



HIGH SPEED TWO PHASE ONE INFORMATION PAPER

A1: DEVELOPMENT OF THE HS2 PROPOSED SCHEME

This paper outlines the development of the HS2 scheme since the then Government decided to set up HS2 Ltd and explore options in January 2009.

It will be of particular interest to those potentially affected by the Government's proposals for high speed rail.

These papers were prepared in relation to the promotion of the Bill for Phase One of the scheme which is now enacted. Although the contents were maintained and updated as considered appropriate during the passage of the Bill (including shortly prior to the enactment of the Bill in February 2017) the contents are now historic and are no longer maintained. If you have any queries about this paper or about how it might apply to you, please contact the HS2 Helpdesk in the first instance.

The Helpdesk can be reached at:

**High Speed Two (HS2) Limited
Two Snowhill, Snow Hill Queensway
Birmingham, B4 6GA**

by email: HS2enquiries@hs2.org.uk or by phone: 08081 434 434 (lines are open 24 hours)

A1: DEVELOPMENT OF THE HS2 PROPOSED SCHEME

1. Introduction

- 1.1. High Speed Two (HS2) is the Government's proposal for a new, high speed north-south railway. The proposal is being taken forward in two phases: Phase One will connect London with Birmingham and the West Midlands and Phase Two will extend the route to Manchester, Leeds and beyond.
- 1.2. HS2 Ltd is the non-departmental public body responsible for developing and promoting these proposals. The company works to a Development Agreement made with the Secretary of State for Transport.
- 1.3. In November 2013, HS2 Ltd deposited a hybrid Bill¹ with Parliament to seek powers for the construction and operation of Phase One of HS2 (sometimes referred to as 'the Proposed Scheme'). The Bill is the culmination of nearly six years of work, including an Environmental Impact Assessment (EIA), the results of which were reported in an Environmental Statement (ES) submitted alongside the Bill. The Secretary of State has also published draft Environmental Minimum Requirements (EMRs), which set out the environmental and sustainability commitments that will be observed in the construction of the Proposed Scheme.
- 1.4. The Bill is being promoted through Parliament by the Secretary of State for Transport (the 'Promoter'). The Secretary of State will also appoint a body responsible for delivering the Proposed Scheme under the powers granted by the Bill.
- 1.5. This body is known as the 'nominated undertaker'. There may well be more than one nominated undertaker – for example, HS2 Ltd could become the nominated undertaker for the main railway works, while Network Rail could become the nominated undertaker for works to an existing station such as Euston. But whoever they are, all nominated undertakers will be bound by the obligations contained in the Bill and the policies established in the EMRs.
- 1.6. These information papers have been produced to explain the commitments made in the Bill and the EMRs and how they will be applied to the design and construction of the Proposed Scheme. They also provide information about the Proposed Scheme itself, the powers contained in the Bill and how particular decisions about the project have been reached.

¹The High Speed Rail (London – West Midlands) Bill, hereafter 'the Bill'.

2. Evolution of the Proposed Scheme

2.1. This Information Paper describes how the Proposed Scheme was conceived, developed and refined since the then Government decided to prepare proposals for HS2 in 2009. It describes the development of the scheme as originally proposed in the Bill deposited in November 2013; for an explanation of the main changes made to the scheme and Bill proposals since then please see HS2 Information Paper B10: High Speed Rail as amended in the House of Commons Select Committee.

2.2. The key milestones in the evolution of the project are as follows²:

- January 2009: HS2 Ltd is founded. The company has a remit to provide advice to Government on options for a rail route from London to the West Midlands, stations and links to High Speed One³ and the existing rail network. HS2 Ltd was also asked to examine the potential for extensions to Greater Manchester, West Yorkshire, the North East and Scotland;
- March 2010: the Command Paper 'High Speed Rail'⁴ is published. Having considered HS2 Ltd's analysis and recommendations the Government published an initial preferred route and its assessment of the options in the Command Paper. It set out a strategy to link London to Manchester and Leeds via Birmingham. It emphasised that no decisions would be taken until after the public had been formally consulted;
- December 2010: Following the General Election in May 2010, the new Government confirmed the initial preferred route, with some refinement and strategy, including delivery in two phases;
- February-July 2011: a formal public consultation on the Government's proposals takes place;
- January 2012: the Government responds to the consultation results. Refined proposals are published in 'High Speed Rail: Investing in Britain's Future - Decisions and Next Steps'⁵, together with the post-consultation route for Phase One;
- January 2013: the Command Paper 'High Speed Rail, Investing in Britain's Future – Phase Two: The route to Leeds, Manchester and beyond' is

² For a chronological summary of the options considered for each element of the Proposed Scheme and the reasons for the choice, see HS2 London-West Midlands Environmental Statement, Volume 5 Alternatives Report (CT-002-000), HS2 Ltd. November 2013, which also includes references to the source documents.

³ The railway between St Pancras in London and the Channel Tunnel. It connects with the international high speed routes between London and Paris, and London and Brussels.

⁴ High Speed Rail, DfT, March 2010 (Cm.7827)

⁵ High Speed Rail: Investing in Britain's Future – Decisions and Next Steps (Cm.8247), DfT, January 2012

published. It set out the Government's initial preferred route with station and depot options for Phase Two of the network;

- May-July 2013: following more detailed work on scheme design and economic appraisal, the public were consulted on further refinements to the proposals and a draft of the Environmental Statement, which included construction arrangements and mitigation proposals;
- July 2013-January 2014: a formal public consultation on the Government's proposals for Phase Two takes place;
- November 2013: the High Speed Rail (Preparation) Act received Royal Assent. This granted financial powers to the Secretary of State for expenditure on preparatory work for Phase One of HS2 and all future stages of high speed rail. This includes the ability to incur expenditure on both the acquisition of, and compensation for, property required for the construction of high speed rail lines; and
- November 2013: a hybrid Bill, seeking powers for the construction and operation of the first phase of the proposed scheme, is deposited in Parliament together with the ES.
- "March 2014: The chairman of HS2 Ltd, David Higgins, publishes 'HS2 Plus', a report which reviews the status of HS2 and makes a number of proposals, including benchmarking the HS2 scheme against international comparators, and accelerating the delivery of the route between the West Midlands and Crewe to a possible new hub station at Crewe.
- October 2014: Building on 'HS2 Plus', HS2 Ltd issues a further report, 'Rebalancing Britain', which sets out the case for improving connectivity across the north of England, and concludes that, subject to further consideration of a number of issues, "the strategic proposition for Phase Two is right."
- November 2015: the Government command paper "High Speed Two: east and west, the next steps to Crewe and beyond" set out the Government's proposals to accelerate the delivery of the Phase Two route from the West Midlands to Crewe, and described the Government's thinking on the wider Phase Two route."

