Heathrow Expansion

Updated scheme design - Surface Access

Development Strategy submitted to the Airports Commission
by Runway Innovations Ltd and Heathrow Hub Ltd

June 2014

RIL Runway Innovations Ltd

Heathrow Hub

URS

aviationeconomics

rdcaviation

Think

GT gardiner theobald

fcp

ORS Oxford Rail Strategies

pba peterbrett

GGau Güller Güller architecture urbanism Rotterdam.Zürich

maitland

QUATRO

HIGH POINT ECONOMICS

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EXECUTIVE SUMMARY

The surface access networks around Heathrow Airport are busy at peak periods. Our approach to the development of this surface access strategy is to provide additional and alternative routes to allow dispersion of surface access traffic so as to limit the impacts of airport growth on any one element – ***An Integrated Transport Solution.*** Our strategy is also designed to be readily deliverable at no additional cost to the public purse.

Our strategy is designed to be fully compatible with both our and HAL's airport masterplan and is therefore presented separately from our airport proposals. It includes the following individual elements to address both passenger and employee challenges;

Heathrow Hub interchange, associated road and rail infrastructure, bag drop and landside APM to the airport campus;

- Modifications to the local road network around the airport
- Firm proposals – package of rail enhancements as agreed with Network Rail and TfL;
- Full strategy – further enhanced rail package, largely agreed in principle with Network Rail and TfL;
- Coach & Bus enhancements

Importantly, our proposals benefit both airport and non-airport traffic.

We summarise below how our strategy satisfies the Airports Commission objectives for Surface Access.

Objective 1: To maximise the number of passengers and workforce accessing the airport via sustainable modes of transport.

- Our strategy delivers a direct or same station single interchange rail journey to the vast majority of airport passengers in the UK, see figure below, transforming rail journey times compared with today's rail and coach times. Connecting existing Great Western Main Line services and the Waterloo/Richmond/ Staines lines to the airport will also be a major benefit for the airport workforce. We forecast that the public transport mode share in the Great Western corridor (Heathrow's largest catchment area outside London) will increase from 35% today to nearly 60%.
- Heathrow Airport has been very successful over the last 10 - 15 years in reducing the car mode share for employees and their strategy moving forward sees this dropping to 24% by 2030. Public transport will pay a key part in this but reinforcement of other measures such as personalised travel planning, expansion of discounted travel and reducing available employee parking spaces, will be key. We fully support the measures HAL Ltd have already taken and propose and do not see any reason to challenge their assumptions and have therefore adopted their 2030 assessment of 24% single occupancy car mode share in our strategy.

Rail Journey Time Comparisons		
	Current	RIL with Heathrow Hub
From	**mins**	**mins**
Leeds	205	116
Birmingham	155	82
Crewe	170	88
Manchester	200	101
Ipswich	145	122
East Croydon	85	61
Welwyn Garden City	94	77
Reading	65	16
Oxford	95	41
Swindon	92	46
Bristol	133	87
Cardiff	163	110
Plymouth	259	190

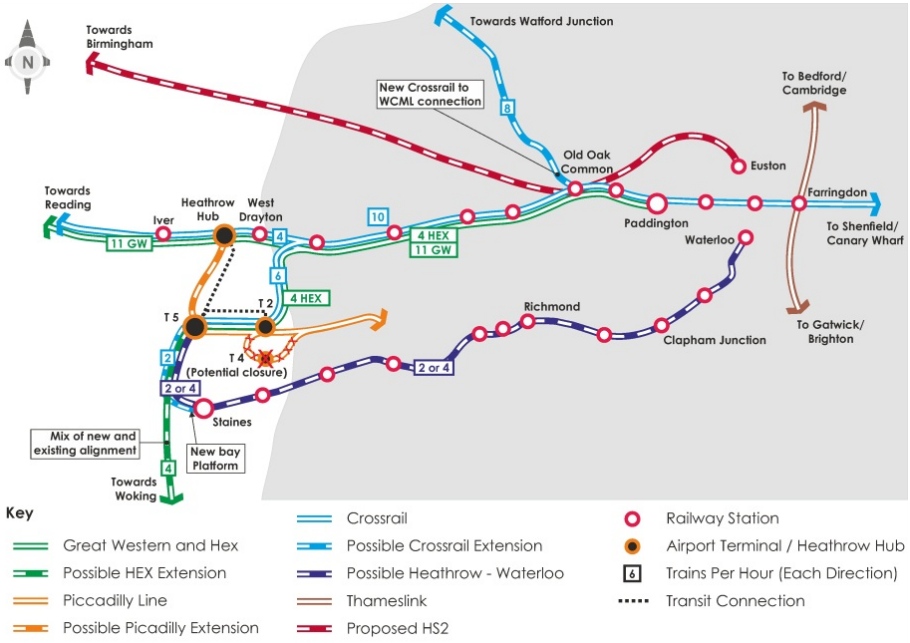
note: 20 minutes interchange penalty(interchange + wait ti
assumed where interchange required

Objective 2: To accommodate the needs of other users of transport networks, such as commuters, intercity travellers and freight

- Our dispersion strategy means that rail access to London is spread across 4 different corridors (Heathrow – Paddington / Crossrail (10tph), Piccadilly line, Heathrow via Staines to Waterloo (2tph min) and Heathrow Hub (GWML) - Paddington / Crossrail (30tph), compared with only 6tph today between Heathrow and Paddington. As a result: our strategy provides high levels of resilience & flexibility; minimises the impact of airport demand on the commuter and inter-city networks and indeed we expect no further loading on the Piccadilly line.

