



High Speed Rail London to the West Midlands and Beyond

A Report to Government
by High Speed Two Limited

PART 4 of 11

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Chapter 1:

ICE 3 high speed train on the Frankfurt-Cologne high-speed rail line, Sebastian Terfloth;

Eurostar, Dave Bushell www.canbush.com/ppbfrontpage.htm;

Gümmenen viaduct over the river Sarine with TGV 9288, Berne, Switzerland, Chriusha;

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Chapter 5:

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3.3 Interchanges with Heathrow, Crossrail and Great Western main line

Introduction

3.3.1 This chapter sets out our consideration of options for an interchange on the Great Western Main Line (GWML) and with Crossrail, providing convenient access to Heathrow, as specified in the remit. This consideration depends on the options for the HS2 route leaving London, which is therefore also covered below.

Objectives for the interchange

3.3.2 Reflecting our remit, we have assumed the two main objectives for the interchange would be to:

- Provide good access for HS2 passengers to London, whilst relieving pressure at Euston.
- Provide access to Heathrow airport for HS2 passengers.

3.3.3 To the extent that these objectives conflict with each other, we maintained an open mind on the possibility of having two interchanges, one near London, one at or near Heathrow.

Our approach to the choices for the interchange

3.3.4 The range of options for serving Heathrow is wide and the issues complex. The airport is physically complex with three main widely-separated terminal areas at present (the Central Terminal Area, Terminal 4 (T4) and Terminal 5 (T5)). There is also the prospect of a third runway and a Terminal 6 (T6) to the north. It is therefore difficult to be certain about the way in which it will develop in future. Our consideration of the issues had four main steps:

- We began with looking at the market for the interchange, and in particular the numbers of people who would use HS2 (and, at a later stage, a wider high speed network) to get to Heathrow.
- We then looked at how best a high speed line could serve the airport itself, whether by routing HS2 via Heathrow, or by a spur or loop off the main HS2 route. This required consideration of the route that HS2 could take out of London.
- We then extended our analysis to look at all possible locations for the interchange station, including those at or close to Heathrow itself and those more distant from it.
- This led to a more detailed comparison of a Heathrow option with an interchange closer to London, leading to selection of our preferred option.

In carrying out this assessment, we had in mind that our analysis showed the majority of HS2 passengers would want to go to central London rather than to Heathrow.

The market for the interchange

Dispersal from HS2 to central London

- 3.3.5** More than 80% of passengers using HS2 would be going to London itself. For many of these passengers, an interchange with Crossrail would provide an opportunity for quicker access to parts of the West End, the City and Canary Wharf than changing at Euston. Furthermore, without an interchange, the addition of the HS2 services to Euston station, together with additional services using released capacity on the WCML, would increase the number of passengers using this station by 60,000-70,000 per day, compared with the number who would otherwise be using the station in 2033. Half of these passengers would use the already heavily used London Underground for their onward travel.
- 3.3.6** The closer the interchange is to London, the more people would be likely to use it for onward travel into London, especially if there were frequent trains to interchange with and an opportunity to secure a seat. Options further to the west would be far less attractive for passengers travelling to London as the journey time on Crossrail would be greater and they would have a far less frequent service to central London.

Crossrail

Crossrail will connect central London, the City, Canary Wharf, the West End and Heathrow Airport to areas east and west of London. It brings 1.5 million people within a 60-minute commute of the city. The current intention is that Crossrail will begin operating in 2017.

It is proposed that Crossrail will provide a 24-train an hour service at peak times in each direction in the central area between Whitechapel and Paddington. 14 trains start or end at Paddington. Trains will then run across or connect with the National Rail network on three branches. To the west, on the Great Western Corridor 4 tph will run in each direction between central London and Heathrow Airport. These services are additional to the 4 tph Heathrow Express service. In addition there will be 4 tph in each direction between Maidenhead and central London and 2 further trains per hour between central London and West Drayton. On the east, Crossrail connects to two rail corridors. On the Great Eastern Corridor at peak times 12 tph in each direction will be provided between central London and Shenfield, replacing 10 of the 16 tph currently provided by National Express East Anglia. The remaining 6 National Express trains would continue serving Liverpool Street. On the Abbey Wood Corridor, there will be 12 tph in each direction between Whitechapel and Abbey Wood serving the Isle of Dogs, Custom House and Woolwich. Further details are available from www.crossrail.co.uk.

The preferred option of an HS2 Heathrow interchange at Old Oak Common has been developed to enable all 24 Crossrail trains per hour to stop at this station. It is proposed that the 14 tph which operate in the central corridor area start or end at this station rather than at Paddington. Further work would be required to understand the implications on Crossrail and the GWML of stopping Crossrail trains at Old Oak Common.

Access to Heathrow

- 3.3.7** The market for access to Heathrow has four main elements:
- Those who use surface modes to access Heathrow and might transfer to HS2.
 - Those who fly 'point to point' between a UK airport and Heathrow.
 - Those flying from a UK airport to Heathrow to transfer to a long haul flight – the 'interliner' market.
 - Those who would otherwise interline at a European hub airport.
- 3.3.8** There are currently around 40m surface access trips to and from Heathrow every year. Of these, over 80% start within London and the South East. The market for access to Heathrow declines rapidly with distance. Journeys to and from Birmingham account for just 270,000 trips each year. We estimate that at most 2.5 million surface trips to and from Heathrow originate in and beyond the West Midlands.
- 3.3.9** For locations north of Birmingham, air access to Heathrow becomes increasingly important. There were around 2 million passenger trips by air to and from Manchester and Glasgow in 2008. Around half of these are domestic 'point to point' passengers, for whom a connection to central London is probably more important than a station at Heathrow. The remaining 1.2 million passengers use domestic flights to transfer to other connecting flights. For these people, a station at Heathrow would make HS2 more attractive.
- 3.3.10** This suggests that the total market for accessing Heathrow from the West Midlands, North West, North and Scotland is currently around 3.7 million trips. Our modelling suggests relatively little of this would shift to HS2, with the rail share increasing by less than 1 percentage point (about 2,000 passengers per day, or just over one train load each way). This reflects the inherent attractiveness of road (for people travelling in groups) and relatively low air fares for connecting flights.
- 3.3.11** Even if HS2 were to capture the whole market of 3.7 million trips (which is unrealistic given the size of the catchment area), this would represent just 8% of HS2 demand. The percentage would increase with growth in the total number of air passengers using Heathrow, either through general growth in air travel or by attraction of passengers to Heathrow from other UK airports and European hubs. However even so Heathrow passengers would remain a minority of passengers using HS2.