2.3. Between March 2010 and February 2011 (before the consultation), the initial preferred route was developed and environmental mitigation added. During this time, outstanding issues such as depot location and proposals for access to Heathrow were also determined. The scheme was reviewed again in late 2011 in the light of responses to the consultation and amendments were made to the proposals in January 2012. In 2013, more detailed design and construction proposals were developed, which led to further modifications and mitigation measures. These were published in the Design Refinement Consultation document and a draft of the ES.

- 2.4. At each stage in the development of the project the design, cost, construction and operational feasibility were examined in more detail, in parallel with the development of the economic and environmental appraisals and preparation of mitigation packages. As the work has progressed, stakeholder and community consultation has increased. In March 2012 Community Forums were set up to enable HS2 Ltd to meet and discuss issues with those affected along the proposed route. There have also been an increasing number of discussions with public and private agencies and affected property owners on topics that affect them directly. In many cases, comments received during this engagement have resulted in changes being made to the proposals.

3. Requirements, objectives and selection criteria

- 3.1. During the scheme development process, numerous options were considered. They were assessed against selection criteria derived from three sources:
- the Government's transport and economic objectives to provide for long-term demand;
 - the Treasury Green Book⁶ requirement to ensure "that public funds are spent on activities that provide the greatest benefits to society, and that they are spent in the most efficient way"; and
 - national sustainability objectives and environmental policies and requirements and local spatial considerations.

Objectives

- 3.2. The proposed scheme has been developed in pursuit of Government's objectives for rail capacity, connectivity and sustainability. As set out in the Strategic Case⁷ the objectives for HS2 are:
- "to provide sufficient capacity to meet long term demand, and to improve resilience and reliability across the network;
 - to improve connectivity by delivering better journey times and making travel easier."

"Any solution must:

- minimise disruption to the existing network;
- use proven technology that we know can deliver the desired results;
- be affordable and represent good value to the taxpayer;
- minimise negative impacts on local communities and the environment."

⁶The Green Book: appraisal and evaluation in central government, HM Treasury, 18 April 2013

⁷The Strategic Case for HS2, DfT, October 2013

Option selection criteria

3.3. In order to apply the overall objectives to specific choices of options for the scheme design, HS2 Ltd developed a set of principles and approaches to guide option development. The principles included maximising the benefits from HS2, including the benefits of increased capacity on the existing networks; integrating with other transport networks, and designing a sustainable railway. Appraisal criteria were developed reflecting the objectives and principles. During the early stages of the project the options were considered at a higher level under fewer headings. For appraisal of more detailed options during the later stages, eleven categories of criteria have been used:

- strategic fit;
- construction feasibility;
- operational feasibility – trains (HS2 and Network Rail (NR));
- operational feasibility – operations (stations, depots etc.);
- operational feasibility – passengers;
- journey time and demand (which indicate benefits);
- costs;
- environment (using Environmental Impact Assessment (EIA) topic areas);
- safety;
- commitments; and
- development opportunities.

4. Remit and approach

4.1. The original remit to HS2 Ltd⁸ in 2009 included the following requirements for the elements of a high speed railway from London to the West Midlands:

- "a proposed route with any options as appropriate;
- options for a Heathrow International interchange station on the Great Western Main Line with an interchange also with Crossrail;
- options for access to central London and the other cities served;
- options for linking with HS1 and the existing rail network, including the potential for services to continental Europe;
- options for providing an intermediate parkway station between London and the West Midlands. Any such station should not be detrimental to the

⁸High Speed Rail London to the West Midlands and Beyond, HS2 Ltd, December 2009 p.13 paras. 1.1.10-11

overall business case, and should support economic and spatial strategies;
and

- ...potential development of a high speed line beyond the West Midlands, at the level of broad 'corridors'...[and] to consider in particular the potential for HS2 to extend to the conurbations of Greater Manchester, West Yorkshire, the North East and Scotland".
- 4.2. HS2 Ltd's remit has been modified on several occasions since 2009. The main change to the remit affecting the elements of the Proposed Scheme was in 2010 when provision for consideration of direct access to Heathrow was added⁹. The options for routes north of the West Midlands are not part of the Phase One scheme, but they were considered at strategic level because the choice of route (or routes) has implications for Phase One¹⁰. An intermediate parkway station between London and the West Midlands has not been included in the Proposed Scheme¹¹.
- 4.3. HS2 Ltd approached the task of identifying and selecting options for the various requirements by dividing the scheme into four components:
- London stations;
 - Heathrow/Crossrail interchanges;
 - lines of route to the West Midlands; and
 - West Midlands stations and route.
- 4.4. A long list of options was prepared for each component. The options were sifted against the selection criteria to determine a short list, from which a preferred option was then selected. The four components were subsequently reconciled and amalgamated to form the recommended scheme.
- 4.5. The Secretary of State published an amended version of the proposed route and scheme elements in March 2010. Since then, each element of the Scheme has been augmented, refined and reviewed. The main route and scheme component options considered during this process are described below.

5. Technical specifications and train speeds

- 5.1. HS2 Ltd developed a technical specification for the design and operation of the railway based on factors such as ensuring a safe and secure network and compliance with European and UK national railway standards. These technical specifications were reviewed as the design developed. The most significant element of the technical specification that affects the choice of the HS2 route is the maximum design speed, as any curves in the line need to be shallower for

⁹ See Secretary of State for Transport letters to HS2 Ltd 11 June 2010 and 4 October 2010

¹⁰ See Section 1.4 below

¹¹ See Section 1. below

higher speeds and this requirement could reduce the scope for modifying the alignment locally, for instance to avoid environmentally sensitive areas.

