken for worksites, the presence of construction heavy goods vehicles (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) effected 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 effected 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 – operation

15.5.3 The spatial scope will include the transport routes where there is a significant change in the usage either through people accessing the Proposed Scheme, 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 effected 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 effected by the Proposed Scheme.

Temporal Scope

15.5.5 Potential effects of the Proposed Scheme will be considered for the following:

- Construction Period (2017-2026): impacts arising from construction;
- Year 1 operation (2026): impacts associated with operation;
- Year 15 operation (2041): assumed to reflect the full technical capacity and operation of HS2 as a whole (i.e. 18 trains per hour per direction in the peaks); and
- 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 traffic and 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 the 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 traffic and transport assessments should be undertaken the following guidance documents are relevant:

- DfT's Guidance on Transport Assessment[147]; and
- TfL's Guidance Document: Transport Assessments Best Practice[148].

[147] Department for Transport (DfT), 2007, *Guidance on Transport Assessment*, DfT
[148] Transport for London (TfL), 2010, *Transport Assessment Best Practice: Guidance Document*, TfL

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. Some of the significance criteria may be further refined in the development of the traffic and transport assessment.

15.6.6 The criteria have been based on information included in the guidance documents referred to in paragraph 15.6.4, in the following documents, and using professional judgement:

- DMRB Volume 11: Environmental Assessment (1993 and updates);
- DfT's WebTAG;
- Guidelines for the Environmental Assessment of Road Traffic[149]; and
- Guidelines for Traffic Impact Assessment[150].

Public transport delay

15.6.7 A significant impact on journeys by bus, heavy and light rail, and the London Underground effected by the Proposed Scheme will be identified from the traffic and transport assessment and the transport modelling results; and is defined as any of the following where this lasts for more than four consecutive weeks in any 12 month period:

- Changes of more than 10% in a majority of journey times by rail or the Underground;
- Changes in journey distance by bus of more than 400m in urban areas and 1km in rural areas;
- A relevant delay, disruption or overcrowding impact affecting the public transport network over a wide area; and
- A relevant change to service frequency, capacity, loss of through connections or reduction in hours of operation.

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 consecutive 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 'park-and-ride' facilities or operations (e.g. dropping off areas).

[149] Institute of Environmental Assessment (IEA), 1993, *Guidelines for the Environmental Assessment of Road Traffic*, IEA
[150] Institution of Highways and Transportation, 1994, *Guidelines for Traffic Impact Assessment*, Institution of Highways and Transportation

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:

- A 30% increase in traffic flows (i.e. HGVs or all vehicles)[151], where the increase is greater than 40 vehicles per day in urban areas or 10 vehicles per day in rural areas;
- A diversion for more than four consecutive 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; and
- Where a significant change in delay relating to junction congestion resulting from the construction of the Proposed Scheme is forecast in the traffic and transport assessment and the outputs from the traffic modelling. The junctions for consideration will be discussed with the local Highways Authority, based on the increase in the level of congestion at the relevant location. This will be measured either as the forecast ratio of flow to capacity or degree of saturation.

Parking and loading

15.6.10 A significant impact arising from the Proposed Scheme on parking and loading, where facilities are identified to be heavily used, is defined as a change for more than four consecutive weeks in any 12 month period of:

- A predicted increase of 10 or more, or 10%, whichever is the greater, in on-street parking demand in the vicinity of a station/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 ten or more, or 10%, whichever is the greater, private off-street car parking spaces;
- A loss of ten or more, or 10%, whichever is the greater, off-street station car parking spaces;
- A loss of ten or more, or 10%, whichever is the greater, pedal or motorcycle parking spaces; and
- A loss of 10% or more designated loading bay spaces or facilities.

Vulnerable road user delay, amenity and ambience

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.[152] The following information will be addressed:

- Numbers of pedestrians, cyclists equestrians and others; and

[151] Based on Institute of Environmental Assessment (IEA), 1993, *Guidelines for the Environmental Assessment of Road Traffic*, IEA

[152] Based on Department for Transport (DfT), 2003, Transport Analysis Guidance (TAG), *Impacts on Pedestrians, Cyclists and Others: WebTAG Unit 3.5.5*, DfT

- 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 1,000) and major (greater than 1,000). The significance of the impacts are based on the matrix shown in Table 35, 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 35) will be reported as significant.

Table 35 - Significance levels for travellers affected by delay during construction[153]

	Number of Travellers Effected		
Journey Time Changes	**Minor**	**Moderate**	**Major**
Minor	Neutral	Neutral	Minor
Moderate	Neutral	Minor	Moderate
Major	Minor	Moderate	Major - significant

15.6.13 WebTAG Unit 3.3.13's The Journey Ambience Sub-Objective document [154], describes the assessment of ambience, which includes traveller's amenity. Traveller's journey ambience can be affected by:

- Traveller care;
- Travellers' views; and
- Traveller stress.

15.6.14 Traveller care for pedestrians, cyclists, equestrians and others will be assessed through the provision and design of dedicated facilities (e.g. footpaths, cycle lanes and crossings, information), as well as their cleanliness and environment.

15.6.15 The extent to which travellers can see the landscape or townscape view will vary with the relative height of the Proposed Scheme and the surrounding ground, vegetation, buildings and structures. Views can be categorised as providing:

- No view - where the route is in a deep cutting, a tunnel or surrounded by environmental barriers;
- Restricted view - where there are frequent cuttings, tunnels or barriers;
- Intermittent view - where there are shallow cuttings or barriers; and
- Open view - where the view extends over many miles.

[153] Source: Department for Transport (DfT), 2003, Transport Analysis Guidance (TAG), *Impacts on Pedestrians, Cyclists and Others: WebTAG Unit 3.5.5*, DfT

[154] Department for Transport (DfT), 2003, Transport Analysis Guidance (TAG), *The Journey Ambience Sub-Objective: WebTAG Unit 3.3.13*, DfT

15.6.16 Traveller stress is the adverse mental and physiological effects experienced by travellers. Three main factors influence traveller stress:

- Frustration;
- Fear of potential accidents; and
- Route uncertainty.

15.6.17 Taken together, these can lead to feelings of discomfort, annoyance, frustration or fear culminating in physical and emotional tension that detracts from the quality and safety of a journey.

15.6.18 Assessments will be made of the traveller care, travellers' views and traveller stress ambience factors using the pro-forma in Table 36. These assessments will consider the impact of the Proposed Scheme on each of these sub-factors using a simple three point scale (i.e. better, neutral or worse than existing ambience).

Table 36 - Environment: journey ambience

Factor	Sub-factor	Better	Neutral	Worse
Traveller Care	Cleanliness			
	Facilities			
	Information			
	Environment			
Travellers' Views	-			
Traveller Stress	Frustration			
	Fear of potential accidents			
	Route uncertainty			

15.6.19 An overall impact score for the quality of a journey will be determined using the following guidelines:

- The overall assessment is likely to be neutral if the assessment is neutral for all or most of the sub-factors, or improvements on some sub-factors are generally balanced by deterioration on others;

- If the change in impact across the sub-factors is, on balance, for the better, the assessment is likely to be beneficial, and, conversely, it is likely to be adverse if there is an overall change for the worse;
- The overall assessment is likely to be minor (beneficial or adverse) where the numbers of travellers affected is low (less than 200 a day);
- The overall assessment is likely to be major (beneficial or adverse) where the numbers of travellers affected is high (more than 1,000); and
- The overall assessment is likely to be moderate (beneficial or adverse) in all other cases.

15.6.20 The methodology, set out above will be applied to the Proposed Scheme on a locational basis where ambience issues for pedestrian, cyclists, equestrians and others are considered likely to be of concern. In addition, it is likely that more general conclusions in relation to more aggregated areas will also be reached.

Accidents and safety

15.6.21 Significant impacts on accidents and safety risks will be defined for links and junctions as follows:

- 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 consecutive weeks in any 12 month period.

Severance

15.6.22 Severance can affect travellers using non-motorised modes, especially pedestrians. Where reasonable, practically and economically, public footpaths and routes will 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[155] will be classified according to the following four broad levels: no impact, minor, moderate and major.

15.6.23 To ensure a consistent approach, the classification and assessment will be based only on pedestrian movements. The proposed categories of effect are discussed below.