Serving Heathrow directly

- 3.3.12** There are a number of possible options for serving Heathrow, but they fall into two main categories:
- Those that serve the airport most directly, being at or close to the airport.
 - Those that are more distant from Heathrow but are connected by classic rail.

In this section we first consider how Heathrow could be served directly.

- 3.3.13** There is no single destination that is Heathrow. With the current airport, the two possible locations for a station serving HS2 would be the Central Terminal Area or T5. If a third runway were built, there would be the option of T6. Another option would be a site close to the airport, near Iver, from which all terminals could be served by a people mover. These options are considered later in this chapter.

Through, loop or spur?

3.3.14 A direct route for HS2 from London to the West Midlands would take a north westerly route, which would not take it via Heathrow itself. A key question in considering any of the options which serve Heathrow directly is therefore how best to serve it by the HS2 route. The three options are a station on the HS2 main line or via a spur or a loop off the main line. These are illustrated in Figure 3.3a.

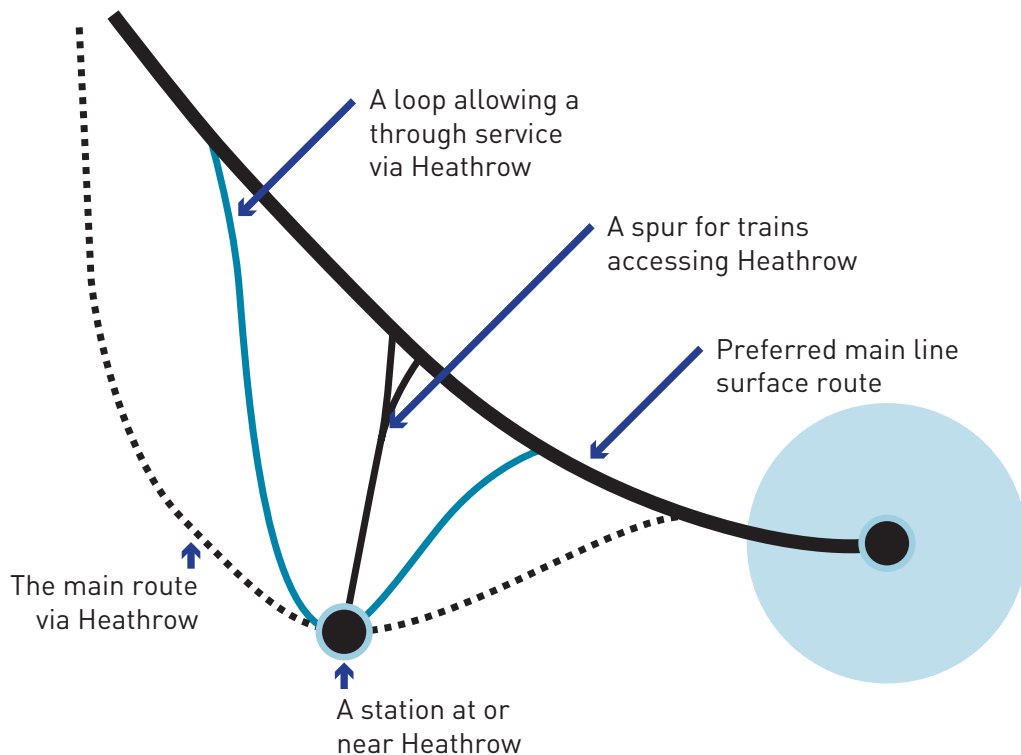


Figure 3.3a Heathrow access options

3.3.15 The relative costs of these options depend on what route would be chosen for the main line if it were not going to Heathrow itself. The least expensive way out of London would be to follow a surface route, rather than tunnel. We have identified only one such feasible surface route. This would follow a widened Chiltern corridor from Old Oak Common near Willesden to the Ruislip area. The initial stretch from Euston to Old Oak Common would need to be in tunnel to avoid the need for land take and, potentially, property demolitions. Construction towards Euston would start from Old Oak Common as the site would be large enough for a work site and it would also be possible for the spoil to be brought out there. If there was no station at Old Oak Common, a tunnel would be required to join the tunnel from Euston to the surface route out of London at a cost in the region of £150m. In scenarios that include a station at Old Oak Common, this is effectively embedded within the overall station costs.

- 3.3.16** The surface route would run close to existing settlements in the London Boroughs of Ealing, Brent and Hillingdon and would require around 20 to 30 residential properties to be demolished. There would be noise impacts for a number of properties along the route. There would be some disruption to groundwater source protection zones and construction in some flood prone areas on the western approach to London. The route would also result in impacts on the mid Colne Valley Site of Special Scientific Interest (SSSI), where the route would be partly on viaduct. Our view, though, is that these effects could be mitigated to acceptable levels through design and, where necessary, by limiting the speed below maximum levels.
- 3.3.17** Any alternative exit from Central London would be in tunnel from the centre to a point close to or beyond the M25. This would be significantly more expensive than following the surface route. For example, a tunnelled route through to Heathrow would be some 20km long, since it would not come back to the surface until approaching the airport interchange station itself. Any route beyond that point towards the north would also entail extensive tunnelling of similar magnitude. The cost would be of the order of £4bn (without allowance for risk).
- 3.3.18** Figure 3.3b sets out the construction costs, excluding risk, of the different ways of serving Heathrow. It shows that a spur is by some way the cheapest option. When the cost of the surface route is included, the costs of the least expensive loop and a through route are broadly comparable. This is because, although the loop produces a greater total length when added to the surface main line, a lower proportion of the combined length of it is in tunnel than the through route.