- Network Rail have confirmed that our Heathrow Hub layout is more than adequate for accommodating any freight aspirations on the GWML. We also retain the Colnbrook freight branch.

- The combination of our passenger and employee strategy for the expanded airport will result in a negligible impact on the total traffic on the road network. Although we are not able to fully analyse the impact, we believe that a cordon charge, providing “the stick” for encouraging greater use of public transport to access the airport, will be justified in the future and would be entirely compatible with the dramatically improved public transport provision we propose - “the carrot”. This would be particularly effective in helping to cap taxi journeys and reduce kiss and fly both of which have a disproportionate impact on road congestion and local air quality. With both the carrot and the stick we would expect there to be no more airport passenger and employee related traffic on the road network than today, with the public transport mode share being near 60%.



- Access by road for airport traffic would be dispersed between the existing site and the hub site. This allows a junction to be removed on the M25 with consequent improvements in safety and capacity by increasing the length for weaving, merging and diverging movements from the existing sub-standard lengths.

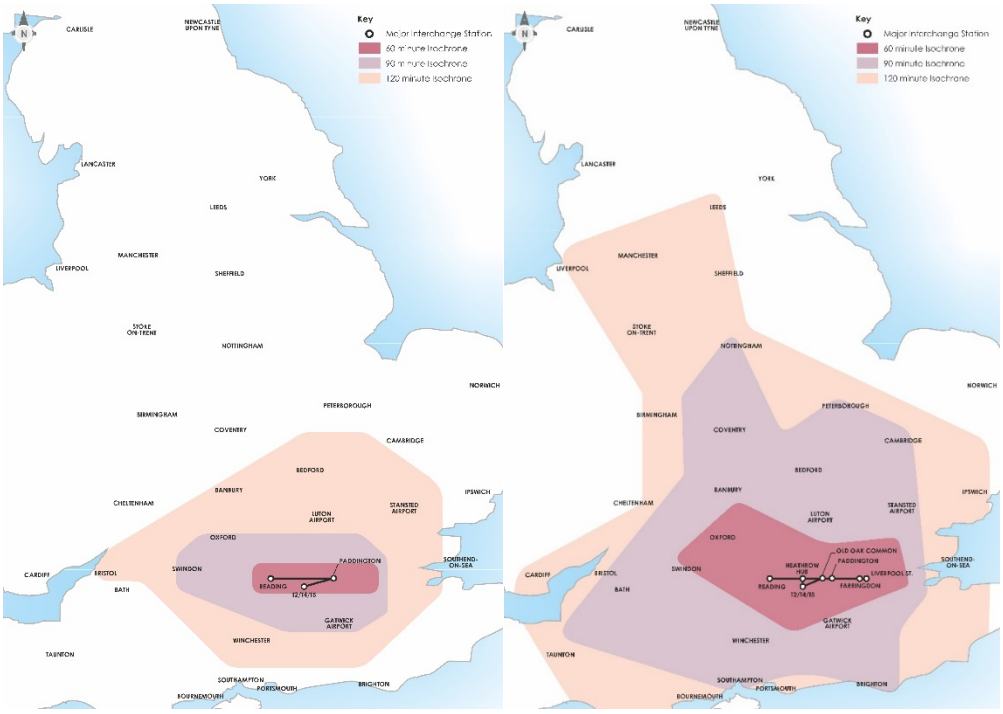
- The local road network would be replaced where required to retain existing connections, whilst trying to address some of the existing issues with rat-running.

Objective 3: To enable access to the airport from a wide catchment area

- Connecting to the countries key main line rail routes (GWML, WCML, HS2, MML, ECML, GEML, WAML, SWML) either directly or with a single same station connection at either Old Oak Common, Farringdon, Clapham Junction or Liverpool Street, will bring an unprecedented 95% of the airports passengers within 120 minutes of the airport by rail.

- Our coach/bus strategy is complementary to our rail strategy and completes the national network coverage by serving: areas of the airport's catchment not served by rail, provides an alternative for passengers who find price a key determinant of mode choice and provides services early or late in the day when rail is not operating

- No other airport in the UK can or could achieve such geographic connectivity or deliver a greater public transport mode share. The rail current and future rail catchment isochrones are shown below.



We have not at this stage been able to undertake detailed modelling of the overall impact on mode share if all our proposed options are implemented. However, we note that Heathrow Airport Ltd (HAL) forecast a public transport mode share of more than 50% in their response to the Commission of 17th July 2013. Given that we propose significantly more effective public transport interventions than HAL, we would expect that we would achieve a higher public transport mode share than HAL's proposals, particularly as HAL assumed the construction of the HS2 spur to Heathrow in 2032, which now looks highly uncertain.

Our objective has been to develop a surface access strategy capable of delivery with as close as possible to a neutral impact on public finances. This is possible as a result of the potential offset costs of ca £1.1bn for rail projects which would not be required with Heathrow Hub, eg Western Rail Access to Heathrow (WRAtH - see section 6 of this report). The result is that our rail enhancement proposals (excluding the Heathrow Hub interchange itself) could effectively be cost neutral, whilst delivering much greater benefits and additional fares revenue compared to current proposals. The Hub interchange itself could either be funded through the airports RAB, or by adopting the existing successful model of privately developed and operated railway stations. Overall we believe our proposals provide an extremely cost effective solution to the unavoidable issue of surface access to an expanded Heathrow.