15.6.24 *Minor*: In general the current journey pattern is likely to be maintained, but there may be some hindrance to movement for example:

- Pedestrians at-grade crossing of a new road carrying less than 8,000 vehicles per day (annual average daily traffic - AADT); or

[155] Based on Department for Transport (DfT), 2011, Transport Analysis Guidance (TAG), *The Severance Sub-Objective: WebTAG Unit 3.6.2*, DfT; and the Highways Agency, 1993, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 8 Pedestrians, Cyclists, Equestrians and Community Effects*, The Stationery Office

- A new bridge which will need to be climbed or a sub-way traversed; and/or
- Journey lengths being increased by up to 100-250m (less than 100m increase in journey length is considered to be of no impact).

15.6.25 *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
- Pedestrians at-grade crossing of a new road accommodating between 8,000-16,000 vehicles per day (AADT) in the opening year; and/or
- Journeys lengths being increased by 250 - 500m.

15.6.26 *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:

- Pedestrians 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'.

15.6.27 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 and 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 effected 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 effects a moderate or high number of people or the total numbers of people effected 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 people are affected.

15.6.28 Table 37 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 37 will be reported as significant.

Table 37 - Assessment of Change in Severance Scoring[156]

	Severance scoring 'with the Proposed Scheme'			
Severance scoring 'without the Proposed Scheme'	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

Waterways

15.6.29 British Waterways' document Third Party Works' Procedures, Section 2, Code of Practice [157] (Sections 4.1 - 4.3) identifies their requirements that need to be followed in relation to works affecting the navigation or amenity of canals. In summary, these are that generally no stoppages of the canal or navigation or towpath will be allowable, except for technical reasons. Stoppages must be discussed and agreed in advance with British Waterways and all stoppages must be of minimised duration. For the purpose of the EIA, a significant stoppage is defined as occurring when an unbroken stoppage exceeding six weeks in duration is required, as this is when specific arrangements regarding the transfer of boats around the works by road may be required.

15.6.30 British Waterways also require that towing paths must remain open wherever possible. If a diversion is unavoidable, these should be localised. They may be used by the British Waterways maintenance plant and be of a standard to allow continued use by existing visitors – walkers, anglers, people with disabilities, cyclists etc. Only as an unusual event would towing paths be permitted to be used for access to the temporary and permanent works for the Proposed Scheme because of conflict with visitors and the

[156] Source: Department for Transport (DfT), 2011, Transport Analysis Guidance (TAG), *The Severance Sub-Objective: WebTAG Unit 3.6.2*, DfT

[157] British Waterways, 2012, *Third Party Work's Procedures Section 2 Code of Practice*, British Waterways

unsuitability of the towing path for vehicular use. Impacts on pedestrians, cyclists, mobility impaired persons and equestrians using the towing paths will be assessed in relation to the vulnerable road user and ambience heading and associated criteria.

Significance criteria for operational assessment

15.6.31 The criteria outlined below will be used to assess the significance of traffic and transport impacts during the operational phase of the Proposed Scheme.

Public transport delay

15.6.32 Significant permanent impacts on journeys by bus, heavy and light rail, and the Underground effected by the Proposed Scheme will be identified from the traffic and transport assessment and the transport 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

15.6.33 Impacts that may be caused by additional passengers of the Proposed Scheme arriving and departing at the stations/interchanges will be assessed using modelling information, taking account of:

- Forecast numbers of additional passengers using the Proposed Scheme;
- Local transport conditions at each location;
- Resulting increases in congestion levels arising from increased usage or changed journey patterns arising from the arrival and departure, by all available modes, of passengers using the Proposed Scheme ; and
- Any loss of physical linkage for the next stage of the journey.

15.6.34 The results from the traffic and 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

15.6.35 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:

- A 10% increase in peak hour two-way traffic flows[158];
- Increases in traffic flows that cause the design capacity to become exceeded, on links that would not otherwise be congested;
- A 30% increase in the average off-peak hour two-way traffic flows;
- A permanent diversion that results in an increase in journey length of more 1km; and

[158] Based on Institute of Environmental Assessment (IEA), 1993, *Guidelines for the Environmental Assessment of Road Traffic*, IEA

- Where a significant change in delay relating to junction congestion resulting from the operation of the Proposed Scheme is forecast in the traffic and transport assessment and the outputs from the traffic modelling. The junctions for consideration will be discussed with the local Highways Authority, based on the increase in the level of congestion at the location. This will be measured either as the forecast ratio of flow to capacity or degree of saturation.

Vulnerable road user delay, amenity and ambience

15.6.36 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

Parking and loading

15.6.37 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

Severance

15.6.38 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

Waterways

15.6.39 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

Accidents and safety

15.6.40 The assessment criteria for the operational phase of the Proposed Scheme will be the same as that described previously for the construction phase.

15.7 Assumptions

15.7.1 The following assumptions are relevant to the traffic and transport assessment:

- Operational patterns and capacities of the Proposed Scheme and Phase 2;
- Number of train services associated with the Proposed Scheme and Phase 2;
- Change in operational patterns and stations serviced by other operators; and
- Construction impacts of the Proposed Scheme.

15.7.2 The modelling for the traffic and 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 and 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 of the Report describes the scope and methodology that will be used to assess the likely significant environmental impacts and effects associated with the generation of solid waste during the construction and operational phases of the Proposed Scheme.

16.1.2 Liquid waste such as wastewater from dewatering operations and sewage from buildings and operation of the rolling stock is covered in Section 17 (Water Resources and Flood Risk Assessment) of this Report.

16.1.3 The consideration of material resources in the context of this Report comprises maximising the beneficial re-use of materials arising from the construction of the Proposed Scheme (e.g. excavated materials). Only if materials are not required or are unsuitable for the construction of the Proposed Scheme will they become waste.

16.1.4 The likely significant environmental impacts and effects from the use of materials (e.g. aggregate, concrete, brick and steel) for the construction of the Proposed Scheme will not be addressed in the EIA.

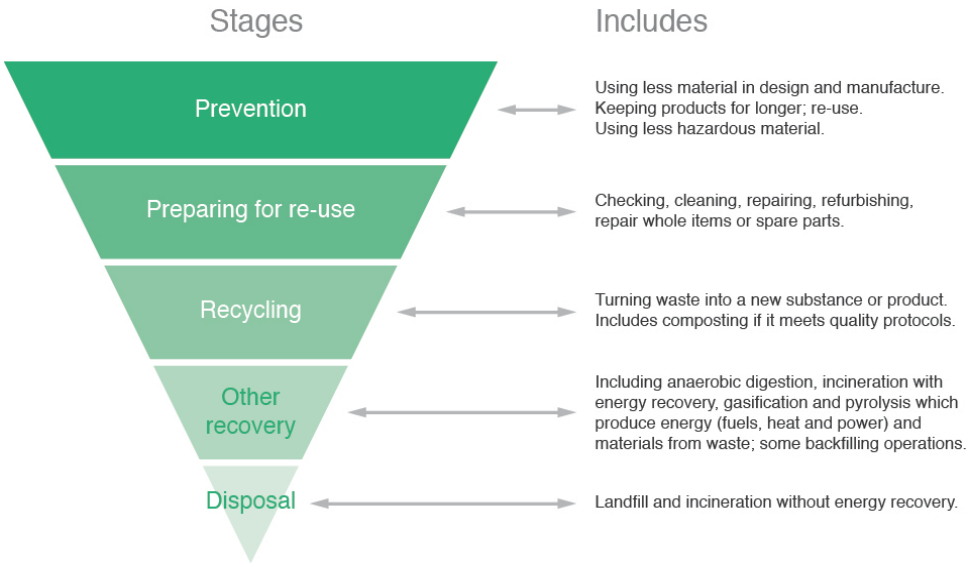
16.1.5 Safeguarding and extraction of mineral resources located along the route of the Proposed Scheme will be considered as part of the route engineering design, construction logistics as well as within Section 11 (Land Quality) of this Report.

16.1.6 The principal objective of sustainable waste and material resource 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.

16.1.7 Where waste is generated, HS2 Ltd proposes that it will be dealt with in line with the Government's waste hierarchy (see Figure 6), which is a guide to sustainable waste and material resource management, and implements the revised EU Waste Framework Directive.[159]

[159] The revised EU Waste Framework Directive (revised WFD) was adopted on 20 October 2008, signed on behalf of the European Parliament and the Council on 19 November 2008, and published in the Official Journal of the European Union on 22 November (L312/3) as Directive 2008/98/EC. The revised WFD entered in to force on 12 December 2008; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:312:0003:0030:EN:PDF

Figure 6 - The Government's Waste Hierarchy[160]



16.1.8 The waste hierarchy generally describes a priority order of what constitutes the best overall environmental option for the management of waste. It 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, GHG emissions, and nuisance effects (e.g. dust and odour emissions).