Heathrow Options	Cost (£bn) (Base construction cost only, excluding risk)	
Heathrow Terminal 5 loop	3.6	All these Heathrow options include the costs of getting to/from the preferred surface route plus the station. The estimated cost of the preferred route itself over this section is £1.9bn. This would need to be added to these costs.
Heathrow Terminal 5 spur	2.0	
Heathrow Terminal 6 loop	3.1	
Heathrow Terminal 6 spur	1.7	
Iver loop	2.0	
Iver spur	1.6	
Heathrow through route via Iver	4.1	

Figure 3.3b Construction costs of serving Heathrow, excluding risk and optimism bias (2009 prices)

- 3.3.19** On sustainability grounds, beyond consideration of the surface route, there is no overwhelming reason to prefer one approach to the other. All options would be predominantly in tunnel, requiring a high level of energy intensive construction which would generate a high level of spoil. A loop would produce up to twice the amount of carbon dioxide resulting from tunnel boring as a spur. It would also involve approximately 10 properties requiring demolition with a further 17 at risk. For the spur, some ancient woodland would be lost from the local nature reserve where the junction box is located, as well as approximately 50 demolitions which could arise from the grade-separated junctions.
- 3.3.20** A key issue differentiating the options is the extent to which the different types of solution have different impacts on the capacity of the high speed line, and particularly on the number of train paths available to serve London. Although there would be some (limited) spare capacity on HS2 in the opening year with the Day One service, a longer term network would use all the capacity on the line.
- 3.3.21** In the case of a spur solution, one complete train path into London would be lost for every train serving and terminating at Heathrow via the spur. Hence it is an unattractive option, as the value of the capacity foregone, threatening for instance the ability to provide a reasonable service to Birmingham or to serve Leeds via the East Midlands and Sheffield as part of a wider network, would significantly exceed the cost saving of up to £1.5bn. A spur option was therefore not considered further.
- 3.3.22** With a loop option, not all trains would stop at Heathrow and, depending on operational timetabling practice, potentially no capacity would be lost. With a through station on the main line, a choice would need to be made on stopping patterns:
- If all trains stop at the through station, there will be no impact on the capacity of the line. There will, however, be significant time penalties for those passengers travelling beyond the through station, who make up the majority.
 - In the case of selective stopping, there may be an impact on capacity depending on the operational timetabling practice adopted. Operational timetabling practices – selecting a pattern of stopping services which avoids loss of train paths, though at a potential cost in dwell time – may avoid loss of capacity without a significant additional time penalty to passengers on non-stopping services.
- 3.3.23** The pros and cons of both types of through station and a loop are set out in Figure 3.3c. For selective stopping we assume that one train in three would stop at Heathrow. This allows around an hourly service from Heathrow to most destinations, the frequency suggested by some airlines as necessary to offer a sufficiently attractive service to travellers currently flying domestically to interline.

	At or close to Heathrow Station Through route, all stopping	At or close to Heathrow Station Through route, selective stopping	At or close to Heathrow Station Loop from the preferred route, selective stopping
Impact for Passengers going to/from a Central London Station	All through passengers would suffer a 7 minute penalty (4 minute journey time penalty as the route is longer and 3 minute dwell time and acceleration/deceleration penalty).	4 minute penalty for 2/3 of through passengers as the route is longer. 1/3 of through passengers would suffer a 7 minute penalty, (as for all stopping).	2/3 of through passengers on non-stopping trains would have the fastest journey times. 1/3 of through passengers, routed by the loop, would suffer a 9 minute penalty, consisting of a 7 minute journey time penalty including acceleration/deceleration and a 2 minute penalty for dwell time.
Impact on capacity and Long Term Strategy	No impact on capacity.	Providing a mix of stopping and non-stopping trains could reduce the capacity of the line by up to one train for each train stopping at the station, depending on the pattern of stopping and through trains.	There would be no loss of train path capacity provided the stopping patterns of trains via the loop was optimal, thus offering a somewhat better option than a through station.
Non-London Passengers	All non-London passengers would have the choice of all services.	Non-London passengers would have only 1/3 the frequency of an 'all trains stopping' through service.	As for the selective stopping through service.

Figure 3.3c Differential impacts of Heathrow options

3.3.24 The analysis in Figure 3.3c suggests that:

- For those airport passengers who would use the station at Heathrow to access the airport a through station with all trains stopping is very much the best option.
- For these passengers there is very little to choose between a selective stopping through station and a loop.
- However, for the much larger market of passengers wanting to travel to or from central London, all the arguments strongly suggest that a loop would be preferable.

Overall we conclude that a loop is the preferred way of serving Heathrow directly.

Locations for the interchange

3.3.25 The next stage in our analysis was to examine all the potential locations for the Heathrow interchange, including those more distant from Heathrow as well as those serving it directly. This followed the same process as we used for the London stations: initial sifting of a long list in stage 1, shortlisting in stage 2, and finally selection of a preferred location and alternatives in Stage 3.