Initial discussions with the Highways Agency, Network Rail and TfL confirm that the principles of our approach and the practicalities of delivering the strategy, as described, are sound at a strategic level. Journey time, reliability and interchange are key factor is determining public transport mode share. Over the next 20 years the road network will become more and more congested with journey times becoming less reliable.

This level of connectivity is not achievable with Heathrow Airport Limited's proposals, nor for Gatwick or a Thames Estuary Airport; we are concerned that Gatwick in particular has made some extraordinary claims in relation to average journey times. We will shortly submit a separate note comparing the surface access plans for the different proposals.

ABBREVIATIONS

Abbreviation	Meaning
AC	Airports Commission
APM	Automated People Mover
Bn	Billion
CAA	Civil Aviation Authority
CDG	Charles de Gaulle Airport
CTA	Central Terminal Area (of Heathrow Airport)
DfT	Department for Transport
ECML	East Coast Main Line
EIA	Environmental Impact Assessment
EU	European Union
GEML	Great Eastern Main Line
GW	Great Western
GWML	Great Western Main Line
HAL	Heathrow Airport Limited
HEX	Heathrow Express
HGV	Heavy Goods Vehicle(s)
HH	Heathrow Hub Transport Interchange
HS1	High Speed 1 (rail scheme)
HS2	High Speed 2 (rail proposals)
IATA	International Air Transport Association
kph	Kilometers per hour
M	million
MML	Midland Main Line
mppa	million passengers per annum
NPS	National Policy Statement
NR	Network Rail
p	page
pa	per annum

Abbreviation	Meaning
pax	passenger
PV	Present value
RAB	Regulatory Asset Base
RIL	Runway Innovations Limited
sqm	square metre
SWML	South West Main Line
T2, T4, T5	Terminals 2, 4 and 5 at Heathrow Airport
T6	A possible new terminal at Heathrow to support airfield expansion
TfL	Transport for London
TOC	Train Operating Company
tph	Trains per hour
WRAtH	Western Rail Access to Heathrow
WAML	West Anglian Main Line
WCML	West Coast Main Line

1. INTRODUCTION

This submission provides further detail of our Heathrow Hub interchange proposal and our associated surface access strategy. It supplements Runway Innovations Ltd and Heathrow Hub Ltd's main submission - Heathrow Expansion – to the Airports Commission dated 29 May 2014 (v2).

Whilst that focused on the airport masterplan, this further submission gives more detail and supporting evidence to demonstrate the robustness of our interchange proposal and surface access strategy and assumptions. It also provides a record of our principal discussions with key stakeholders including Highways Agency, Network Rail and TfL.

Our strategy is designed to be fully compatible with both our and HAL's airport masterplan and includes the following individual elements;

1. Heathrow Hub interchange, associated road and rail infrastructure, bag drop and landside APM to the airport campus.
2. Modifications to the local road network around the airport.
3. Firm proposals - package of rail enhancements as agreed with Network Rail and TfL.
4. Full strategy – further enhanced rail package, largely agreed in principle with Network Rail and TfL.
5. Coach and bus enhancements.

Our overall strategy delivers a step change in public transport access to Heathrow, particularly by rail

To consider expansion of the airport without considering surface access is *non sequitur* and that is why we have developed an ***"Integrated Transport Solution"***. This also aligns with the integrated approach to airport expansion and surface access adopted by the Airports Commission.

Our strategy aims to address and satisfy as a minimum the Airports Commission core objectives for Surface Access as set out in Section 4 of the Appraisal Framework:

1. To maximise the number of passengers and workforce accessing the airport via sustainable modes of transport.
2. To accommodate the needs of other users of transport networks, such as commuters, intercity travellers and freight.
3. To enable access to the airport from a wide catchment area.

The surface access networks around Heathrow Airport are already busy at peak periods, and forecast background growth will add to the stress already evident on both the road and rail routes. Our whole approach to the development of our strategy is to provide alternatives and dispersion of surface access traffic to limit the impacts of airport growth on any one element.

Key factors in the approach are

1. Provision of Heathrow Hub - a new gateway site which:
   a. Aims to limit road traffic on the most sensitive parts of the highway network and distribute airport traffic around the network.
   b. Provides connection to a wide-range of mainline rail services.
   c. Takes advantage of the co-location of these elements of the surface access system to provide a high-quality fast link to the major airport terminals.
2. To avoid over-concentration of traffic on congested sections of the road and rail networks and to provide opportunities for dispersal – spreading high volume flows

over a range of routes through the provision of enhanced existing and new fast, convenient and reliable public transport links;
3. To use the committed rail enhancements to provide capacity on the principal rail corridors. We will work with partner agencies to implement cost-effective increments;
4. To develop schemes for additional capacity and new journey opportunities by rail and bus for air passenger and employee trips; and
5. To consider both for the needs of growing numbers of airport users and other, non-airport, travellers.

Initial discussions with the Highways Agency, Network Rail and TfL suggest that the principles of our approach and the practicalities of delivering the strategy, as described, are sound at a strategic level. Journey time, reliability and interchange are key factors in determining public transport mode share. Over the next 20 years the road network will become more and more congested with journey times becoming less reliable.