16.1.9 Types and quantities of waste for each phase of the Proposed Scheme, from initial design through to construction, operation and eventual decommissioning will be considered in the assessment.

16.2 Establishment of baseline and definition of survey

16.2.1 A description of the baseline environment for the 2011 consultation scheme is contained within the AoS [Section 7 (Sustainability baseline) in Volume 1). Section 7.6 (Sustainable consumption and production) of the AoS describes the baseline environment in relation to materials and waste.

16.2.2 A baseline will be developed for waste and material resources as part of the EIA. Baseline conditions shall be identified with respect to:

- Types, quantities and management of construction, demolition and excavation waste 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

[160] Department for Environment, Food and Rural Affairs (Defra), 2011, *Government Review of Waste Policy in England 2011*, Defra

- Availability (types and capacity) of existing and planned waste infrastructure for managing construction, demolition and excavation waste 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.[161] Waste planning authorities are usually constituted at a county or unitary authority (e.g. most cities and larger towns) level.

Local and regional baseline - waste arisings

16.2.4 Data on construction, demolition and excavation waste arisings for the route 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 and other public sources.

16.2.5 Data on commercial and industrial waste generated for the route of the Proposed Scheme will be identified as part of the baseline data gathering where this information exists. Sources of information will include:

- Operational waste data from Eurostar and Southeastern trains for HS1, where available; and
- Operational waste data for existing railway stations along the route of the Proposed Scheme (e.g. Euston station and Birmingham International) and rail stabling and maintenance depots operated by Network Rail, where available.

Local and regional baseline - waste management infrastructure capacity

16.2.6 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:

- Defra Waste and Recycling Statistics[162];
- Department of Energy and Climate Change Renewable Energy Statistics (RESTATS) online database[163];
- Environment Agency Waste Data and Information[164];
- 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);
- London Capital Waste Facts information[165]; and

[161] See Local Government Boundary Commission for England; www.lgbce.org.uk
[162] Department for Environment, Food and Rural Affairs (Defra); Statistics; Environment and wildlife statistics; Waste and recycling; www.defra.gov.uk/statistics/environment/waste/
[163] Department of Energy and Climate Change; Planning Database; Renewables Map; http://restats.decc.gov.uk/app/pub/map/map/
[164] Environment Agency; Planning & research; Our library; Data & statistics; Waste data and information; www.environment-agency.gov.uk/research/library/data/34169.aspx
[165] Capital Waste Facts; www.capitalwastefacts.com

- London Waste and Recycling Board, London Waste Map.[166]

16.2.7 The waste and minerals plan, together with any relevant evidence which supports it and up to date waste capacity information held by the Environment Agency, will be used to indicate where and how much landfill void space is likely to be available during the construction phase of the Proposed Scheme. If surplus materials from the Proposed Scheme arises, this information will be used to assess whether or not there is likely to be a shortfall of suitable landfill void space for the management of these materials.

16.2.8 Site visits to the existing railway stations/interchanges, infrastructure maintenance depots and landfill sites located along the route of the Proposed Scheme will also be undertaken.

16.3 Consultation

Consultation on the AoS

16.3.1 In relation to waste and material resources management, very few comments were made during the consultation on the 2011 consultation scheme. However, a number of comments were made regarding the generation of 'spoil' from the construction of the scheme, the impacts of transporting the spoil on local communities and road congestion and safety. The Environment Agency 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 2011 consultation scheme through the use of the waste hierarchy and include waste minimisation as a design aim, which was supported by the Environment Agency.

Consultation as part of the EIA process

16.3.3 Consultation will be undertaken primarily with the Environment Agency to agree the approach for re-use of excavation materials and other materials resulting from the construction of the Proposed Scheme 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 (including Waste Planning Authorities) to identify and confirm the following:

- Local and regional waste arisings used to inform the baseline and assessment of the likely significant environmental effects of waste;
- Availability of local and regional waste infrastructure to be used to inform the baseline and assessment of the likely significant environmental effects of waste; and

[166] London Waste and Recycling Board; London Waste Map; www.londonwastemap.org

- Planning, development management and waste management policies to be considered during the assessment process; and particularly with respect to defining any mitigation measures required.

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 and demolition materials from the Proposed Scheme.

16.4 Key aspects of the Proposed 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, foundations and drainage. In addition, the demolition of existing commercial and residential buildings within the line of the route of the Proposed Development will generate large quantities of demolition materials such as steel, broken concrete, timber and brick. The rebuilding of railway stations/interchanges, highways and bridges and the construction of stabling and maintenance depots will also generate construction waste.

16.4.2 Waste may 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 [Section 11 (Land Quality)].

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 surplus to the Proposed Scheme's requirements.

16.5 Scope of assessment

16.5.1 The likely significant environmental impact and 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 materials would be generated as a result of site clearance works and from the demolition of buildings and other structures currently in existence along the route of the Proposed Scheme. Natural, uncontaminated and contaminated materials are likely to be excavated or generated as a result of construction of the Proposed Scheme.

It is likely that the majority of the excavated materials will comprise natural and inert soils.

16.5.3 The assessment of contaminated soils and materials will be addressed in Section 11 (Land Quality) of this Report. The quantity and type of waste likely to be generated from contaminated land after remedial measures have been applied will be determined and the impacts and effects assessed in the EIA.

16.5.4 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 infrastructure maintenance depots. Waste would also be generated by the construction and installation of 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.

16.5.5 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.[167] This is in accordance with Article 2 of the revised EU Waste Framework Directive and will reflect incorporated mitigation measures that have been considered during the design phase to prevent waste. It is also assumed that such materials will meet the requirements of The Definition of Waste: Development Industry Code of Practice.[168] This industry Code of Practice has been developed to enable the transfer or re-use of clean naturally derived soil materials, and provides a framework for proactively managing contaminated materials on the sites of production. As stated in Section 16.3 (Consultation), consultation will be undertaken with the Environment Agency regarding the approach for the re-use of materials resulting from the construction of the Proposed Scheme.

Operation

16.5.6 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 maintenance facilities. Waste would also be generated by passengers and staff on trains whilst these are in use along the route of the Proposed Scheme and from track maintenance works.

[167] 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*'

[168] Contaminated Land: Applications in Real Environments (CL:AIRE), 2011, *The Definition of Waste: Development Industry Code of Practice*, CL:AIRE.

16.6 Assessment methodology

16.6.1 There is no recognised methodology or waste significance criteria to assess the likely significant environmental impacts and effects of solid waste generation from either construction or operation. The proposed assessment methodology is, therefore, based on EIA practitioners' professional judgement and experience with the application of EIA to rail-related and other large scale transport infrastructure projects.

16.6.2 The assessment will consider the types and quantities of solid waste that would be generated during construction and operation, and the severity of the likely significant environmental impacts and effects that may arise from the quantity of waste requiring off-site disposal to landfill (this being a finite and least preferred waste management option). The assessment will consider waste arisings and waste infrastructure capacity at local and regional levels, alongside the route of the Proposed Scheme.

Legislation and guidance

16.6.3 The assessment will consider relevant waste management legislation, policies and guidance applicable to all buildings and infrastructure components along the route of the Proposed Scheme. This will include, but will not be limited to the legislation, policy and guidance set out within this section.

Legislation

16.6.4 The Waste Management (England and Wales) Regulations 2011[169] transpose the revised EU Waste Framework Directive into English law.

16.6.5 Site Waste Management Plans Regulations 2008 (as amended)[170] require the preparation of a site waste management plan (SWMP) for any construction project 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. It is acknowledged that these regulations are likely to be repealed through the Defra Red Tape Challenge[171]. However, HS2 Ltd will apply an integrated approach to the design of the Proposed Scheme aiming to maximise the beneficial re-use of materials where possible, and minimise the generation of waste, which will be facilitated through the implementation of the Environmental Design Aims and Code of Construction Practice for the Proposed Scheme.