Creation and initial sifting of the long list of station options – Stage One

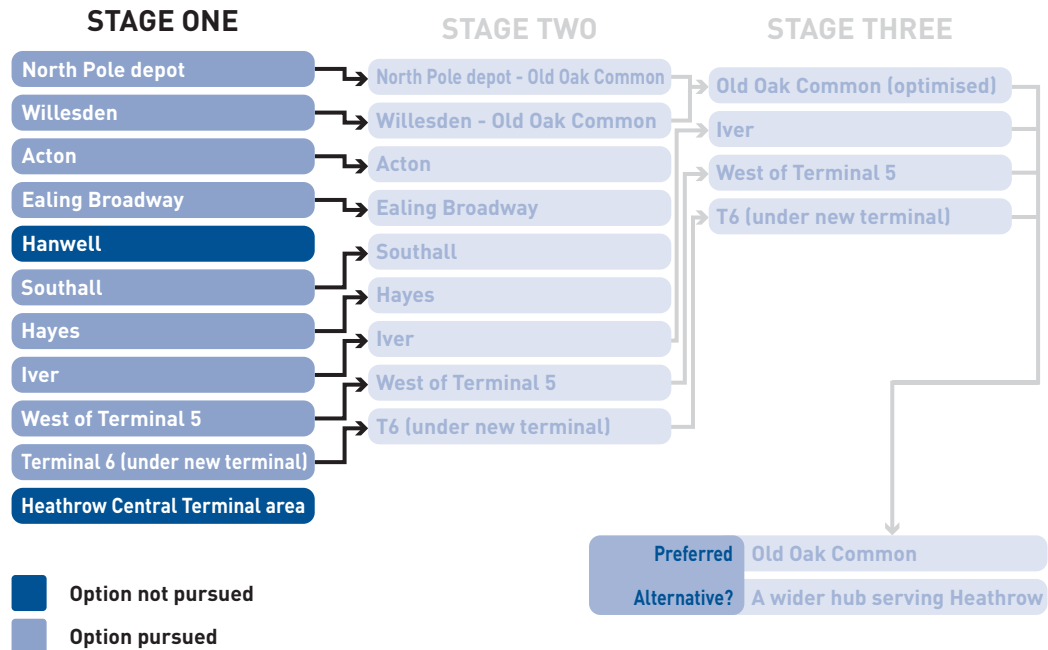


Figure 3.3d Interchange sifting process – Stage One

3.3.26 As noted in Figure 3.3d, for those options not serving Heathrow directly we started by identifying a number of sites along or near the GWML and Crossrail over the whole route section between West London and Heathrow. The long list comprised potential stations at Old Oak Common, Willesden, Acton, Ealing Broadway, Hanwell, Southall, and Hayes, plus the sites at Heathrow - a site at Iver, west of T5, beneath (the proposed) Terminal 6 and beneath the Central Terminal Area. We narrowed down this long list using the following criteria:

- Overall fit with the remit.
- Operational/Engineering feasibility.
- Demand – a non-modelled broad assessment of likely scale of demand for both dispersal into London and Airport passengers.
- Cost – at the level of a basic order of magnitude.
- Other relevant factors, including obvious potential environmental constraints.

3.3.27 As noted in Figure 3.3d, this led to two station options not being pursued further:

- **Heathrow Central Terminal Area.** With no space for a surface station, it would be necessary to construct it deep underground between the runways whilst avoiding existing sub-surface services and transport links. Building a cavern at least 1km long and over 60m wide underneath a live airport would be extremely difficult, entailing similar construction risks as the London cavern options.
- **Hanwell.** The site identified at Hanwell was located about ¾ mile south of the current GWML, just north of the M4 motorway on Osterley Park. This site was not pursued given its very poor onward transport links and environmental impact.

Determining the short listed options – Stage Two

3.3.28 From this point the options at North Pole and Willesden were merged to become one optimised ‘Old Oak Common’ option as they were very close in location. Through the application of the following criteria we decided not to pursue four of the options as described below and shortlisted Old Oak Common and the sites west of T5, near Iver and the proposed T6:

- Passenger demand.
- Environmental, social and spatial considerations – simplified appraisal.
- Costs – based on an initial evaluation of the high-level scope with a generic unit rate applied.
- Engineering and construction feasibility.

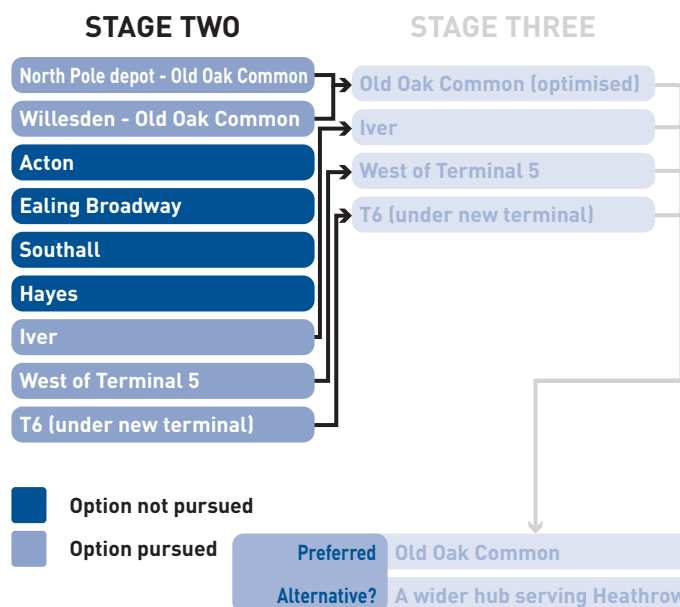


Figure 3.3e Interchange sifting process – Stage Two

3.3.29 As noted in Figure 3.3e, the sites not pursued further were:

- **Acton.** The land we identified at Acton is currently a major freight facility used to stage freight movements from the GWML. It would be extremely difficult to relocate this facility further west given the insufficient capacity on the GWML, or further east due to the track gradients. Its loss would result in additional road freight and so, while other options existed, we did not pursue it further.
- **Hayes.** A site at Hayes was substantially inferior to that nearby at Southall, with a significant heritage impact and difficult and disruptive construction.
- **Ealing Broadway.** We concluded that there was insufficient undeveloped land at Ealing Broadway to consider building a station without significant demolitions, or unacceptable construction risk. A station in a cavern below ground risked unacceptable settlement issues and would be very expensive even if feasible.
- **Southall.** Southall, though it is currently a largely unused site, performed badly in comparison to options at Old Oak Common, particularly as a result of its limited onward connectivity and the disruption it would cause to planned development.