We have not at this stage been able to model the overall impact on mode share if all our proposed options are implemented. However, we note that Heathrow Airport Ltd (HAL) forecast a public transport mode share of more than 50% in their response to the Commission of 17th July 2013. Given that we propose significantly more effective public transport interventions than HAL, we would expect that we would achieve a higher public transport mode share than HAL's proposals, particularly as HAL assumes the construction of the HS2 spur to Heathrow in 2032, which now looks highly uncertain.

Previous studies carried out by Ove Arup & Partners for Heathrow Hub Ltd. suggested that the Heathrow Hub interchange, together with a less comprehensive suite of rail enhancements than that those now proposed, could increase public transport mode share to ca. 60% (assuming cordon charging of ca. £20 per vehicle at 2009 prices) [1]

This report is structured as follows:

Section 2: The Current Situation – This gives a snapshot of what happens today and includes the levels of demand, mode share, service levels, congestion and problems

Section 3: The Challenge 2030 – This outlines the challenge for surface access for the airport in 2030 based on an expanded airport and also taking account of background growth

Section 4: Our Philosophy – This sets out the basis of our strategy and what it aims to achieve

Section 5: Our Proposals – This provides details of our proposals by mode

Section 6: Costs – This provides details of the costs of our proposals

Section 7: Deliverability & Phasing

The environmental and economic impacts of the modifications to the highway network and the core facilities at the Hub Site have been assessed and were included in our original submissions. The wider benefits and impacts of the rail developments have not been assessed at this stage.

[1] *"Our proposals, including the use of charging for car use for passengers entering the airport, have the potential to drive the public transport share of journeys to Heathrow up from its present level of 39% to 60%, with the share of rail services increasing from 10% to over 30%"* – Heathrow Hub: The UK's Global Gateway, Ove Arup & Partners December 2009 http://www.arup.com/~/media/Files/PDF/News_and_Press/2010_04_April/091210_Arup_submission_to_HS2_Ltd_Full_Report_c_ARUP.ashx

2. THE CURRENT SITUATION

2.1 Demand Overview

According to CAA data 69.5m passengers used Heathrow in 2012 of which 43.9m were terminating at Heathrow. The current public transport mode share is some 41%[2] as shown in Table 2.1 below. The vast majority of passengers who use rail/tube come from London via the Piccadilly line of Heathrow Express.

Table 2.1 Public Transport access to Heathrow – passengers as percentage of all journeys	
Coach	9
Bus	3
Rail	16
Tube	13
All public transport	**41**

In terms of the distribution of non public transport surface access trips 22% are park & fly, 49% are taxi and 29% of kiss & fly, it should be recognised that kiss & fly tend to require twice as many vehicle km for each passenger since for both drop off or pick up one leg is run empty.

The geographic distribution of surface access trips for passengers to Heathrow is heavily skewed to London and the Southeast with some 75% of all demand coming from these areas and over 51% of this coming from Greater London. The South East excluding Greater London accounts for some 24% of which 19% comes from west of Heathrow. A summary of the geographic distribution of demand is given in the table 2.2 below which is derived from the CAA Passenger Survey Report 2012.

Table 2.2 Heathrow Terminating Passengers 2012

Region	Passengers (000's)	%
East Midlands	1,301	3.0
East of England	3,653	8.3
North East	101	0.2
North West	297	0.7
Scotland	101	0.2
South East excl Greater London	10,341	23.6
Greater London	22,602	51.5

[2] Derived from CAA 2012 survey data

Region	Passengers (000's)	%
South West	3,006	6.8
Wales	824	1.9
West Midlands	1206	2.7
Yorkshire & Humberside	466	1.1
Ireland	11	0.0
Total	**43,909**	**100.00**

We also recognise the importance of employee travel to the airport, with over 100,000 airport related jobs on and around the airport. Table 2.3 below shows the breakdown for mode of travel to work in 2011 by the ca. 77,000 staff employed by the airport (but excluding those employed in other airport related business inside or outside the airport boundary) [3]

Table 2.3 Travel to Work Mode Shares

Main Mode of Transport	Total	
	Count	%
Car driver travelling alone	43,062	58.8%
Local bus	10,402	14.2%
Underground	6,068	8.3%
Air	3,063	4.2%
Car passenger	2,475	3.4%
Car driver with passenger(s)	2,397	3.3%
Work bus/ Company transport	2,191	3.0%
Motorcycle [More than 125cc]	724	1.0%
Heathrow Connect	672	1.0%
Heathrow Express	438	0.6%
Motorcycle [125cc or less]	381	0.5%
Coach	377	0.5%
Bicycle	362	0.5%
Walked from home	203	0.3%

[3] Heathrow and Surface Transport Stress, Campaign for Better Transport
http://www.bettertransport.org.uk/sites/default/files/research-files/surface-access-final.pdf

Main Mode of Transport	Total	
Train	202	0.3%
Taxi/Minicab	191	0.3%
Total	**73,208**	

We are confident that our surface access proposals, in conjunction with other employee initiatives, many of which are proposed by HAL, would offer very attractive options for employee public transport access to the airport.

2.2 Highways

Airport related traffic comprises accounts for only a small percentage of the total traffic, with, for example, less than 10% of the peak M25 traffic between junctions 13 -14 being airport related. However, the M25 in the vicinity of Heathrow Airport suffers from serious congestion despite being up to 6 lanes wide in each direction in places. The general levels have been derived by URS from DfT data and are discussed in TN01 which is included as Attachment 2-1.