[169] HM Government, 2011, *Waste (England and Wales) Regulations 2011*, The Stationery Office
[170] HM Government, 2008, *Site Waste Management Plans Regulations*, The Stationery Office
[171] Department for Environment, Food and Rural Affairs (Defra); Publications; About Defra; Red Tape Challenge – Environment Theme proposals; http://www.defra.gov.uk/publications/2012/03/19/pb13728-red-tape-environment/

Policy

16.6.6 The Government Review of Waste Policy in England 2011 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.

16.6.7 Planning Policy Statement 10: Planning for Sustainable Waste Management[172], as exempted within the NPPF, sets out Government policy on waste planning which is of relevance 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[173], which sets out strategic planning policies for the management of waste generated in Greater London and elsewhere along the route of the Proposed Scheme. 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 Relevant guidance includes The Definition of Waste: Development Industry Code of Practice and the 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. The Designing out Waste Tool for Civil Engineering Projects and Net Waste Tool).[174]

Significance criteria

16.6.10 There are no recognised significance criteria against which direct and indirect waste impacts and 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 previously applied to large-scale infrastructure projects, and takes into account:

- The net change in solid waste arisings overall as a result of the Proposed Scheme;
- 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 impact and effects of solid waste generation are shown in Table 38 for inert waste and Table 39 for non-hazardous waste.

[172] Communities and Local Government (CLG), 2011, *Planning Policy Statement 10: Planning for Sustainable Waste Management*, The Stationery Office
[173] Greater London Authority (GLA), 2011, *The London Plan: Spatial Development Strategy for Greater London*, GLA
[174] WRAP; http://www.wrap.org.uk/content/designing-out-waste-tool-civil-engineering; and http://www.wrap.org.uk/content/net-waste-tool-0

Table 38 - Waste significance criteria for inert waste

Degree of Significance	Waste Criteria
Major adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme 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 future baseline without the Proposed Scheme 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 future baseline without the Proposed Scheme 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 future baseline without the Proposed Scheme 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 future baseline without the Proposed Scheme resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of waste treatment and disposal infrastructure

Table 39 - Waste significance criteria for non-hazardous waste

Degree of Significance	Waste Criteria
Major adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme 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.[175] 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 decision-making
Moderate adverse	Net increase in waste arisings relative to the future baseline without the Proposed Scheme 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[176] 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 future baseline without the Proposed Scheme 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 future baseline without the Proposed Scheme 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 future baseline without the Proposed Scheme resulting in an environmental improvement. Positive effect on waste arisings overall and available capacity of waste treatment and disposal infrastructure

[175] Waste throughput capacity based on large-scale waste infrastructure project experience

[176] The waste throughput capacity of greater than 50,000 tonnes per annum has been selected with reference to the Department for Communities and Local Government (DCLG), 1999, *Circular 02/99: Environmental Impact Assessment*, DCLG; which states in Annex A: Indicative Thresholds and Criteria for Identification of Schedule 2 Development Requiring EIA, under 'Installation for the disposal of non-hazardous waste' at A36: "*…EIA is more likely to be required where new capacity is created to hold more than 50,000 tonnes per year…*"

Construction effects

16.6.11 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 the Proposed Scheme. Quantification will be on the basis of survey information, using published waste generation rates or forecasting tools such as the WRAP Net Waste Tool.

16.6.12 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 materials, excavated materials and construction materials 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

16.6.13 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. This forecast will be based on an assumption of maximum capacity of the Proposed Scheme as described in Section 2.2 (Scope of the assessment) and any impacts will be assumed to be annual. Quantification may be on the basis of existing operational waste management performance data (e.g. for stations/interchanges) or using published operational waste generation rates for the relevant land-use activities.

16.6.14 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

16.6.15 The construction of the Proposed Scheme will generate economic stimulus for development along the route, and particularly at the proposed railway stations/interchanges. In combination with developments that are already taking place or anticipated along the route of the Proposed Scheme, will result in increased pressure on material resources and waste generation.

16.6.16 Cumulative effects will be assessed qualitatively (based on professional judgment) taking into account other major development proposals along the route of the Proposed Scheme.

Mitigation, enhancement and off-setting

16.6.17 Mitigation and enhancement for waste and resources management during construction and operation will be considered in line with the waste hierarchy and residual environmental effects identified.

16.7 Assumptions

16.7.1 It has been assumed that all existing land uses along the route of the Proposed Scheme would remain unchanged should the Proposed Scheme not proceed.

16.7.2 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 will be covered in Section 11 (Land Quality) of this Report. This will also include hazardous materials.

16.7.3 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 that generated during excavation, they will contain a wider range of materials such as asbestos, green waste from site clearance, concrete, brick, metals, timber, plasterboard, insulation and plastics. Following best practice for large infrastructure projects, all such activities are within the scope of the assessment of construction effects. This also applies to the generation of solid waste during operation of the Proposed Scheme.

16.7.4 Assumptions will 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 will 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.

16.7.5 Waste transferred off-site would be handled by a registered waste carrier authorised by the Environment Agency and taken to a permitted or exempt facility authorised to receive and handle that waste under Duty of Care arrangements (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 will be in accordance with the relevant environmental regulatory requirements.

16.7.6 The assessment of likely significant environmental effects associated with waste-related transport, including the interactive effects of air quality, climate, sound and noise will be addressed in Section 5 (Air Quality), Section 6 (Climate), Section 14 (Sound, Noise and Vibration) and Section 15 (Traffic and Transport) of this Report.

17 Water resources and flood risk assessment

17.1 Introduction

17.1.1 This section of the Report sets out the scope and methodology for assessing the likely significant impacts and effects of the Proposed Scheme on the water environment. This includes effects on water resources (both surface water features and groundwater), hydrology, flooding and drainage. Surface water features 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 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 usually feasible to set a baseline for the future (i.e. the time of construction or operation of the Proposed Scheme). However, where projected climate change effects predict a future trend, a future baseline condition will be identified.

17.2.2 The Proposed Scheme crosses 24 major rivers (having an upstream catchment greater than 50km^2) 88 minor rivers, 12 navigable canals and 11 lakes or reservoirs. Many of these rivers have adjacent flood plains. There is a total of 16.2km in Flood Zone 3 and 19.1km in Flood Zone 2. The Proposed Scheme also crosses lengths of aquifer, including 4.9km of Source Protection Zone (SPZ) 1 and 15.7km of SPZ2.[177]

17.2.3 Baseline conditions will be set, where appropriate, 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 30 and 1 in 200 year);
- Surface water quantity and quality and Water Framework Directive[178] (WFD) Status (both physico-chemical and hydromorphology quality elements);

[177] Environment Agency; At Home & Leisure; What's in your backyard?; http://www.environment-agency.gov.uk/homeandleisure/37793.aspx

[178] European Commission (EC), 2000, *Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy*, EC

- Surface water designations, licences/consents;
- Surface water / groundwater interaction;
- Groundwater quality and quantity (including WFD Status);
- Hydrogeology, including geology, aquifer hydraulic parameters, groundwater level and flow directions;
- Groundwater yield, licences/consents; and
- Hydro-meteorological conditions and variability arising from climate change.

Baseline Data and Sources

17.2.4 Table 40 sets out the baseline data to be collected, along with the likely source.

Table 40 - Baseline data and sources

Baseline data	Source
Flood plain extent, depth, velocity, hazard Surface water flood depths Groundwater level and flow directions Groundwater yield Aquifer extent (vertical and horizontal) and hydraulic parameters	Targeted hydraulic modelling, Information held by the Environment Agency, 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 and Surface Water Management Plans
Surface water quality Groundwater quality	Targeted water sampling and testing at accredited laboratory. Information held by the Environment Agency, River Basin Management Plans, Local Authorities, Water companies
Surface water designations	Information held by the Environment Agency and Natural England
Surface water licences/consents Groundwater licences/permits Unlicensed abstractions	Information held by the Environment Agency Information held by the Environment Agency Information held by local authorities
Hydro-meteorological data, as needed	Met Office, Environment Agency

17.3 Consultation

Consultation on the AoS

17.3.1 The following key organisations responded to the consultation on the AoS:

- Environment Agency;
- British Waterways Board;
- The Inland Waterways Association;
- Water and sewerage companies; and
- Water supply companies.

17.3.2 The Environment Agency 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 2011 consultation scheme on the hydrology of any watercourses 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, wherever practicable, by creating new floodplain nearby and by considering the risks on a catchment basis. The rate of discharge of storm runoff and water supply to canals 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 as a minimum will be consulted:

- Environment Agency;
- British Waterways Board (likely to become the Canal and River Trust in 2012);
- Natural England;
- Water and sewerage companies;
- Water supply companies;
- Internal Drainage Boards;
- Lead Local Flood Authorities;
- District Councils; and
- Land owners.