- 5.2. HS2 has been designed for speeds of up to 250mph (400kph). When it comes into operation, the trains will run at speeds of up to 225mph (360kph), a speed similar to routes being developed elsewhere in Europe for which there is proven technology.
- 5.3. Before confirming its choice of design speed in January 2012, the Government and HS2 Ltd reviewed alternative speed options on several occasions. In 2009/10, high speed was compared with conventional speed (125mph, 200kph). It was estimated that though conventional speed could offer cost savings of £1bn, the loss of revenue and benefits from slower journeys would be much greater than the reduction in cost.
- 5.4. In response to the public consultation in 2011, HS2 Ltd examined the potential for reductions in adverse environmental effects by reducing the design speed to 186mph (300kph). The effects examined included reducing carbon, reducing noise impacts and providing greater flexibility to avoid sensitive areas as a result of tighter curves. It was concluded that a conventional speed line would not offer a reasonable alternative as the economic and transport benefits of high speed would be far greater and any environmental advantage would be relatively marginal. A higher design speed was also examined, but it would save little time because of the time taken to accelerate between stations, tunnels and junctions where the maximum speed is below 225mph (360kph).
- 5.5. Local speed reductions to 186mph (300kph) and 225mph (360kph) in order to reduce environmental impacts were also examined. This applies only between Amersham and Birmingham Interchange as the remainder of the route is below 225mph (360kph) in any event. Six areas were looked at, but in three the reduced effect on the environment could be (and was) achieved by realignment and mitigation, and in the other three areas it has been achieved by mitigation alone. It was therefore concluded that the only environmental improvement attributable to reducing design speed would be a marginally lower noise impact that would be outweighed by a substantial reduction in economic benefits. Consequently, in January 2012 the speed specification was confirmed.

6. London stations and Heathrow

- 6.1. The Proposed Scheme has a terminus at Euston and an interchange station at Old Oak Common. Euston will be the station of choice for an estimated 62% of passengers because it will be faster for people starting or ending their journeys in most of north, central and south London. Old Oak Common would serve east and west London and parts of the Central Area by providing an interchange with trains on the Great Western Main Line including Crossrail and the Heathrow Express.

London terminus

- 6.2. After examining 27 potential locations in 2009, HS2 Ltd concluded that Euston is the only viable option for the London terminus. It is already a major transport interchange connecting the West Coast Main Line to the Victoria and Northern Underground lines, and via Euston Square to the Circle, Metropolitan and Hammersmith and City Lines, as well as to an extensive network of bus services.
- 6.3. Unlike any other central London station, a substantial part of the site needed to accommodate ten 400m platforms and a concourse can be accommodated within the existing station boundary. It would nevertheless be necessary to extend the station on the west side by approximately 75m as far as Cobourg Street including part of St. James' Gardens. It would also be necessary to demolish part of the Regents Park Estate to accommodate additional tracks north of the station.
- 6.4. Various locations in inner London and further afield were considered for the London terminus including Old Oak Common, Heathrow and Watford, but they were not pursued because the journey time penalties for passengers travelling into or through central London would severely reduce HS2's passenger benefits.
- 6.5. The central London locations that were considered included:
 - expansion of seven of the other existing London termini – all were eliminated because there was little or no spare capacity within the station and HS2 Ltd considered the land take in heavily built-up areas to be unacceptable while other options remained in play;
 - below-ground station options in a deep tunnelled cavern at Paddington or King's Cross – but these would be prohibitively expensive and entail a significant ground settlement risk;
 - a station located below ground on the King's Cross railway lands to the north of the station – this was rejected because of the complexity and cost of avoiding London Underground tunnels, the Thameslink station and below-ground utilities, as well as adversely affecting the regeneration plans for the area; and
 - options considered for St. Pancras – would provide a better connection with HS1, but would require either complete closure of the station during construction and/or extensive demolition.
- 6.6. Having selected Euston as the location for the London terminus, various design options were considered, including double-deck platforms to minimise the additional land take. These were rejected because they would be significantly more expensive and disruptive during construction, and would create substantial visual and noise effects. Subsequently, further work has been undertaken which has shown that they would still require significant land take and demolitions on the west side of the station. Pursuing double-deck platforms would also mean

that the capacity to run long distance services would have been reduced by around 50% for five years. Other drawbacks include:

- a double-deck station above ground would require a much higher station, with the railway passing over Hampstead Road, though property demolition in the Regents Park Estate and in the area around Cobourg Street could be avoided. Construction of this option would take fifteen years to complete, compared with ten years for the Proposed Scheme; and
- a double-deck station below ground would be even more expensive and would take 19 years to construct. Moreover, the London Underground lines running directly below the station limit how far down into the ground the lower level could be placed. The station concourse would have to be around 4m higher than Eversholt Street. It would require more land to the west of the existing station than a “double-deck up” option, including the demolition of two housing blocks on the Regents Park Estate.

London interchange station

- 6.7. Old Oak Common is not a viable alternative to Euston for the London terminus because the additional journey time for central London passengers would make HS2 a less attractive alternative to existing services, reducing the benefits of HS2. But as an additional station, Old Oak Common would spread the load on London's transport networks, particularly the Underground, because an estimated 38% of HS2 passengers would avoid Euston.
- 6.8. Those travelling to east, west and parts of central London would save time by changing to Crossrail or Great Western Main Line trains. The interchange with the Heathrow Express and Crossrail provides access to all the Heathrow terminals. This would reduce journeys from Birmingham to Heathrow to around an hour compared with over two hours currently. The economic analysis showed that an interchange at Old Oak Common would be justified whether or not there was also a station at or near Heathrow.
- 6.9. Seven locations on the Great Western Main Line from Iver to Old Oak Common were considered for the interchange as well as a site at Hanwell and three Heathrow Airport options (assuming the HS2 route ran through the airport). Hanwell had no advantages over the other options, while the Heathrow would be less attractive for the 80%+ passengers not going to the airport, as well as being much more expensive.
- 6.10. Of the Great Western Main Line options, only Iver emerged as a realistic alternative to Old Oak Common as none of the other locations would be better on any significant criterion. Iver could be the location for a park-and-ride station for HS2 and Crossrail and would be closer to Heathrow. But an interchange at Iver would add 15-30 minutes to journeys to central London when compared to the Old Oak Common option via Crossrail. Consequently, fewer passengers would use it as an interchange and it would be significantly less effective in relieving congestion on the public transport network around Euston station. An

interchange station at Iver would also be much more expensive to build because it would require a people mover or rail link to connect it to the Heathrow terminals and it would have a greater impact on the local environment.