Whilst traffic volumes are the biggest contributor to congestion, the high frequency of junctions and the very nature of the M25 as an orbital motorway leads to high weaving flows between junctions. Therefore weaving distances available between junctions, especially given the high lane provision, are critical to the safe and reliable functioning of the motorway. Details of weaving lengths for the junctions in the vicinity of Heathrow Airport and concerns relating to under provision are detailed below

Weaving distances between Junction 14A and 15 in both directions are below the DMRB minimum standard for rural motorways of 2km. The northbound provision is approximately 1.5km and the southbound provision is 0.9km. This is very poor considering the lane provision on this link is 6 lanes in each direction. Any congestion or delays due to incidents in this vicinity can have a serious impact on journey time reliability for Heathrow traffic as knock on effects can quickly cause problems at all the major access points to Heathrow airport from the motorway system.

Weaving distances between Junction 13 and 14 in both directions are also below the DMRB minimum standard for rural motorways of 2km. Northbound and southbound provision is approximately 1.75km, and as above, combined with high weaving flows and lane provision (5 lanes in each direction) can lead to the same problems.

From an airfield operation perspective the standing traffic in the Public Safety Zones, with its increased density of people, is also cause for concern. Both the Northern and Southern runway PSZ's cross the M25 in the vicinity of Junctions 14A and 14 respectively.

The existing layout of Bath Road, mirroring the A4 with similar connectivity, has potential for 'Rat Running' through Brands Hill, Colnbrook and Poyle if there is congestion on the major routes.

2.3 Overview of current rail access to Heathrow

Heathrow currently has good rail access from central London. The Piccadilly Line provides both good distribution in central London and good connectivity to other London Underground lines, also to the national rail routes serving Kings Cross/St.Pancras, although other main line

termini are not directly served. The service is however relatively slow, with numerous stops, and there is significant overcrowding in the central area at peak periods, with standing passengers during much of the day. Seating is cramped and there is very limited luggage space.

Despite its drawbacks, the Piccadilly line is the most heavily used public transport route to London (13% mode share), reflecting its good connectivity and, critically, its relatively low fares, and it's incorporation in TfL's London-wide fare structure.

Heathrow Express provides a fast, premium service to Paddington using spacious trains with ample luggage space. However, its terminus at Paddington is relatively poorly connected to the London Underground network, and the fares are very high, so average load factors are low, and the service carries significantly fewer air passengers than the Piccadilly Line.

Heathrow Express also demonstrates the fundamental challenge in providing rail services for dedicated airport traffic alone at the high frequencies necessary to attract time sensitive airport passengers when loadings are entirely dependent on airport traffic. Despite connecting one of the world's busiest airports with the dense central London market, Heathrow Express only achieves an average loading of 30% in the three hour morning peak. This contrasts with other GWML services loading in excess of 100%. [4] Network Rail's RUS therefore notes the wider benefits on network capacity if alternatives to current Heathrow Express service patterns are considered on or before expiry of the service's Track Access Agreement in 2023. [5]

Paddington is also served by the slower, half hourly "Heathrow Connect" service, which calls at most stations between the airport and Paddington. This carries relatively few air passengers, despite cheaper fares than Heathrow Express. Heathrow Express and Heathrow Connect have a 16%[6] mode share between them.

There is no other direct rail access to the airport, although there are connecting coach links from railheads at Reading and Woking, and a "Green Line" service also serves Watford. Other than from central London, rail's mode share to Heathrow is very low, typically much lower than for coach, as National Express and other operators, (notably from Oxford), provide a comprehensive network of direct coach services to the airport; at present this is a much better public transport option for many parts of the country.

Network Rail specifically recognise the need for better, direct access to Heathrow from the West and South West of England and South Wales. [7]

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[4] Network Rail GWML Route Utilisation Strategy peak demand and capacity 2010 for each London terminus/ cordon and London and South East Route Utilisation Strategy, Network Rail July 2011GWML Route tion%20strategration%202/london%20and%20south%20east/london%20and%20south%20east%20route%20utilisation %20strategy.pdf

[5] "Option A5 - This option is the only realistically viable means of fully responding to the peak capacity gap. It is therefore likely to be required within the RUS timescale, providing four extra fast trains per peak hour from Reading or beyond to London in the current Heathrow Express paths" - London and South East Route Utliisation Strategy, Network Rail July 2011

[6] Derived for CAA passenger survey data 2012

[7] *"Despite the largely successful development of airports in the South West, London Heathrow is by far the most important airport hub for passengers in the Greater Western area. Poor rail access to and from the west puts additional stress on the strategic road network and impairs the South West's economic potential. Heathrow needs direct rail access from the west."*□- London & South East Route Utilisation Strategy, Network Rail, July 2011 http://www.networkrail.co.uk/browse%20documents/rus%20documents/route%20utilisation%20strategies/rus%20generation%202/london%20and%20south%20east/london%20and%20south%20east%20route%20utilisation%20strategy.pdf

Indirect rail access is already possible using existing services, but the need to change trains acts as a severe disincentive. British Airways note rail travel to Heathrow "*is an experience that passengers in South Wales and the West of England could enjoy today by changing trains at Paddington. However, they choose instead to drive to the airport or travel via a European hub.*" [8]

2.4 Overview of current coach/bus access

Heathrow has a major coach station that, as well as serving the needs of air passengers and airport employees, is now used as an interchange point between many coach services of National Express, the leading UK express coach operator. This enables passengers not on airport access journeys, to make connecting point-to-point journeys without the need to go through central London. The airport is also served by an intensive network of local buses, used particularly by employees.