17.4 Key aspects of the Proposed 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 in any one year) and a further 19km in Flood Zone 2 (land having an annual flooding probability of between 1% and 0.1% in any one year). These lengths include 24 major crossings of rivers, 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 so, will 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 (Ecology) of this Report;
- Sections of the Proposed Scheme located above aquifers and planned to be in cutting or in tunnel may require dewatering. The Proposed Scheme has a length of 230km with approximately 36km of tunnels and 90km of cuttings. The Proposed Scheme requires cut or tunnel through principal and secondary aquifers and in areas close to licensed abstractors with protected rights (particularly 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 interchange, Curzon Street station and Old Oak Common interchange, the depots at Calvert 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 Proposed Scheme 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 where is clearly no hydraulic connectivity and 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 Exceptions to the above 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 SPZ 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);
- The route intersects the inundation area of a reservoir; and
- Other scenarios, as deemed appropriate when the route is reviewed in line with data received.

17.5.4 When considering the possible effects of the Proposed Scheme on a watercourse or aquifer, the assessment will consider the possible effects throughout the catchment of the impacted watercourse or the wider aquifer extent.

17.5.5 It is not considered that the Proposed Scheme will be affected by coastal or tidal impacts; hence 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 another assessment in the period up to 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 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 WFD; EU Groundwater Directive[179]; EU Floods Directive[180] and associated UK Flood Risk Regulations 2009[181]; EU Habitats Directive;
- Flood and Water Management Act[182]; Water Act[183] and any new provisions brought in through the current Water White Paper[184]; the Environmental Protection Act 1990; the Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009[185]; Land Drainage Act[186];
- 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 policy); and
- Environment Agency Groundwater Protection: Policy and Practice (GP3).[187]

[179] Official Journal of the European Union, 2006, *Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration*, European Commission
[180] Official Journal of the European Union, 2007, *Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks*, European Commission
[181] HM Government, 2009, *The Flood Risk Regulations*, The Stationery Office
[182] HM Government, 2010, *Flood and Water Management Act 2010*, The Stationery Office
[183] HM Government, 2003, *The Water Act 2003 (Commencement No. 11) Order 2012*, The Stationery Office
[184] HM Government, 2011, *Water for Life*, The Stationery Office
[185] HM Government, 2009, *Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009*, The Stationery Office
[186] HM Government, 1994, *Land Drainage Act 1994*, The Stationery Office
[187] Environment Agency; Planning & research; Our library; Publications and reports; Water reports; Groundwater; Management and protection; GP3 (Groundwater Protection Policy and Practice); http://www.environment-agency.gov.uk/research/library/publications/40741.aspx

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 NPPF and its Technical Guidance, and also to Environmental Permitting Regulations and amendments.[188]

Significance criteria

17.6.4 The significance of an effect is defined by the magnitude of the impact and the overall value of the receiving water body or receptor (the 'attribute') (see Table 41A and Table 41B). Table 41A, Table 41B, Table 42 and Table 43 have been adapted from the tables in the DMRB.[189]

Table 41A - Significance of effects (excluding flood risk)

Value of Receptor	Magnitude of Impact			
	Negligible	**Minor**	**Moderate**	**Major**
Very high	Neutral	Moderate / Large	Large / Very Large	Very Large -
High	Neutral	Slight / Moderate	Moderate / Large	Large / Very Large -
Moderate	Neutral	Slight	Moderate	Large
Low	Neutral	Neutral	Slight	Slight / Moderate

Table 41B - Significance of effects (flood risk)

	Magnitude of Impact			
	Negligible	**Minor**	**Moderate**	**Major**
Significance (flood risk)	Neutral	Slight	Moderate	Large / Very Large

17.6.5 Table 42 provides an indication of possible impacts and their magnitude. These may be reported as either beneficial or adverse. The list is not exhaustive and is intended as a guide.

[188] HM Government, 2012, *The Environmental Permitting (England and Wales) (Amendment) Regulations 2012*, The Stationery Office

[189] Highways Agency, 2009, *Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 10: Road Drainage and the Water Environment*, The Stationery Office

Table 42 - Magnitude of possible impacts

Magnitude	Criteria	Examples
Major	Adverse: Loss of an attribute and / or quality and integrity of an attribute Beneficial: Creation of new attribute or major improvement in quality of an attribute	Adverse: Increased flood risk to essential infrastructure, highly or more vulnerable developments; loss of a fishery; decrease in surface water ecological or chemical WFD status or groundwater qualitative or quantitative WFD status Beneficial: Creation of flood plain and decrease in flood risk; increase in productivity or size of fishery; increase in surface water ecological or chemical WFD status; increase in groundwater qualitative or quantitative WFD status.
Moderate	Adverse: Loss of part of an attribute or decrease in integrity of an attribute Beneficial: Moderate improvement in quality of an attribute	Adverse: Increased flood risk to less vulnerable developments; Partial loss of fishery; measurable decrease in surface water ecological or chemical quality or reversible change in the yield or quality of an aquifer, affecting existing users, but not changing any WFD status Beneficial: Measurable increase in surface water quality or in the yield or quality of aquifer benefiting existing users but not changing any WFD status
Minor	Adverse: Some measurable change to the integrity of an attribute Beneficial: Measurable increase, or reduced risk of negative effect to an attribute	Adverse: Increased flood risk to water-compatible development or impact which does not affect existing or any possible future developments; measurable decrease in surface water ecological or chemical quality; decrease in yield or quality of aquifer not affecting existing users or changing any WFD status Beneficial: Measurable increase in surface water ecological or chemical quality; increase in yield or quality of aquifer not affecting existing users or changing any WFD status
Negligible	No change to integrity of attribute	Negligible change to flood risk; discharges to watercourse or changes to an aquifer which lead to no change in the attribute's integrity

17.6.6 Table 43 provides an indication of the value of receiving water body or receptor. The list is not exhaustive and is intended as a guide.

Table 43 - Examples of the value of possible water bodies or receptors

Value	Criteria	Examples[190]
Very high	Nationally significant attribute of high value	SPZ 1, Flood Zone 3 with highly vulnerable development, good quality or Principal aquifer; watercourse having a WFD classification and $Q_{95} \geq 1.0\ m^3/s$
High	Locally significant attribute of high value	Poor quality or Principal aquifer; watercourse having a WFD classification and $Q_{95} < 1.0 m^3/s$. Flood Zone 3 without highly vulnerable development
Moderate	Of moderate quality and rarity	Watercourses not having a WFD classification, Secondary aquifer, Flood Zone 2

Construction effects

17.6.7 The following possible effects arising from the construction of the Proposed Scheme will be considered:

- 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 surface water or groundwater flows, during adjacent works;
- Effects on water bodies that support habitats and ecosystems;
- 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 on 'areas with critical drainage problems' (as notified by the Environment Agency to local planning authorities);
- Effects of liquid wastes on the environment;
- Effects on flood defence schemes;
- Effects on water abstractors; and

[190] Q_{95} is the flow equalled or exceeded in a water course for 95% of a recording period - typically over several years

- 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 Assessment of the effects arising from construction of the Proposed Scheme will take into account the requirements of the Code of Construction Practice.

Operational effects

17.6.9 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 and flows caused by the permanent discharge to or diversion of watercourses, and consequent effects on groundwaters;
- 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, and consequent effects on surface waters;
- Effects on water bodies that support habitats and ecosystems;
- Effects on other flood defence schemes;
- Effects on 'areas with critical drainage problems' (as notified by the Environment Agency to local planning authorities);
- Effects on water abstractors; 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.

17.6.10 When assessing the effects on the quality of surface watercourses, details of the receiving watercourse and an estimate, based on a combination of expert judgement and analysis, for the quantity of pollution that could be released during routine operations, will be used. Estimates will be conservative and assume little or no dispersion. An assessment will be made of the risk of accidental spillages and the possible effects on water quality.

17.6.11 The effects on groundwater, both in quantitative and qualitative terms, will be assessed using a suitable combination of professional judgement, analytical calculation and computational modelling. This will include the impacts of any contaminated land causing an effect on groundwater quality.

17.6.12 The assessment of flood risk will be made using the guidance in BS8533[191] and national policy.

17.6.13 Where significant adverse effects are identified on groundwater, the design will be amended where possible to mitigate the effects, for example by reducing the effect of dewatering by the use of cut off walls or by recharging water to aquifers. In some cases, groundwater sources may need to be augmented with alternative supplies or boreholes deepened, with agreement from owners. Effects on surface waters would be mitigated by the use of sustainable drainage systems. Pollution risk would be mitigated through pollution prevention measures and environmental permitting.