Selecting the preferred and alternative options – Stage Three

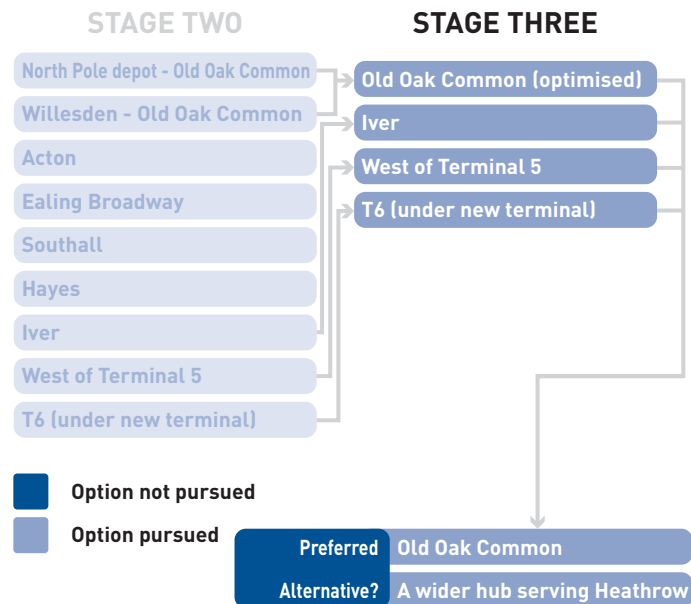


Figure 3.3f Interchange sifting process – Stage Three

3.3.30 As shown in Figure 3.3f, the short list of options contained three stations at or near Heathrow Airport and one option nearer to West London. Below is a description of the engineering and sustainability issues associated with the locations, followed by the analysis which led us to select the preferred option:

- **T5** – Cut and cover box on a brown field site just to the west of T5 and the A3044. It would be aligned north-south making through and loop access options particularly circuitous. It would comprise 4 HS2 platforms plus 2 fast lines in the through option and could offer some parking facilities with good links to the M3, M4 and M25. However the entire station would be within the Hillingdon Air Quality Management Area. The T5 option would not be in conflict with and could complement the proposed Airtrack alignment. Flood compensation would be required due to the associated floodplain.
- **T6** – Cut and cover box on ground by then already cleared for a third runway. It would comprise 4 HS2 platforms plus 2 fast lines in the through option. If T6 is built, inter-terminal connectivity would be part of that construction. The T6 option is also within the Hillingdon Air Quality Management Area. Since it is assumed that the station site for T6 would have already been cleared for Runway 3, the additional impacts from the HS2 station would be minimal. (If a third runway and T6 were not built, there would still be a possibility of using a site at or close to this proposed site for an HS2 station, such as a site adjacent to the Northern Perimeter Road, requiring the potential relocation of short stay airport parking and allied facilities; but further work would be needed to develop this option, including consideration of the effect on the existing communities.)
- **Iver** – Cut and cover box on a site located immediately north of the GWML near the M4. It would comprise 10 platforms (4 high speed platforms, 4 GWML platforms on the fast lines and 2 GWML platforms on the relief lines) plus 2 fast high speed lines in the through option. We have assumed a rapid Advanced People Mover link to the airport and an interchange with the GWML. We have not assessed the cost of providing this link. Any station at Iver would have a major adverse environmental impact with over 50% being within the Colne floodplain with potential to disturb riparian habitat. There would be serious flood plain impacts which would be difficult to mitigate.
- **Old Oak Common** – The station would be in the area of railway land between Wormwood Scrubs and Willesden with limited environmental impacts. The HS2 part of the station would be below ground in a cut and cover box whereas the remainder would be on the surface. It would comprise 14 platforms (6 high speed platforms, 4 platforms serving the GWML fast lines, 2 platforms for the GWML relief lines and 2 dedicated Crossrail turnback platforms). We estimate the cost of this station at £570m. This includes all contractor costs but excludes particular location-specific construction risks, ancillary items, environmental mitigation, land purchase, TOC compensation, project costs and any routewide or programme level risks which are included in the overall costs. Given its proximity to London and therefore the lower time penalty associated with stopping and higher benefit to London passenger dispersal, we have assumed that all HS2 trains would stop at Old Oak Common thereby maximising connectivity without reducing the capacity of the line. The site also offers significant regeneration potential.

Choosing between the options: Old Oak Common and Heathrow

3.3.31 Given the considerable uncertainty about the future development of Heathrow and of the other opportunities for Western access, it is not our intention to make recommendations between the stations near Heathrow. At this stage we have sought to identify whether an Old Oak Common station or a station at or near Heathrow provides a better overall case. We therefore continued our analysis on the basis of a generic Heathrow station that serves the GWML and Heathrow Airport's terminals equally well – a 'best case' Heathrow option.

The case for and against a Heathrow station

3.3.32 A station at or near Heathrow would better serve the airport market, although our modelling suggests that market amounts to only just over 2,000 HS2 passengers per day in 2033 to and from Heathrow. A station at Iver (but not T5 or T6) would also provide interchange opportunities for up to 20,000 GWML passengers wanting to change to and from HS2, who would benefit from a shorter overall journey time than with an interchange at Old Oak Common. However this would be offset by the average wait time if only 1 in 3 trains stopped at Iver as opposed to all trains stopping at Old Oak Common.

3.3.33 A Heathrow station is less attractive for the more than 80% of HS2 passengers travelling to and from London, who would have a journey time penalty of some 4 minutes by virtue of the longer route via Heathrow. This would extend to 7 minutes for trains stopping at Heathrow. If served by a loop from the preferred main line route (which we have noted would overall be the best option) the penalty for the third of stopping trains becomes 9 minutes. Few, if any, London-bound passengers would interchange onto Crossrail at Heathrow, since it is too distant from London and the frequency would not be attractive; so an interchange at Heathrow would not help with dispersal of London passengers.

3.3.34 Of the three station locations near Heathrow, T5 and Iver could offer the opportunity for people who live or work near these locations to get by car to the HS2 station to travel on to the West Midlands and beyond. Creating a "parkway" station in this way would encourage some people who would otherwise drive to the West Midlands to use high speed rail. However, encouraging any increase in car use in the area would also have congestion and local air quality implications. We estimated that, in 2033, a possible 6,000 per day would use a station for travel to and from stations served by HS2 if it had good, uncongested access to the M25 junction.

3.3.35 There would also be an additional cost of around £3bn in serving Heathrow directly (rising to around £3bn with risk added). At Iver, the only Heathrow option to provide the direct GWML connection, there would be serious and difficult to mitigate flood plain impacts.