Heathrow currently has three bus stations. Heathrow Central Bus Station, consisting of 11 local bus stands and 10 express coach stands, Terminals 4 and 5 where hotel and long-stay car park buses share the same stopping area as local buses and at T5, express coaches.

National Express, the dominant express coach operator in England and Wales, provides all express coach services currently running, except "The Airline", which provides services on the route to Oxford and is operated by Go-Ahead subsidiary Oxford Bus and the Reading Rail-Air link operated by First. Heathrow is served by some 290 scheduled coach movements in each direction on a typical day linking 145 towns and cities to Heathrow at least once per day. The importance of Heathrow as a bus interchange is reinforced by the fact that there are only 47 express coach services per day linking Heathrow to Victoria Coach station in central London.

Express coach services connect Heathrow to other airports, with nearly 100 departures a day to Gatwick, 26 to Luton and 18 to Stansted, and several departures each day to Birmingham and East Midland Airport.

2.5 Employees

Heathrow acts as a hub for an intensively used network of bus services linking the large employment centres both on and off the airport with the surrounding areas. The Central Bus Station serves as the focus for local bus services, while there are a number of other bus services which separately serve Terminal 5, and two services link T4 with T5.

The use of public transport by workers at Heathrow has grown significantly from 11% in 1991 to 37% in 2013. This growth has been achieved through significantly increased bus route provision, enhancing of frequencies, and significant expansion of very early and late bus services that suit the needs of shift workers. Rail and coach services also play a part in this increased use. A major element of the high level of use of public transport by Heathrow workers is the free travel area facility agreed between Heathrow Airport, Transport for London, and public transport operators. The bus services at Heathrow form a key part of the free travel area which covers all Heathrow Terminals, and also covers Hatton Cross when used as an interchange.

[8] British Airways Response to the Heathrow Airport High Speed Rail Access Review, 15th April 2010
http://webarchive.nationalarchives.gov.uk/+/http:/www.dft.gov.uk/pgr/rail/pi/highspeedrail/lordmawhinneyreport/

2.6 Taxi and mini-bus

Taxis and mini-bus are a major provider of surface access transport – CAA data shows 25% of surface access journeys used this mode in 2013. Taxi ranks are provided at each terminal and there is a feeder rank where taxis can wait before being called forward to the terminal ranks.

3. THE CHALLENGE IN 2030

3.1 Growth

We forecast that Heathrow's total passenger numbers will increase to 106 million a year by 2030 of which 73m will be Origin and Destination passengers. We have made an assumption at this stage that the distribution of passengers' origins and destinations in Britain are unchanged with the growth of passenger volumes at Heathrow see table 3.1 below. In practice, we believe this is conservative, as improved surface access, together with the improved punctuality and the wider range of destinations possible with the extended runway proposition, (as well as the potential for increased competition enabled by new runway capacity and slot allocations to new entrants) will significantly increase the attractiveness of Heathrow compared with the alternative of hubbing via other European airports such as Schiphol and Charles de Gaulle.

The effect is likely to be particularly marked in relation to Bristol, which has a relatively limited air network and, with the Heathrow Hub interchange, will have superb links to Heathrow and global destinations. It is reasonable to expect that better rail access to Heathrow might attract a significant proportion of the 10,000 passengers per week who currently fly from Bristol to interline at other European hubs. [9]

Table 3.1 Heathrow Terminating Passengers Predicted 2030 based on 106mppa overall

Region	%	Passengers (000's)
East Midlands	3.0	2,163.4
East of England	8.3	6.074.5
North East	0.2	167.9
North West	0.7	493.9
Scotland	0.2	167.9
South East excl Greater London	23.6	17,195.7
Greater London	51.5	37,584.2
South West	6.8	4,998.6
Wales	1.9	1,370.2
West Midlands	2.7	2,005.4
Yorkshire & Humberside	1.1	774.9
Ireland	0.0	18.3
Total	**100.00**	**73,015**

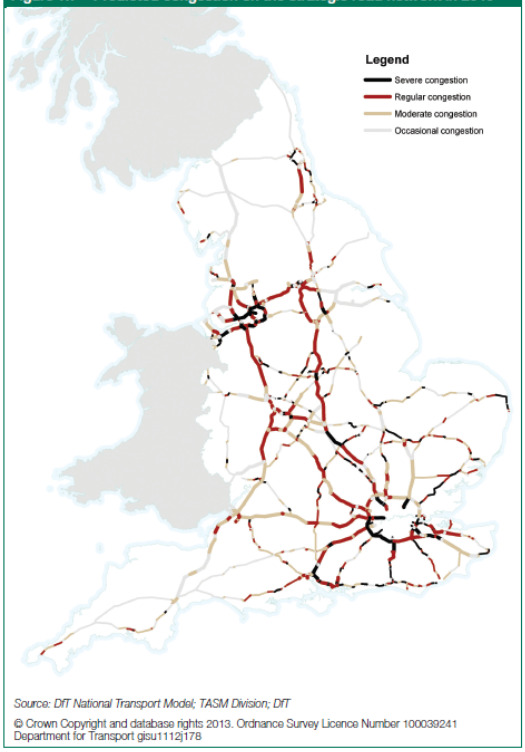
[9] Bristol International Airport press release 13th June 2008 http://www.bristolairport.co.uk/media-centre/news-releases/2008/6/ten-thousand-join-hub-club-at-bristol-international.aspx