Cumulative effects

17.6.14 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 are examples of possible cumulative effects that may be assessed:

- Impacts from the Proposed Scheme will be assessed together with impacts from adjacent development, such as a flood defence scheme, to derive an assessment of the cumulative effects from all the schemes;
- 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), when considered together, constitute a major impact leading to a significant effect.

[191] British Standards Institute (BSi), 2011, BS8533 *Assessing and managing flood risk in development. Code of practice*, BSi

17.7 Assumptions

17.7.1 The assessment will assume that track drainage will wherever possible be kept separate from existing land drainage that crosses the route.

17.7.2 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.[192]

17.7.3 The effects on watercourses 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 and other habitats, that are dependent on surface or groundwater flows, will be included in Section 9 (Ecology) of this Report.

[192] Department for Environment, Food and Rural Affairs (Defra), 2011, *National Standards for sustainable drainage systems: Designing, constructing, operating, and maintaining drainage for surface run-off*, Defra

Part C

18 Structure of the Environmental Statement

18.1.1 Although the requirements for the contents of an ES are set out in Schedule 4 of the EIA Regulations, there is no prescribed form or structure provided. 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 accordance with the requirements of the EIA Regulations. The ES will be structured in a logical and comprehensible manner, taking account of the need for the information to be accessible, understandable and readable to a broad audience. It is intended that it will contain appropriate signposting and web-links (in the case of the electronic version) 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:

- Description of the HS2 project, the need for the project and the main alternatives studied;
- The EIA processes and the consultation that has been carried out;
- Description of the environmental baseline, environmental effects and mitigation, set out in a number of sections (anticipated to comprise 26 Community Forum Areas) along the route;
- Project-wide and cumulative effects assessment;
- Non-Technical Summary; and
- Environmental mapping, Proposed Scheme drawings, and other illustrations.

18.1.3 Further documents will be produced to meet hybrid bill requirements and to support the ES including:

- Scope and Methodology Report (this document);
- Environmental Minimum Requirements;
- Environmental Design Aims;
- Code of Construction Practice; and
- Transport Assessment.

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20 Annex A – List of Consultees

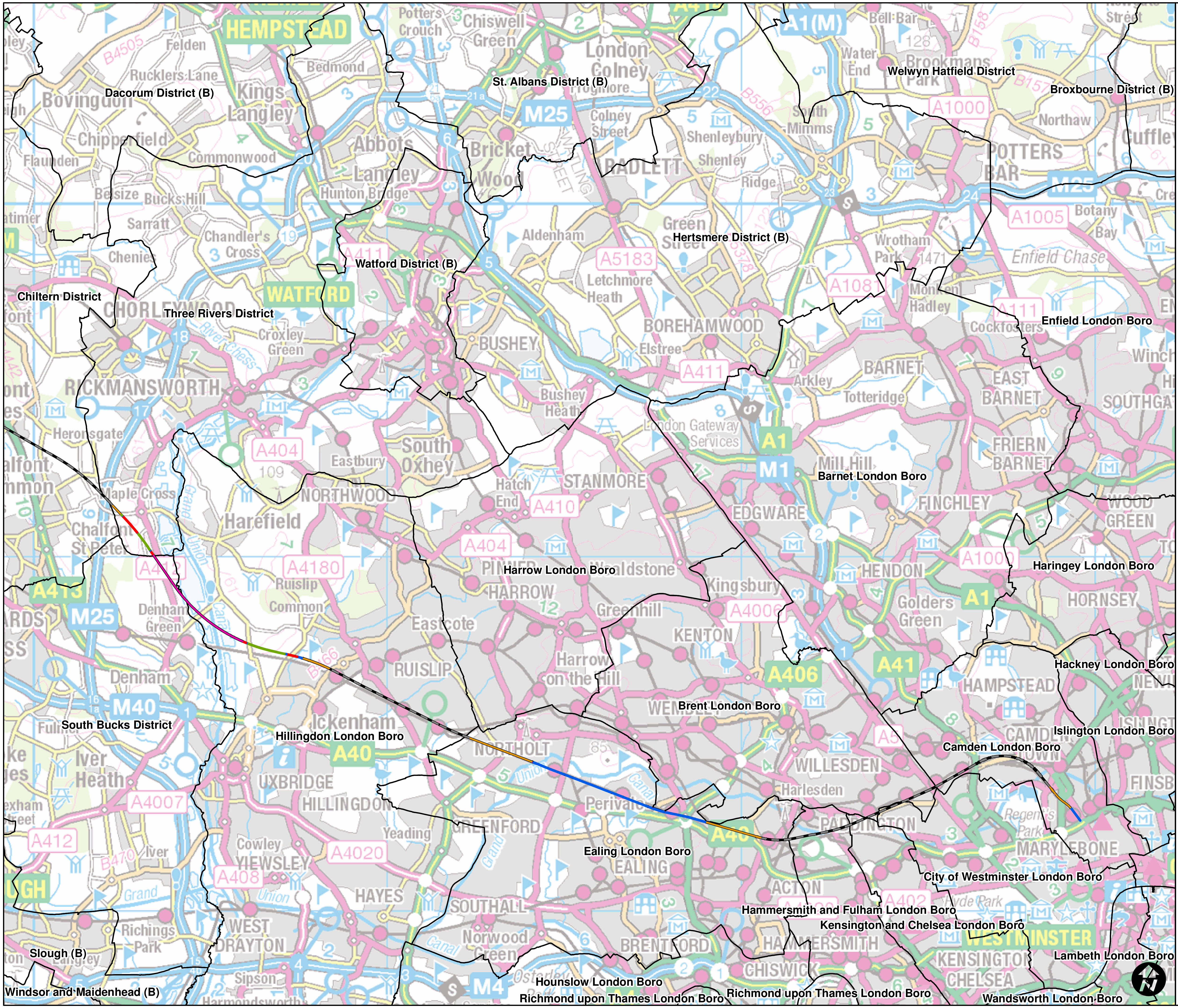
Comment has been sought from the following list of formal consultees on the content of this Scope and Methodology Report. Consultees were not limited to this list and responses received from others, were taken into account where relevant to the Scope and Methodology consultation.

Amersham Parish Council
Armitage with Handsacre Parish Council
Ashow and Stoneleigh Joint Parish Council
Aston le Walls Parish Council
Aylesbury Parish Council
Aylesbury Vale District Council
Balsall Parish Council
Barton Hartshorn Parish Council
Berkswell Parish Council
Bickenhill Parish Council
Birmingham City Council
Boddington Parish Council
Brackley Parish Council
Buckinghamshire County Council
Burton Green Parish Council
Calvert Green Parish Council
Castle Bromwich Parish Council
Centro
Chalfont St Giles Parish Council
Chalfont St Peter Parish Council
Charndon Parish Council
Chelmsley Wood Parish Council
Cherwell District Council
Chetwode Parish Council
Chiltern District Council
Chipping Warden & Edgcote Parish Council
City of Westminster
Claydon with Clattercot Parish Council
Coal Authority
Coldharbour Parish Council
Coleshill Parish Council
Cubbington Parish Council
Culworth Parish Council
Curdworth Parish Council
Denham Parish Council
Drayton Bassett Parish Council
Edgcott Parish Council
Ellesborough Parish Council

English Heritage
Finmere Parish Council
Fleet Marston Parish Council
Fordbridge Parish Council
Fradley & Streethay Parish Council
Godington Parish Council
Great Missenden Parish Council
Greater London Authority
Greatworth Parish Council
Grendon Underwood Parish Council
Hampton in Arden Parish Council
Harbury Parish Council
Hertfordshire County Council
Highways Agency
Hints Parish Council
Kenilworth Parish Council
King's Bromley Parish Council
Kingsbury Parish Council
Kingshurst Parish Council
Ladbroke Parish Council
Lea Marston Parish Council
Lichfield Parish Council
Lichfield District Council
Little Missenden Parish Council
Little Packington Parish Council
London Borough of Brent
London Borough of Camden
London Borough of Ealing
London Borough of Hammersmith and Fulham
London Borough of Hillingdon
London Borough of Islington
Long Itchington Parish Council
Marston St Lawrence Parish Council
Middleton Parish Council
Mixbury Parish Council
Natural England
Network Rail
Newton Purcell with Sherswell Parish Council
North Warwickshire District Council
Northamptonshire County Council
Offchurch Parish Council
Oxfordshire County Council
Preston Bissett Parish Council
Priors Hardwick Parish Council
Quainton Parish Council