Connection to Heathrow Airport

- 6.11. Several options for the location of a Heathrow station were considered including the Central Terminal Area, Terminal 5, on the northern perimeter of the airport and at Iver. During the analysis, options for a direct HS2 route through the airport were rejected on grounds of cost and the delay to passengers not travelling to Heathrow. So any station at Heathrow would be served by a loop or a spur off the HS2 Main Line.
- 6.12. Having recommended Old Oak Common as the interchange station, HS2 Ltd did not recommend an option at Heathrow in 2009. In March 2010, Lord Mawhinney was asked by the Government to undertake a review of high speed rail access to Heathrow, and following the general election the Secretary of State confirmed that he should continue with the review in the light of the new Government's decision not to support a third runway. He also asked HS2 Ltd to develop options for a direct high speed link to Heathrow.
- 6.13. In 2012, the Government accepted the strategic importance of a direct high speed link to Heathrow and opted for a spur to Terminal 5 on grounds of cost, passenger benefits and construction feasibility, to be implemented as part of HS2 Phase Two. However, later in 2012 it set up the Airports Commission to examine options for Britain's international aviation hub, and in January 2013 it suspended further work on a direct HS2 link to Heathrow until the Commission reported.
- 6.14. Subsequently on 9 March 2015, the Secretary of State advised, in response to a House of Commons written question, that the spur would not be implemented as part of HS2 Phases One or Two.
- 6.15. The Select Committee's Second Special Report of Session 2015-16 highlighted that following the update on 9 March 2015, there remained a risk of blight on properties on the trajectory of the previously envisaged spur, and directed that the Promoter should not use the Bill powers to implement passive provision for a Heathrow spur.
- 6.16. In its response to the Select Committee's Second Special Report of Session 2015-16, the Promoter confirmed acceptance of the Select Committee's direction, confirming that the Promoter will not use the powers in the Bill to provide passive provision for a Heathrow spur. An assurance to this effect will be added to the Undertakings and Assurances Register.

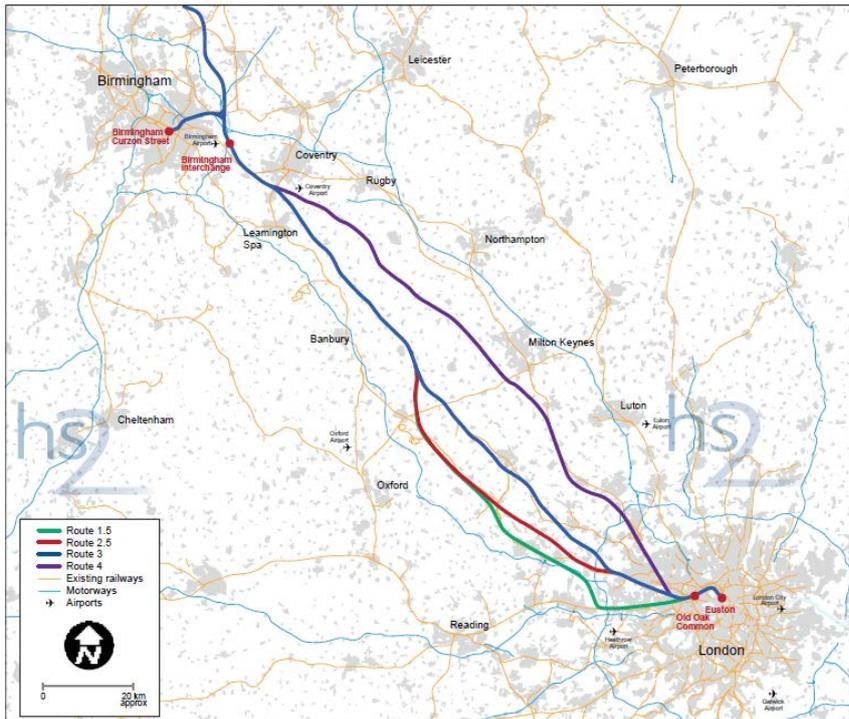
7. Connection to HS1

- 7.1. While a link between HS2 and HS1 was originally included in the plans for HS2, following the Higgins Review in March 2014, the Government removed it from the project.

8. Route from London to the West Midlands

- 8.1. The Proposed Route (Route 3) is in tunnel from Euston to Old Oak Common and on to the Colne Valley at West Ruislip. From there it broadly follows a straight line to the gap between Kenilworth and Coventry, crossing the Chilterns along an existing transport corridor (A413, Marylebone to Aylesbury line) before joining the route of the former Great Central Line between Aylesbury and Brackley. The Proposed Route is not only the shortest, but it is also most likely to be the fastest and cheapest. Though it is the longest route across the Chilterns Area of Outstanding Natural Beauty (AONB), the overall difference between the options in environmental terms is marginal and the Proposed Route is no worse than the other options in terms of sustainability. Where it does impact on residential or other sensitive areas, the adverse effects will be extensively mitigated.
- 8.2. A large number of alternative routes between London and West Midlands were considered and the most promising ones were evaluated on journey time (as a proxy for benefits), engineering feasibility, likely environmental effects and cost criteria. From this evaluation, three options (shown in Figure 1.1) were initially selected for further examination and a route through Heathrow was considered later. In addition to the Proposed Route, the options were:
- Route 2.5 - Chiltern Main Line corridor via Princes Risborough, skirting the north side of High Wycombe - This route passed through three tunnels under the Chilterns, then largely on surface before re-joining the Proposed Route near Bicester. It would offer some localised environmental benefits compared with the Proposed Route, but would require a high viaduct across the Hughenden valley. It would also cost more and journey times would be longer;
 - Route 1.5 - M40 route, a through route via Heathrow Airport - Of the four options this route is the most circuitous and could only be justified if the HS2 main line ran through Heathrow. It would follow the M40 corridor with a tunnel under Beaconsfield and High Wycombe before re-joining Route 2.5 north-east of Bicester; and
 - Route 4 - West Coast Main Line corridor - This route would be in tunnel to Kings Langley and then run broadly parallel with the West Coast Main Line corridor to pass to the west of Milton Keynes and between Kenilworth and Coventry. This route would be slightly shorter than Route 2.5 and slightly longer than the Proposed Route, but would require more tunnelling and be more expensive. Providing a spur link from Route 4 to Heathrow would be a major undertaking.