The case for and against Old Oak Common

- 3.3.36** With 14 Crossrail trains starting at Old Oak Common, rather than Paddington, we would expect around one third of London-bound HS2 passengers to get off here. Between half and two thirds of those passengers would use Old Oak Common to get to locations such as the City and Canary Wharf via Crossrail, experiencing better journey times than if they had stayed on HS2 to Euston. The remainder would be using Old Oak Common to change onto GWML services or to access Heathrow.
- 3.3.37** A station at Old Oak Common would also offer a connection to Heathrow. We assumed 4 Heathrow Express trains an hour stopped there, giving a modelled journey time to Heathrow of 14 minutes (which it might be possible to improve in practice), along with 4 slower Crossrail trains an hour to Heathrow. In order to allow Heathrow Express trains to stop we have designed a station layout which, with timetable optimisation, would avoid reduction in capacity on the GWML fast lines. Our modelling suggests that, on this basis, around 1,000 airport passengers would use HS2 to access Heathrow via Old Oak Common. Moreover, the 14 minute journey time we have assumed from Old Oak Common to access Heathrow is not a “gross” penalty compared with options that serve Heathrow directly. From Old Oak Common, Heathrow passengers could make a direct journey to the Central Terminal Area or T5, whereas both T5 and T6 station options would have inter-terminal journey times for passengers not travelling from those terminals, and an Iver station would be 8-9 minutes off-airport whichever terminal was being used.
- 3.3.38** A station at Old Oak Common with all HS2 trains stopping would disbenefit the 95,000 passengers travelling on HS2 to and from Euston and not wanting to interchange at Old Oak Common, who would experience an additional penalty of 4 minutes in their journey. There would also be disbenefits for passengers stopping there on the GWML who do not want to use HS2. On the plus side, there would be benefits to GWML passengers travelling to the Midlands and North who can access HS2 more quickly via Old Oak Common rather than going into central London first (though a Heathrow station at Iver might be better); and GWML passengers could also access Crossrail for journeys into London. A station at Old Oak Common would have limited road access and so could not provide the same parkway opportunities as Heathrow.
- 3.3.39** Taking the benefits and disbenefits together gives an overall benefit of £2bn for a station at Old Oak Common and some revenue gains. These figures do not fully capture the benefits of relieving overcrowding at Euston, as they do not reflect impacts such as the closure of stations due to overcrowding. There are very limited adverse sustainability impacts at Old Oak Common, and significant regeneration potential.
- 3.3.40** We recognise that there would be a number of possible ways to reduce the impact on the Underground from the additional passengers likely to use Euston, as described in section 3.2. Most of these could be developed in conjunction with an interchange station. However, the TfL option of diverting suburban London Midland services onto Crossrail would have implications for an HS2 station at Old Oak Common. Crossrail trains would already be relatively full when they reached Old Oak Common if they started in Milton Keynes, Tring or Watford, potentially reducing the attractiveness of the change for HS2 passengers.

Overall

3.3.41 The comparison of Heathrow (assuming a loop) and Old Oak Common options is summarised in Figure 3.3g. The key points are:

- For those going to Euston and for GWML passengers there is little between the options.
- Heathrow is better for those accessing Heathrow.
- Old Oak Common is better for those accessing London via Crossrail, and eases congestion problems at Euston.
- Serving Heathrow directly costs around £1.4bn more (excluding risk) than an interchange at Old Oak Common.

	Heathrow (Loop) (A third of trains stopping)	Old Oak Common (All trains stopping)
Passengers to Euston	Two thirds have no time penalty. One third have a time penalty of 9 minutes.	All have a four minute time penalty.
London passengers changing at interchange onto Crossrail	Interchange not attractive.	Around 20% of passengers would change to get shorter journey times to parts of London
GWML passengers (interchanging to HS2)	Journey time up to 20 minutes quicker than via Old Oak Common, but lower HS2 frequency means an average interchange penalty of 24 minutes on the assumption of 1 train per hour to each of Birmingham and Manchester.	Journey time slower than via Heathrow, but higher HS2 frequency means an average 8 minutes interchange penalty.
Heathrow access	Better journey times, for those using the terminal served by HS2 (if T5 or T6) though with a time penalty for those using other terminals.	Up to 14 minutes longer journey time.
Parkway	Benefits for modal shift to rail for long distance journey; but possibly outweighed by local impacts.	No opportunities

3.3.42 While we recognise that the air passenger market may develop in a way which we cannot forecast and while there may be wider arguments for a rail hub or interchange to the west of London near Heathrow, our conclusion, in terms of the balance of benefits and disbenefits, and given the substantially higher cost of serving Heathrow, is that the case for an HS2 station at Old Oak Common is stronger than for a station at Heathrow.