Radbourn Parish Council
Radstone Parish Council
Royal Borough of Kensington and Chelsea
Smiths Wood Parish Council
Solihull Metropolitan Borough Council
South Buckinghamshire District Council
South Northamptonshire District Council
Southam Parish Council
Sports England
Staffordshire County Council
Steeple Claydon Parish Council
Stoke Mandeville Parish Council
Stone with Bishopstone and Hartwell Parish Council
Stoneton Parish Council
Stratford on Avon District Council
Swinfen & Packington Parish Council
The Association of National Parks Authorities
The British Waterways Board
The Environment Agency
The Lee Parish Council
Thorpe Mandeville Parish Council
Three Rivers District Council
Transport for London
Turweston Parish Council
Twyford Parish Council
Ufton Parish Council
Waddesdon Parish Council
Warwick District Council
Warwickshire County Council
Water Orton Parish Council
Weeford Parish Council
Wendover Parish Council
Westbury Parish Council
Weston under Wetherley Parish Council
Whitfield Parish Council
Whittington Parish Council
Wishaw Parish Council
Wormleighton Parish Council

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

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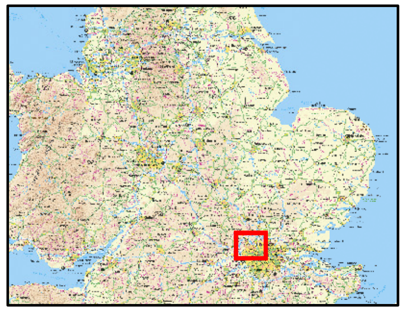
www.arup.com

Client

Job Title
High Speed 2

Key Plan



Drawing Title
HS2 Scope and Methodology Report - Proposed Scheme Route (1of6)

Scale at A3
1:100,000

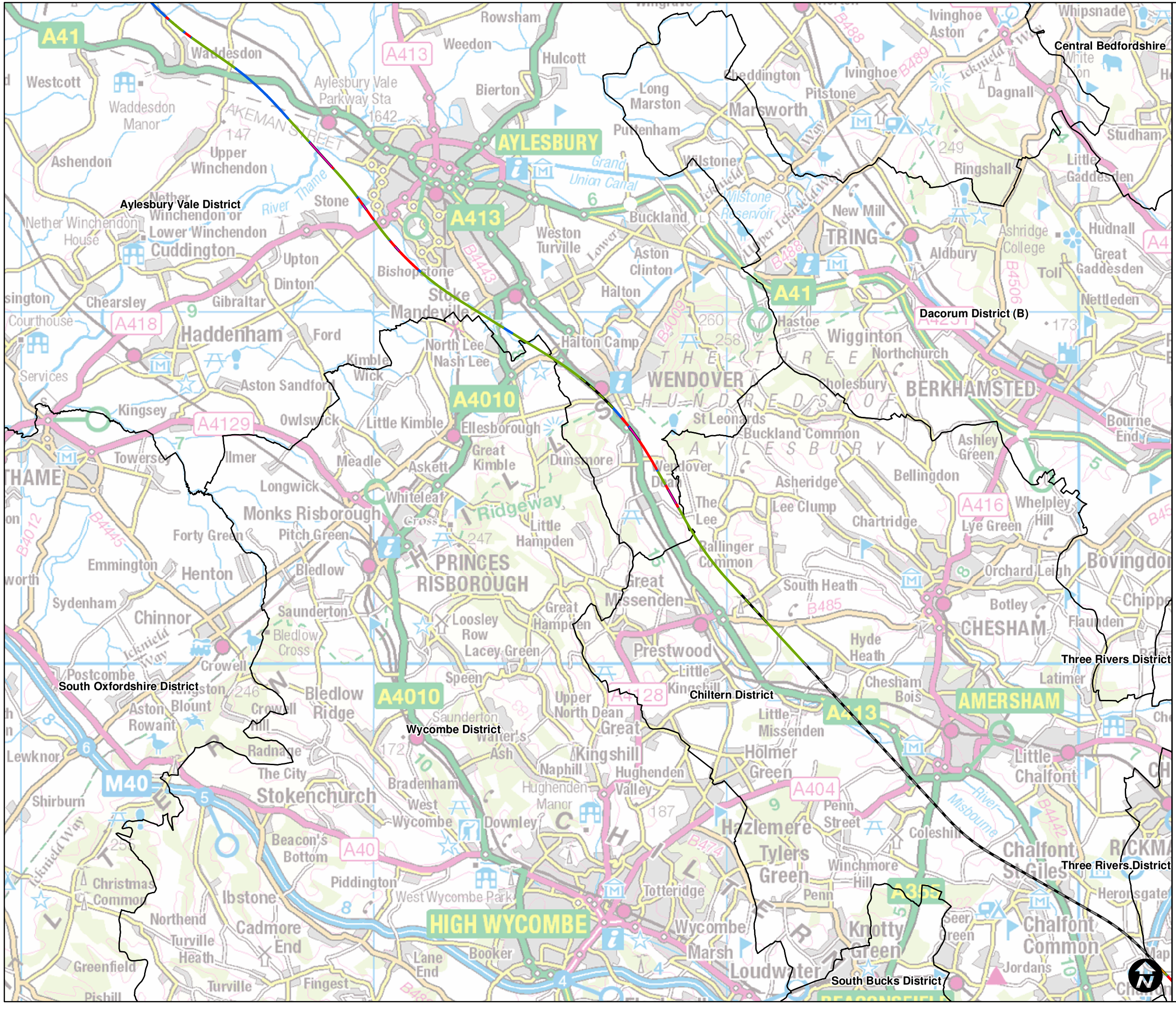
Discipline
GIS

Drawing Status
For Information

Job No
209742-00

Drawing No
C221-HS2-EV-MAP-000-000001

Issue
1



Legend

Proposed Route

- At Grade
- Cutting
- Fill
- Green Tunnel
- Retained Cutting
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- Tunnel
- Viaduct

Issue	Date	By	Chkd	Appd
1	30/03/12	DMc	PJ	CB

Kilometres

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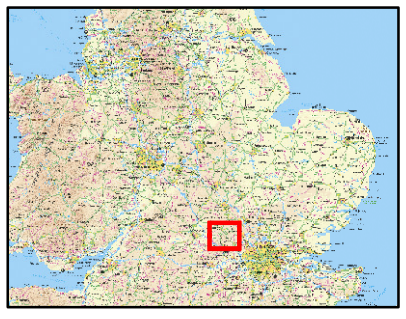
Client

hs2

Job Title

High Speed 2

Key Plan



Drawing Title

HS2 Scope and Methodology Report - Proposed Scheme Route (2of6)