Figure 1.1 - Route options between London and the West Midlands



Source - London-West Midlands Environmental Statement Non-technical summary, November 2013

In each case there are settlements and environmentally sensitive areas which need to be traversed and long tunnels through London and its immediate environs would be necessary. Route 3 offers significant advantages in terms of cost and journey times and is no worse than other options on sustainability grounds. Following consultation, in January 2012 the Government concluded that the proposed corridor including the proposals for mitigation is the best option, but that a package of alterations should be made to further reduce its impacts on the local environment and communities. There have been further refinements on which the public have been consulted and a comprehensive package of mitigation has been prepared in response to continuing work on environmental impact assessment.

Intermediate stations between London and the West Midlands

- 8.3. The case for an intermediate station between Old Oak Common and Birmingham Interchange was investigated in 2009 and was re-examined following consultation in 2011. This analysis was undertaken prior to consideration of the choice of route between London and the West Midlands because, if an intermediate station were included in the proposals, it could have implications for route selection.
- 8.4. Intermediate stations bring a range of potential benefits to the communities they serve in terms of improved connectivity and congestion relief, especially on commuter services into London. However, these benefits would come at the cost of slower journey times for through passengers and reduced train path capacity on HS2. The reduced capacity effect would be particularly significant for the Phase Two proposals to Leeds and Manchester, and for services to the

north, as demand pressures would be much greater when both phases are implemented.

- 8.5. In 2009 HS2 Ltd analysed existing rail trips from twelve of the largest population centres in the London-West Midlands corridor and identified existing rail demand for a long list of potential intermediate stations. Three locations - Aylesbury, Milton Keynes and Bicester (serving Oxford) - were selected for further assessment.
- 8.6. The potential demand at an intermediate station would largely comprise commuting trips into London, particularly in the case of smaller towns such as Bicester. Against these benefits to the passengers using an intermediate station, there would be very substantial costs to other passengers. More significantly, it was estimated that the trains would be relatively crowded with long-distance passengers by 2033, particularly at peak times. Additional intermediate station passengers would therefore (notionally) displace those already on the trains. This would result in a net disbenefit because the time savings for longer-distance passengers would be greater than for medium-distance passengers. Fare revenues would also be lower.
- 8.7. In addition, a three-trains-per-hour service to an intermediate station would result in the loss of three train paths per hour, leading to a 20% reduction in the maximum capacity of the route. The only ways to avoid losing a train path for each stopping train would entail either far too many trains stopping than could be justified by the demand, or very long stops in the station. Either way, the disbenefit to through passengers could not be justified.
- 8.8. As well as having a very poor business case, there would be adverse environmental effects. Typically, a parkway location would entail roads, car parks, visual intrusion and other environmental effects, while a town centre location would require property demolition and disturbance to adjacent occupiers.
- 8.9. Due to the weakness of the business case, no intermediate stations were included in the Bill. From a strategic point of view, if the primary function of an intermediate station is to serve the commuter market to London, capacity and/or journey time enhancements to existing main lines are a more cost-effective solution than filling long-distance trains with commuter-distance passengers. In addition, by releasing long-distance train paths, HS2 will enable more medium-distance services to run on the West Coast Main Line.

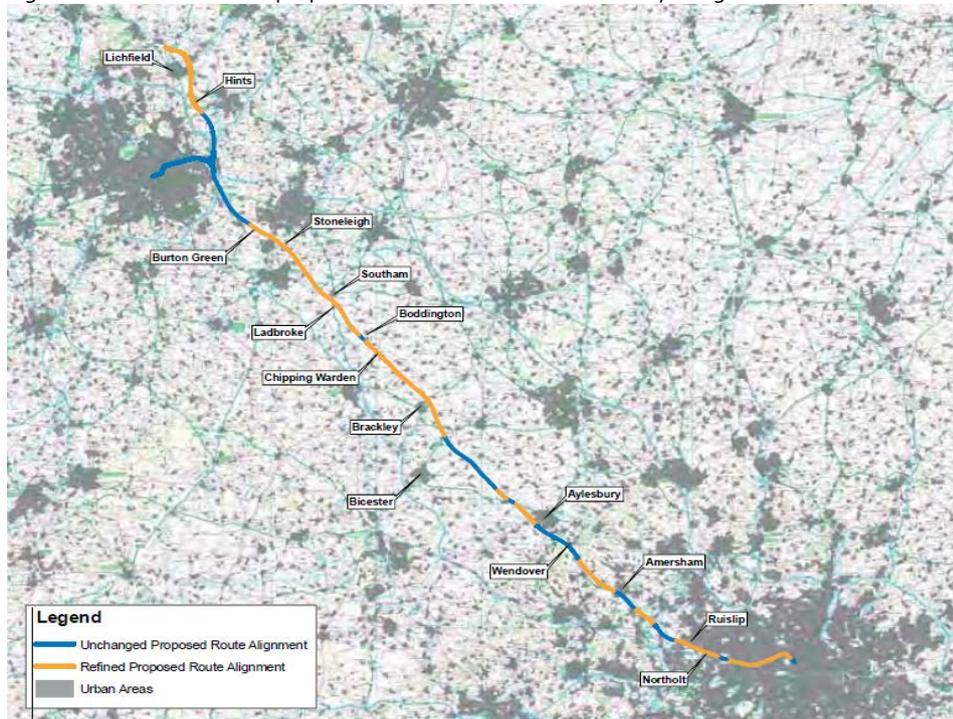
Refinements following selection of Route 3