Without action to increase the mode share for public transport, particularly rail, by improving public transport links, and to manage traffic flows to relieve the highway network, this would put an intolerable strain on the road network around Heathrow, which in any case will come under increasing pressure as a result of a general background growth in road traffic. Similarly, while capacity will be increased as part of the overall upgrade programme for the Underground, TfL forecast that the Piccadilly Line will become increasingly congested, and it is not realistic to assume that it will continue to carry the same share of air passengers in the longer term as Heathrow's passenger numbers grow. It is therefore essential that the rail routes to or via Paddington (Heathrow Express and Crossrail) carry a much higher proportion of rail movements to London, and that infrastructure is put in place to enable rail to become a more attractive mode for other parts of the country.

3.2 Highways Network

The DfT forecasts[10] for congestion on the strategic road network in 2040 are shown below. Even without a doubling in the number of air passengers at Heathrow the road network will be under major stress in the future. The proportion of traffic related to the airport depends on both the location and time of day and is in the range 5%-25% dependent on these factors based on URS analysis of DfT data. Notwithstanding this, capacity is under severe pressure (lines shown in black) from London via M40 and the south via M25. Regular congestion will also be experienced on Heathrow's approaches from the M40/ M25 north and M3. The approach of simply assuming that extra road and airport demand can be channelled through the one of the most congested sections of the highway network in Europe is not sustainable.

Figure 1.7 – Predicted congestion on the strategic road network in 2040



Source: DfT National Transport Model; TASM Division; DfT

[10] Action for Roads - A network for the 21st century, DfT July 2013
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/212590/action-for-roads.pdf

Following shortlisting, we have held a number of meetings with the Highways Agency (for notes see Attachment 3-1) and we understand from these that they have near future plans to increase capacity via a managed motorway system using hard shoulder running in this vicinity. The managed motorway scheme for the M4 is included in the extended baseline advised by the Airports Commission in its paper of 16 April 2014.

For our proposal to extend the northern runway over the M25, the general requirement is that potential for incidents within the structure must be reduced to the absolute minimum as the consequences of any such incident within the confines of a highway tunnel are much more severe than in the open. This requirement gives rise to the following restrictions:

- No weaving should occur in the tunnel.
- No merge or diverge features should be present in the tunnel.
- No standing traffic should occur in the tunnel due to congestion as the tunnel would have to be closed to maintain acceptable air quality.
- Layout of the M25 corridor and associated tunnel should provide resilience against a cell/bore closure event.
- The tunnel format should provide for future growth as capacity improvements that involve structural work would be prohibitive.

It should be noted that although the structure will create a "tunnel" on the highway, the construction will in fact more closely resemble a bridge, with the motorway level 4-5m below existing ground and the top of the structure and runway surface above existing ground level

3.3 Committed Rail Investments

3.3.1 Crossrail

The opening of Crossrail in 2019 will provide a step change in rail access to Heathrow from across London and the South East. In addition to the improvements in connectivity within London, with fast direct services to the West End, the City and Canary Wharf, Crossrail will provide major connectional opportunities:

- Single station interchange with 8 London Underground lines
- A strategic interchange with the Thameslink network at Farringdon, providing single station interchange to towns as widespread as Peterborough and Cambridge to the north of London and Croydon and Brighton to the south
- Single station interchange with Greater Anglia services at Liverpool Street, making rail a much more attractive option for access to Heathrow from towns such as Ipswich, Colchester and Southend.

3.3.2 The Piccadilly Line

Capacity and frequency on the Piccadilly Line will be upgraded as part of TfL's overall upgrade programme for the London Underground. However, TfL forecast that, despite this, overcrowding on the route will become progressively more serious.

3.4 Other Planned Rail Investment

3.4.1 WRAtH

The WRAtH project is not yet fully committed, as the DfT position set out in the 2012 High Level Output Statement is that the project is dependent on its business case and a private sector contribution. [11] WRAtH would provide greatly improved access to Slough, Maidenhead and Reading, and HAL Ltd also propose that WRAtH trains would run through to Oxford, albeit as a premium service, (although it is not clear how this would impact on line and platform capacity at Reading and Oxford). However, interchange would still be necessary for other Great Western corridor destinations, and, although rail access would be improved, this would still be much less attractive than the range of direct, fast services which would be provided at Heathrow Hub.

Journey times for Heathrow Hub and WRAtH are compared below:

From	Rail time to T5 with WRAtH [12]	Rail Time to Heathrow Hub
Reading	28	16
Oxford	53	41
Swindon	75	46
Bristol	117	87
Cardiff	142	110
Plymouth	222	190

With the possible exception of Oxford, for which HAL Ltd have assumed that WRAtH will operate direct services, albeit at a premium fare, Heathrow passengers from beyond Reading will have to change there, increasing journey times and making use of rail significantly less attractive. In contrast to Heathrow Hub WRAtH does not therefore provide a step change in rail access from the West of England and South Wales, nor does it make efficient use of capacity.