Scale at A3

1:100,000

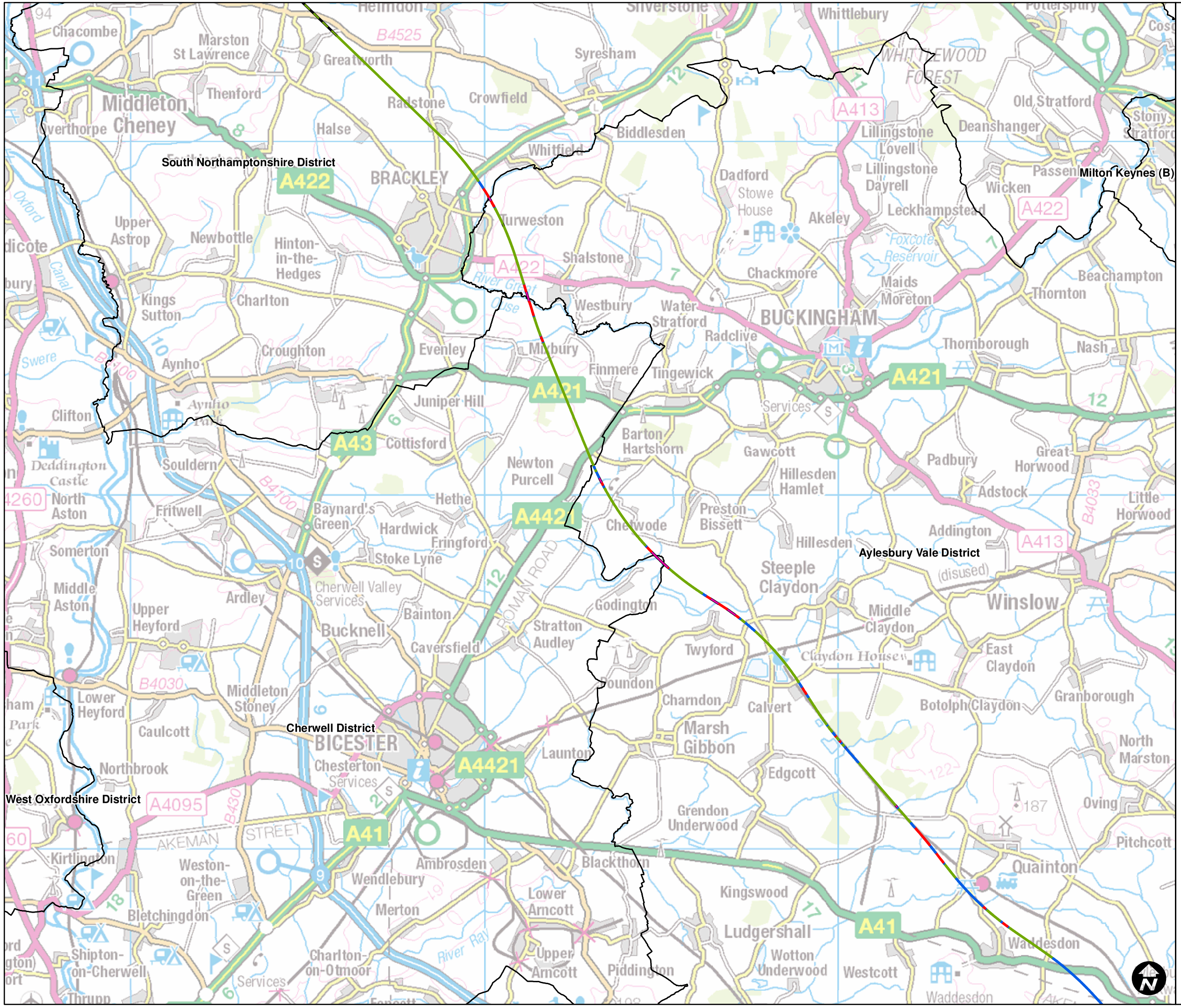
Discipline

GIS

Drawing Status	Job No	Issue
For Information	**209742-00**	**1**

Drawing No

C222-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

0 1.5 3 6

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Job Title
High Speed 2

Key Plan

Drawing Title
HS2 Scope and Methodology Report - Proposed Scheme Route (3of6)

Scale at A3
1:100,000

Discipline
GIS

Drawing Status	Job No	Issue
For Information	**209742-00**	**1**

Drawing No
C222-HS2-EV-MAP-000-000002

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

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Client

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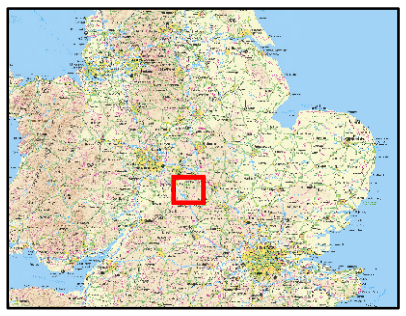
Job Title
High Speed 2

Key Plan



Drawing Title
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Scale at A3
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Discipline
GIS

Drawing Status	Job No	Issue
For Information	**209742-00**	

Drawing No
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Issue
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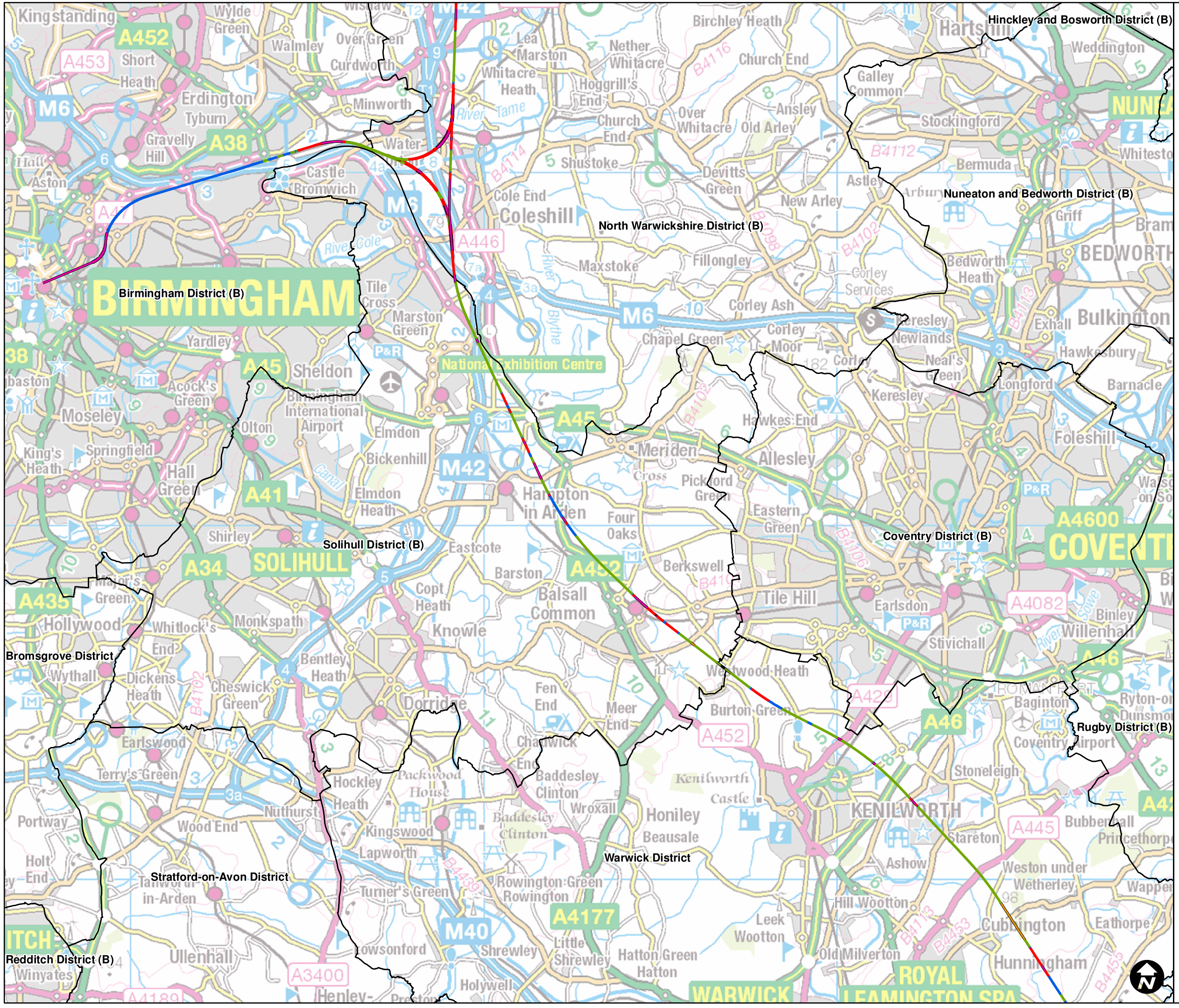

Legend

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

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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

1:100,000

Discipline

GIS

Drawing Status	Job No	Issue
For Information	**209742-00**	**1**

Drawing No

C223-HS2-EV-MAP-000-000002

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

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Client

hs2

Job Title

High Speed 2

Key Plan

Drawing Title

HS2 Scope and Methodology Report - Proposed Scheme Route (6of6)

Scale at A3

1:100,000

Discipline

GIS

Drawing Status

For Information

Job No

209742-00

Drawing No

C224-HS2-EV-MAP-000-000001

Issue

1

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 to Protect 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
EPUK	Environmental Protection UK
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
TIA	Transport Impact Assessment
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 Analysis 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 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 1,600
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
Classic Rail	The existing GB inter-city 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 results. 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
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
Inert waste	The EU Landfill Directive in Article 2(e) defines 'inert waste' as follows: Waste is considered inert if: 1) It does not undergo any significant physical, chemical or biological transformations; 2) It does not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health; and 3) Its total leachability and pollutant content and the ecotoxicity of its leachate are insignificant and, in particular, do not endanger the quality of any surface water and/or groundwater
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	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

Non-hazardous waste	The EU Landfill Directive in Article 2, paragraph (d) defines ‘non-hazardous waste’ in reference to Article 2, paragraph (c) as follows: “(d) ‘non-hazardous waste’ means waste which is not covered by paragraph (c);” Article 2 paragraph (c) states the following: “(c) ‘hazardous’ waste means any waste which is covered by Article 1(4) of Council Directive 91/689/EEC of 12 December 1991 on hazardous waste.”
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 space
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