- 8.10. When the Government selected Route 3 as its preferred option, it did so subject to further work on reducing specific impacts on the local environment and communities. Since then the route has been extensively realigned and mitigated. In March 2010, 12.6 miles (20.3km) (8.9%) of the proposed route was in tunnel, most of it between Euston and Old Oak Common and under the hilly part of the Chilterns south of Amersham. The tunnel sections now total 29 miles

(46.7km) (over 20% of the total route length) including almost all the route through London and through the Chilterns to South Heath, as well as several cut-and-cover 'green tunnels'¹² further north.

- 8.11. The effects of the Proposed Scheme through the Chilterns have been extensively mitigated. As a result, 7.5 miles (12km) of the route will be in tunnel through the AONB and 5km in cutting. Only 1.9 miles (3km) in two short sections of embankment and viaduct south of Wendover will be visible. This scheme was developed from the initial Route 3 in 2009 which included approximately 4.3 miles (7km) of tunnel through the AONB. In 2012, following public consultation, the alignment and tunnels through the Chilterns were reconsidered. The long tunnel was realigned approximately 1 mile (1.5km) to the south to avoid an important aquifer and it was extended by 2.3 miles (3.7km) to Hyde Heath, (which was partly in green tunnel in the previous version).

Figure 1.2 - Sections of the proposed line that have been altered by mitigation



Source - High Speed Rail: Investing in Britain's Future Consultation Document, February 2011

- 8.12. Further north, prior to the public consultation in 2011 in places the alignment between Aylesbury and Coventry was moved away from sensitive locations or lowered into the landscape to reduce adverse effects. Since then there have been further improvements to the horizontal alignment in a dozen locations. More sections of tunnels have been added, between Old Oak Common and

¹² A cut-and-cover tunnel with soil spread on top to integrate into the landscape, thus minimising visual impacts and making the presence of a railway less noticeable. Access tracks and vegetation can be placed on the surface above the tunnel and it can be used for amenity, parkland and agricultural uses etc

Northolt, at Greatworth, Turweston and through Bromford in Birmingham, and the proposed tunnels at South Heath and Long Itchingham Wood have been extended. Throughout the route a comprehensive mitigation package has been prepared as part of the Environmental Impact Assessment process. This includes allocation of land to compensate for open space, ecological areas and flood plain taken by the railway, community facilities and noise reduction and protection.

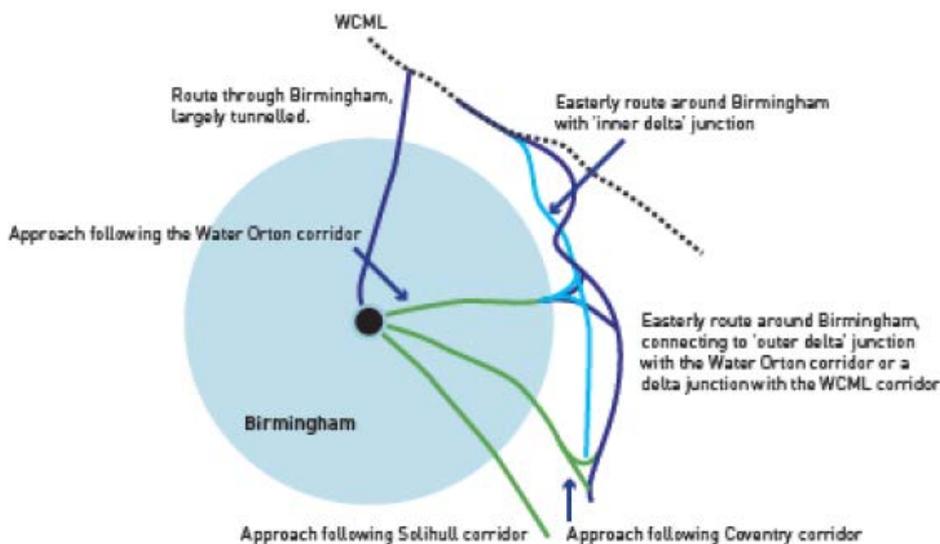
9. West Midlands stations and routes

Birmingham terminus

- 9.1. The Proposed Scheme will serve Birmingham by a spur off the HS2 Phase One Main Line at Water Orton (to the east of the city) leading to a new station in the city centre at Curzon Street, next to Moor Street and approximately 400m to the east of New Street. The station will be built on a vacant site and the route will run through the Heartlands industrial estate and along the M6/West Coast Main Line Bromford corridor where it would be partly in tunnel. This solution minimises journey times between London, Birmingham and the north and minimises cost, demolition and damage to the local environment through the urban area. It also offers the best opportunities to support regeneration in the Eastside area.
- 9.2. As with the central London station, analysis of potential demand demonstrated that there would need to be a station in or close to Birmingham city centre. Options were considered for a through station as well as a terminus. Three general route corridors through the West Midlands were therefore considered:
 - directly through Birmingham city centre;
 - around the west side of Birmingham, with a link into the city centre; or
 - around the east side of Birmingham, with a link into the city centre.
- 9.3. There are no existing surface locations for a through station in central Birmingham and extensive property demolition would be necessary to build the infrastructure required to connect the tracks at either end. An entirely tunnelled route through the centre was discarded because of the cost in relation to viable surface alternatives.
- 9.4. The routes round the west side were not pursued, because not only would they be longer and more circuitous, they would also present significantly greater environmental and technical difficulties than a route to the east. The only credible option therefore was a terminus linked by a spur to an HS2 route to the east.
- 9.5. Eight options were considered for a terminus station in central Birmingham, including upgrades and expansions of Moor Street, Snow Hill, New Street stations and development of a completely new station. Extending New Street would offer the best solution for passengers, but unfortunately it is not feasible. Even if the cost could be justified, an additional new station would be required

somewhere else in the city, and existing trains services would be severely disrupted during construction. Extension of Snow Hill would also present fundamental problems as the shallow tunnels at either end would need to be rebuilt. Because of its orientation, Moor Street is not compatible with a route via the Water Orton corridor. It was concluded that a new station would be needed as all the other options had significant engineering, capacity and/or land use constraints. Curzon Street was selected as the best location as it had fewer local impacts.