Preferred option: Old Oak Common

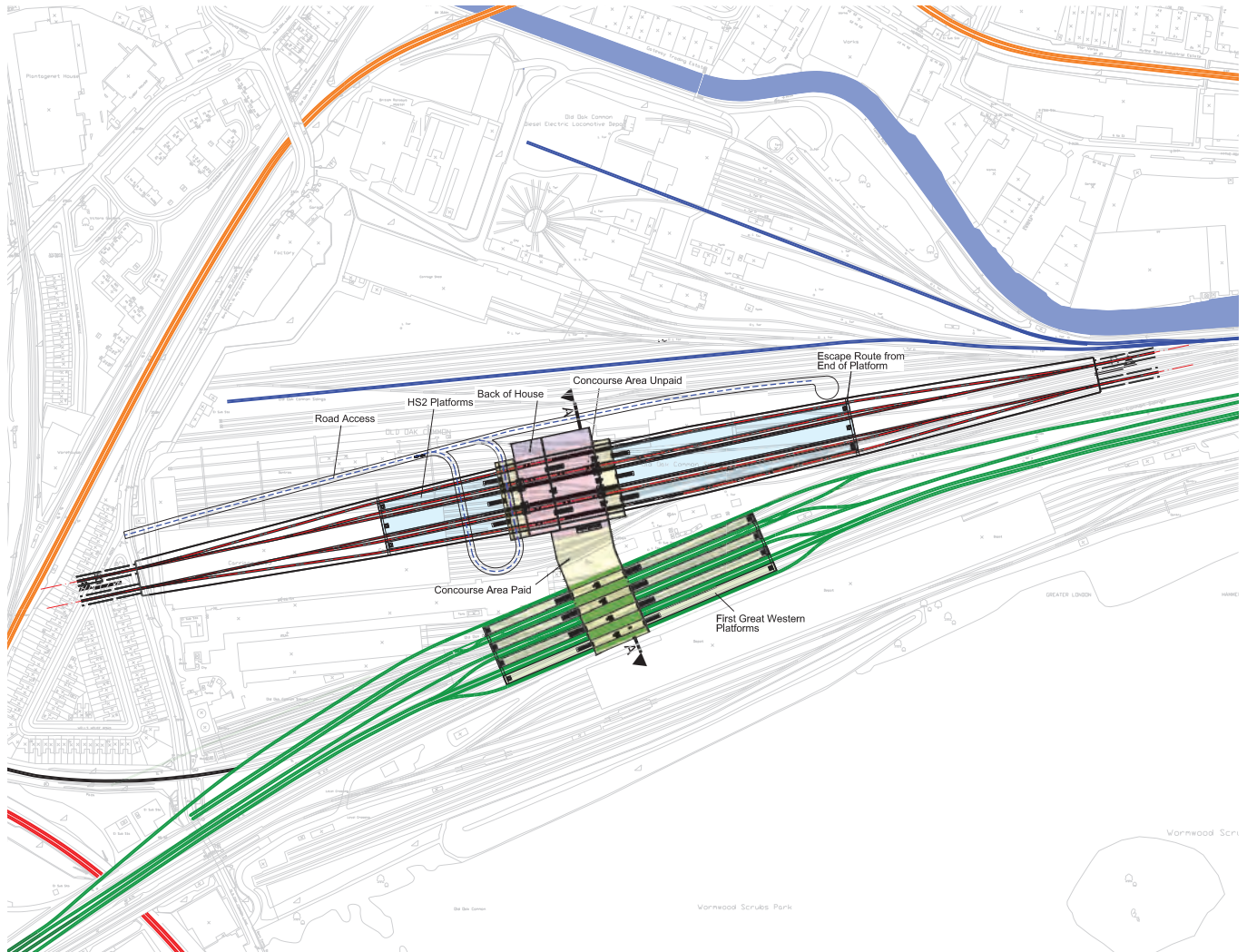


Figure 3.3h Proposed Old Oak Common station platform layout

3.3.43 We therefore included a station at Old Oak Common in the preferred scheme. Figure 3.3h shows the platform layout. Given the site is located on railway land which is extensively used for depots and sidings, there are few environmental constraints. However there is likely to be some impact on housing to the west due to shallow tunnelling. The proposed station location avoids the Grand Union Canal and the large regionally important Metropolitan Open Land at Wormwood Scrubs to the south. As with Euston, the site also offers significant potential for regeneration of the area, particularly given it is within one of London's growth corridors, the Western Wedge. The area also falls within the opportunity area for London's largest industrial site, Park Royal and is likely to provide the catalyst to bring forward other redevelopment projects in west London as well as creating a number of different employment opportunities. Benefits could be realised for the London Boroughs of Ealing and Brent, as well as for the London Borough of Hammersmith and Fulham.

Summary of evidence from London Borough of Hammersmith and Fulham

The London Borough of Hammersmith and Fulham commissioned work to investigate the transport and regeneration case for a High Speed Interchange at Old Oak Common. They believe that an interchange station could act as a catalyst to achieve dramatic transformation of the area and its surrounding neighbourhoods through:

- Improving labour supply and skills.
- Promoting economic growth and diversification.
- Supporting wider regeneration initiatives.
- Stimulating strategic inward investment.

The London Borough of Hammersmith and Fulham see a HS2 interchange opening up the opportunity for employment and residential development with the Grand Union Canal becoming a key feature, possibly providing a marina or riverside park, and Wormwood scrubs providing valuable open space. With a balance of housing types and tenures it is expected that the development would promote diversified communities and contribute to local requirements for affordable housing. Similarly, the development could transform the quality of the local business base and labour market and provide a significant source of construction and permanent employment for local people – potentially 5,000 new jobs. The interchange station could also significantly enhance the nearby Park Royal industrial estate as a strategic investment location.

3.3.44 Also within close proximity to this location are the West London Line, the North London Line, the Central and Bakerloo lines (Underground) and the Dudding Hill Line (with potential links to Thameslink via Cricklewood). It could be possible to provide links to these lines creating a station here with greater connections. As part of the Old Oak Common station proposal, we recognise that an alternative depot site for Heathrow Express would be required and that Great Western train depot facilities would be reviewed.

Heathrow as a future increment

- 3.3.45** Pursuing an Old Oak Common interchange as part of our preferred package leaves open the opportunity of adding a loop to Heathrow in the future at an additional cost of £2bn excluding risk, or at least £2.5bn including risk. The case for this and the choice of location would be dependent on a number of future decisions and ought to take account of the scope to enhance wider public transport options for airport passengers.
- 3.3.46** We have not sought to model and analyse the benefits of improved connectivity to Heathrow generally through, for instance, improved Western access. We focussed on the case for high speed and considered a Heathrow station on the basis of a wider high speed network. Against this background the case looks weak with significant disbenefits to HS2.
- 3.3.47** However, other developments to improve surface access to Heathrow could provide opportunities to include a high speed station in a wider interchange that serves Heathrow Airport directly. Similarly, future decisions on the development of Heathrow Airport, including decisions on the third runway and the scope for improved links between terminals, would affect the best way of serving Heathrow.
- 3.3.48** If it was thought likely that there would be a good case to serve Heathrow in future, it would be prudent to build the civil engineering structures at each end of such a loop from the main line, from Day One, to allow the connection to be built later with minimal disruption to HS2.

An airline's view

HS2 would capture a significant proportion of the existing point-to-point passenger market from airlines. However, this market is not the key determinant of the domestic flight schedule for airlines. It is the maintenance of the transfer passenger markets that lead the airlines to operate a given level of flights to make connections possible.