Figure 1.3 - West Midlands Route options remaining after Stage 2 Sifting



Source - ES Volume 5; Alternatives Report (CT-002-000)

9.6. Three route options for a spur off an Hs2 main line east of Birmingham were identified: the Solihull corridor; the Coventry corridor; and the Water Orton corridor. They were assessed as follows:

- a spur along the Solihull corridor would have a greater social and environmental impact as the railway would need to be widened through residential areas. Crucially, it would lead to a significant increase in journey time for Phase Two services between Birmingham and Leeds or Manchester, as the trains would suffer a long detour to the south east before accessing the city.
- a spur in the Coventry corridor would also run through residential areas. The main line junction would not be as far south of Birmingham as the Solihull corridor, but would entail similar – though less severe – journey time disadvantages to Leeds and Manchester. Importantly, there would be no obvious location for an interchange station near Birmingham International station and the airport. Compared with the proposed route it would cause greater disruption during construction, severance, noise and water resource effects.

- The West Coast Main Line/M6 Bromford corridor with a junction at Water Orton was therefore selected as the route into Curzon Street station. It provides a much better solution in terms of environmental and regeneration criteria, as well as being a better transport solution.

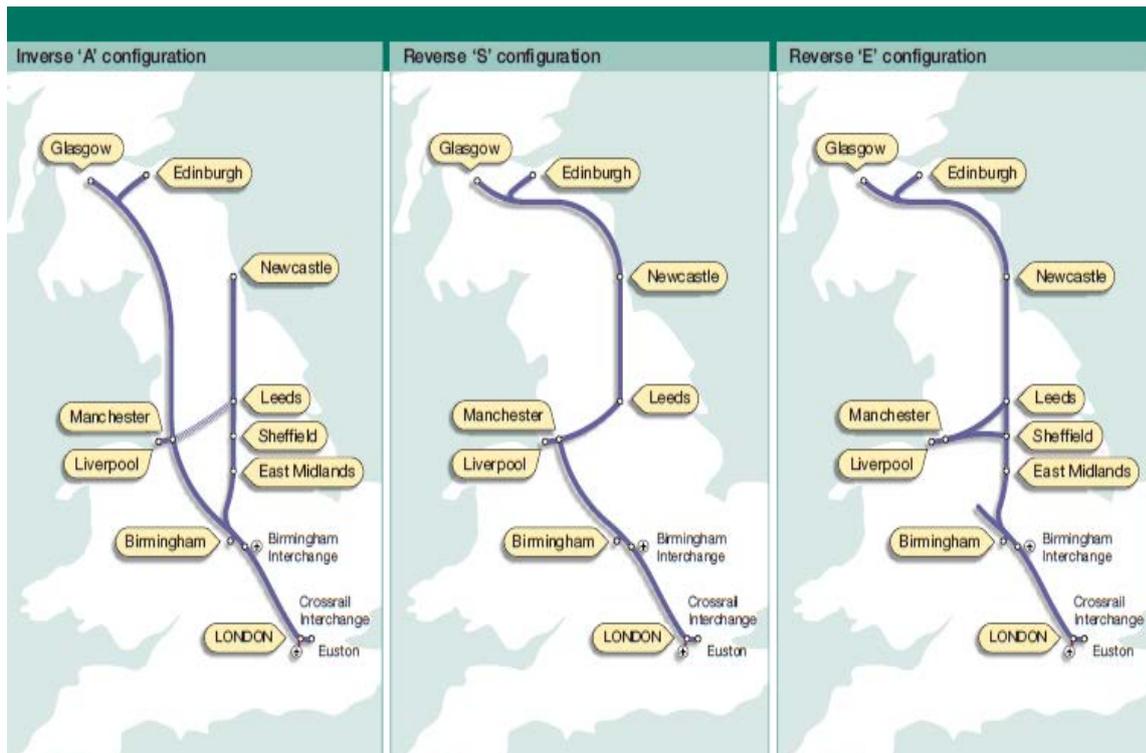
Birmingham interchange

- 9.7. As with London, in 2009, Hs2 Ltd explored the options for an interchange station as well as a city centre station. Though ten options around Birmingham were considered, a site close to the NEC and Birmingham Airport and International station is the obvious choice. Not only are they strategic destinations, but as a parkway station this location is within ten miles of Sutton Coldfield, the east side of Birmingham, Solihull, Coventry and Kenilworth - all connected by major roads including the M6, M42, A45 and A452. The economic analysis undertaken at the time estimated that, for Phase One of HS2, 42% of London-West Midlands passengers would use Birmingham Interchange and 58% would use Curzon Street.
- 9.8. The interchange is to the east of the M42 so that the HS2 route can continue northwards to the Birmingham Junction at Water Orton, following the existing motorway corridor so far as possible avoiding residential areas. However, a consequence of this location is that a people mover would be necessary to connect the Interchange with the NEC (1 mile (1.5km) away), Birmingham International station (1.2 miles (1.9km)) and the airport terminal (1.4 miles (2.3km)).

Route options for extension to Manchester, Leeds, the North and Scotland

- 9.9. Phase Two of HS2 is intended to connect Britain's four largest conurbations - London, Birmingham, Manchester and Leeds. Conceptually, the route to the north and eventually Scotland can be either to the east or the west of the Peak District, or it can be on both sides, bifurcating north of Birmingham with a western route to Manchester and Scotland, and an eastern route to the East Midlands, South Yorkshire, Leeds and north to Scotland. These three options (the 'Reverse S', the 'Reverse E' and the 'Inverse A' respectively) were reviewed in 2009/10. Following a high level economic and environmental analysis, it was concluded that, of the three, the 'Inverse A' would offer the best value for money, but that the proposed 'Y' network to Manchester and Leeds - a shortened version of the 'Inverse A' - would offer most of the benefits at a much lower cost.