It is likely that transfer passengers will favour flying domestically instead of using a high speed network. HS2 would have to service Heathrow directly at a competitive price and recognising issues of convenience of through baggage handling and end-to-end carrier liability otherwise airlines would maintain the transfer passenger market share. A codeshare arrangement between the airlines and the HS2 promoter would be required to prevent the transfer passengers moving to EU hub airports and would allow Heathrow to maintain its share of the transfer passenger market. Such an arrangement may even capture transfer passengers that currently fly from the UK regions to EU hub airports. The connection between HS2 and Heathrow, and the on-board experience whilst using HS2, would be an essential element of that codeshare agreement.

BAA submission to HS2

BAA made a submission to HS2 providing their high level technical appraisal of possible options for high speed rail to serve Heathrow Airport, and their preferred option. BAA identified six critical factors for a successful high speed service to Heathrow:

1. Frequency of service: critical for rail-air substitution
2. Wider transport connectivity: national, regional and local
3. 'At Heathrow' passenger experience: should feel like a plane-to-plane interchange
4. Ease of interchange: time, distance, ambience
5. Baggage management: check-in points, amount of handling
6. Inter-Terminal connectivity: efficient movement to/from each of the airport terminals

They identified 5 options for serving Heathrow by high speed rail, varying by proximity of the station to the airport, and the type of connection (through route, spur or loop).

Setting aside funding issues, BAA conclude that their preferred option is a station at Heathrow itself served by 'through-running', of which a loop from the high speed line is one version. A station at Heathrow is considered to provide a better passenger experience of interchange, baggage management and inter-terminal connectivity than an option near Heathrow such as the Arup Heathrow concept. However BAA recognise that an option near Heathrow can meet some of the criteria whilst also providing a connection to the Great Western rail network.

BAA's least preferred option is a station remote from Heathrow serving the airport via classic rail such as Heathrow Express. They consider that the need for interchange would provide a worse passenger experience and thus reduce the likelihood of air-rail substitution.

Arup's proposal for "Heathrow Hub: The UK's Global Gateway"

Arup has developed a proposal for a multi-modal interchange near Heathrow Airport, which they call the *Heathrow Hub*. It would be located on the GWML, 3.5 km north of Heathrow, at the site we refer to as Iver. The proposed 12 platform station would permit direct interchange between Heathrow, HS2, GWML, Crossrail, and assuming provision of an appropriate link, to HS1. Direct connections would be provided to the strategic road network (including the M25) and provision made for a bus and coach station, the objective being to promote public transport use and keep car parking provision to a minimum. The proposed site lies within the Green Belt, with a water treatment works and other developments currently occupying a significant part of the site. The eastern edge of the site is in the River Colne floodplain. Arup's proposals would impact on a small number of residential properties.

The proposal envisages that an airport terminal would be integrated with the Hub station (initially illustrated with a capacity for 30 million passengers per annum). The station and air terminal would be linked to the rest of the airport with a fast and frequent, automated people mover and baggage systems. Arup estimates that the journey time from the Hub to T5 would be 3.5 minutes and 6 minutes to the central terminal area.

Arup envisages 25-70 million Hub users per annum by 2030 of which 9-11 million would be passengers interchanging for non airport journeys. The proposal includes adoption of a charge for cars to enter the airport (level unspecified), which helps increase the rail share of surface access to Heathrow from 10% today to 25-45% in 2030, and raises revenues to contribute to the costs of infrastructure. Arup argues that 50 to 80% of all domestic and international short haul air travel to and from Heathrow could switch to high speed rail via the Hub; and that 50 to 80% of trips between UK regional airports and European hubs would switch to using rail to Heathrow for onward long haul flights rather than using other European airports. Arup argues that the top end of the forecast represents what could be achieved with a deliberate policy to encourage modal shift with air taxes and regulation of rail fares.

Arup proposes that the Hub would be directly on the route of HS2, to give the best level of service for airport passengers. The proposed station and connecting rail links would permit "through running" of trains to minimise delays for non airport passengers. Arup argues that direct high frequency interchange between air and rail maximises modal shift.

Arup argues that the Hub would support the affordability of HS2, through increased fare revenues, enhancing the value of HS1, and other transport and commercial development. A phased development is proposed with Phase 1 establishing the integrated station and terminal on the GWML and connection to Crossrail services. Phase 2 links the Hub to HS1 and Euston as part of new HS2 infrastructure. Figures are not provided for the cost of the proposal, or funding sources.

Summary and key recommendations

- 3.3.49** The market for access to Heathrow by HS2 is small compared with the market for London. The options for serving Heathrow directly are stations at T5, T6 or a site close to the airport at Iver. Given the uncertainties around future development at Heathrow, and the wider opportunities for improving access from the west, we do not make a recommendation for a preferred option at Heathrow.
- 3.3.50** If Heathrow were to be served directly, the best option for serving it is a loop from a surface main line route which would follow the existing Chiltern line corridor to the Ruislip area.
- 3.3.51** Initially at least there is a stronger case for an interchange closer to London at Old Oak Common, providing good access to London and helping the dispersal issue at Euston. We therefore recommend that:
- For Day One a station at Old Oak Common is included in the core HS2 scheme.
 - If serving Heathrow was still a priority, we recommend further work on the options in the light of developments at Heathrow and the opportunities and plans for a wider hub.
 - If Old Oak Common was pursued from Day One, a station at Heathrow, served by a loop, could still be built following the construction of a wider network. If Government wishes to keep this option open, passive provision should be made for the loop in the Day One scheme.
- 3.3.52** If work is to be taken forward on a station at Old Oak Common, we recommend that:
- A more detailed understanding of the implications of the interchange with the GWML should be obtained to inform the next stages of assessment.
 - Further consideration should also be given to the wider public interchange opportunities offered at this location, along with options for the effective provision of road access.
 - Additional work should be carried out to assess the long term implications for depot management on the existing railway, given the impact on existing depot land that the HS2 proposals would entail.