Figure 1.4 - HS2 Ltd's wider network options



Source - High Speed Rail Command Paper, March 2010

- 9.10. The consequence of this conclusion is that the two legs would need to be joined to HS2 Phase One somewhere north of Birmingham. The proposed scheme provides for a junction to the Leeds leg along the M42 in order to minimise severance and other environmental impacts and to provide the most direct route to the proposed station option in the East Midlands north of the Water Orton junction. The Eastern Leg of Phase Two would include stations serving the East Midlands, South Yorkshire, and Leeds, with a connection to the East Coast Main Line south of York.
- 9.11. The Phase One route ends at Fradley Wood with a spur to the West Coast Main Line at Handsacre. From there the proposed Phase Two route would run parallel to the West Coast Main Line north of Rugeley and Stafford. The Western Leg of Phase Two would include stations at Manchester Airport and Manchester Piccadilly, and connections to the West Coast Main Line at Crewe (potentially serving a new hub station), and to the south of Wigan.
- 9.12. HS2 Ltd is working to accelerate the delivery of the route between the West Midlands and Crewe, and proposes to deposit a bill to secure powers for this route ('Phase 2a') by the end of 2017. It is proposed to deposit a bill to secure powers for the remainder of the route by the end of 2019.
- 9.13. HS2 Ltd has also considered the options for further improving services to Scotland and the north of England, beyond the journey time benefits delivered by Phase One and Phase Two. In March 2016, the Government published the HS2 Ltd report 'Broad options for upgraded and high speed railways to the North of England and Scotland'. Based on the findings of this report, the

Government has instructed Network Rail to further investigate options for improving journey times, capacity, resilience and reliability on routes between the England and Scotland.

- 9.14. Work continues to consider how the full HS2 network could best be integrated with existing and proposed investment in the UK rail network. This includes Network Rail's 'Capacity Plus' workstream, and the developing Northern Powerhouse Rail programme.

10. Depot and maintenance facilities

- 10.1. HS2 will require two maintenance depots for its Phase One operations: an infrastructure maintenance depot (IMD); and a rolling stock maintenance depot (RSMD). The Phase One IMD will be located at Calvert, mid-way between London and Birmingham. The RSMD will be located at Washwood Heath in Birmingham. Plans for Phase Two make provision for an IMD and a rolling stock depot on each leg.
- 10.2. In March 2010, the Government agreed that the West Midlands would be the most appropriate location for the rolling stock depot and Calvert for the maintenance depot, but asked HS2 Ltd to do further work on depots before the formal public consultation. This work was undertaken later in 2010. For both facilities it included an assessment of alternatives and led to consultation on the depot proposals at Washwood Heath and Calvert as part of the wider consultation in February 2011.

Infrastructure Maintenance Depot and maintenance loops

- 10.3. The IMD will provide a central depot for maintenance of the track, signalling equipment, power systems, cuttings and embankments and other elements of the HS2 infrastructure. The depot needs to be centrally located on the Phase One route to reduce travel distances to work sites and thereby minimise any disruption to train services. It also needs to be connected to the existing railway to allow the depot to be supplied with material and equipment by rail.
- 10.4. It was concluded that a depot at Calvert (north of Aylesbury) would be the most appropriate location because it is the only location in the middle of the Phase One route that is connected to the existing railway (via the Bletchley to Bedford Line). Other location options were considered, both at Calvert and further north and south, but not only is the proposed site on the intersection of the two railways for maximum operational efficiency, it would also have fewer adverse effects on the environment and local communities than the alternatives.
- 10.5. Two maintenance loops will be needed for holding maintenance trains closer to the worksites during the day to enable the night-time maintenance periods to be used more productively. The loops will also provide a safe stopping location for any HS2 train that develops a fault. One loop needs to be approximately halfway between the IMD and London and one halfway to Birmingham. Seven sites were

considered for the locations of the two loops. From this list, Stoke Mandeville (Buckinghamshire) and Wormleighton (Warwickshire) were selected as they offer the best balance between operational requirements and environmental impact.

HS2 rolling stock depot

- 10.6. A rolling stock depot will be needed to maintain and stable the HS2 trains. One maintenance depot operating 24 hours a day, seven days a week will maintain all trains, although other stabling facilities could be located elsewhere. A light maintenance depot will be needed for each leg of Phase Two.
- 10.7. The Phase One depot will be used for rolling stock inspection, repair, internal and external cleaning, light and heavy maintenance, toilet tank emptying, re-watering and the replenishment of consumables. A flat site approximately 2,000m X 500m is required. A West Midlands location is preferable to London as it would be central to both phases of HS2, allowing a single main RSMD to serve both phases. It would also be beneficial in terms of the availability of suitable sites and the cost and availability of skilled labour.
- 10.8. In 2010, six brownfield and three greenfield sites were identified as possible locations for the RSMD. Five of the brownfield sites were either unsuitable or unavailable and none of the additional options suggested by local stakeholders were large enough. Washwood Heath was preferred to the greenfield options on both accessibility and environmental grounds. Following consultation and the decision to incorporate Washwood Heath into the proposals in January 2012, HS2 Ltd was asked to reconsider the options. From a long list of 86 sites, only 10 could fulfil some or all of the selection criteria.
- 10.9. The most promising alternative was adjacent to Birmingham Interchange. However, it would entail running empty trains to the depot on the main line and reversing moves would result in additional unit mileage and crew hours. Birmingham Interchange is less environmentally favourable than Washwood Heath and would cost more, largely due to earthworks and structures to form grade-separated junctions where the tracks cross the M6 and M42. It was therefore concluded that the depot should be located at Washwood Heath as previously proposed.

11. More information

- 11.1. More detail on the Bill and related documents can be found at: www.gov.uk/HS2
- 11.2. More detail on the proposed route for HS2 can be found at: <http://www.dft.gov.uk/topics/high-speed-rail/line-of-route>