Furthermore, the WRAtH services would use up vital route capacity on the Great Western Main Line, reducing the capacity available for London services and for freight, yet would inevitably have low load factors, as they would only be useful for passengers to and from Heathrow. Taking Oxford as an example, we forecast a 39% rail mode share with Heathrow Hub, as there would still be strong competition from fast and frequent coach services. WRAtH services will be slower, and HAL Ltd propose a premium fare, so the WRAtH mode share

[11] *" the project is subject to a satisfactory business case and the agreement of acceptable terms with the Heathrow aviation industry"* - http://www.dft.gov.uk/news/press-releases/dft-press-20120712b/

[12] 20 minutes allowed for interchange, except for Reading and Oxford. Proposed frequency of WRAtH service not known, which is likely to increase perceived interchange penalty due to low frequency of services

could be expected to be at best around 25%. Using forecast 2030 air passenger numbers, and assuming a half hourly through WRAtH service to Oxford, this indicates average passenger loadings on WRAtH to and from Oxford of only c15 passengers per train. At this level, the service would be highly unprofitable, quite apart from the opportunity cost in terms of route capacity. In contrast, with Heathrow Hub, air passengers would travel on the existing Oxford – Paddington services, significantly improving their profitability, without taking up additional train paths.

The understand that the current estimated cost of WRAtH is ca£740m, of which there is a Government commitment of £500m; the balance is expected to be provided through Heathrow/airline private sector contributions. WRAtH is clearly sub-optimal to Heathrow Hub, and cancellation of the project would enable capital spending to be redirected to other public transport links, particularly the Southern rail links, as discussed below.

3.4.2 HS2 Heathrow Spur

Whilst it is possible that a spur will be built from HS2 to Heathrow as part of Phase 2 of the HS2 project, this is far from committed, but could be accommodated by our proposals. In addition, the spur would face the same problems as WRAtH – train loadings would be low, as it would only be used by Heathrow passengers, and there would be a major opportunity cost, as Heathrow trains would reduce the number of HS2 services to Euston on a one-for-one basis.

Even a two trains per hour service, assuming half trainsets, would provide ca1100 seats per hour in both directions – a capacity equivalent to two A380 aircraft each and every hour to a very limited range of UK regional cities (and with very poor onward connections to the classic rail network at Birmingham, Sheffield, Leeds and East Midlands where HS2 stations are located some distance from existing railheads)

3.5 Coach & Bus

The current arrangements for express coach and bus focus operations around the Central Terminal Area. Expansion of the airport to the west makes the existing Central Area less relevant as the focus for operations. Moreover, many express coaches serving T5 have to use M25 Junction 14A, which is located on a critical section of motorway, affected by the airfield's extension. Continuation of the existing arrangements is therefore likely to be unsatisfactory and impractical.

Additional capacity for air passengers and employees will be required by coach and bus, even with our proposed extensive rail improvements. Local bus operations are critical in providing transport for employees – services must be improved and incentives provided to employees to reduce car journeys.

3.6 Taxi and Mini-bus

Taxis are a major provider of surface access transport currently, but their use of road space is not efficient due to the very high proportion of empty movements, where a loaded journey in to the airport is not balanced by a loaded trip out.

4. OUR PHILOSOPHY

4.1 Overall

To consider expansion of the airport without considering surface access is *non sequitur* and that is why we have developed an ***"Integrated Transport Solution"***.

As outlined above, irrespective of any additional runway at Heathrow (or a second runway at Gatwick), the strategic road network will inevitably become more congested in the next 30 years though background growth and this in turn will lead to less reliable and longer journey times for passengers and employees accessing the airport. Even though airport traffic constitutes less than 10% of vehicles on the key roads round Heathrow, an approach that simply assumes that extra road and airport demand can be channelled through the strategic road network is not sustainable.

The driving force behind our surface access philosophy is to increase the public transport mode share by dramatically improving public transport accessibility, from the Regions as well as London, with fast, frequent and reliable services, providing a real and attractive public transport alternative to the use of the car. In order to achieve this, the following objectives have been developed to underpin our philosophy:

- A strategic, integrated multi-modal solution taking a region-wide view of road and rail
- Enhancements that are credible, deliverable and affordable, both in capital and operational costs
- Deliver benefits to airport and non-airport passengers, and maximise efficient use of scarce network capacity
- Make public transport the mode of choice – delivering a major modal shift from road to rail, with public transport reaching a mode share above 50%. 95% of airport passengers with 120 minutes journey time of the airport by rail and the vast majority within 90 minutes
- Put the airport directly on the national rail network, connected to the whole of the UK to connect the regions to Heathrow [13] and transform inward investor perceptions of regional connectivity [14]
- No overall increase in the number of cars (passenger + employees) accessing the airport
- Dispersal of highway access to ensure no more airport traffic on the busiest section of the M25
- Significant increase in public transport mode share for employees

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[13] *"Access to Heathrow appears as a criterion supporting many of the RDA's economic objectives and highlighting their national economic significance. This reinforces the fact that access to Heathrow is a fundamental requirement to achieving many of the economic objectives which have been set"* - Surface Infrastructure of National Economic Importance (SINEI) - A Study for England's Regional Development Agencies, Faber Maunsell/Ecotec January 2004 http://webarchive.nationalarchives.gov.uk/+/http://www.advantagewm.co.uk/Images/sinei_tcm9-

[14] *"It is clear to me that faster and simpler connectivity to a location is vital, particularly for inward investors. The reality is that for most people outside the UK they think about the UK through the prism of Heathrow. That is how they arrive. The question is not, "Where is it?" The question is, "How long does it take for me to get there from Heathrow*?" - Oral evidence to Transport Select Committee, 13th September 2011 http://www.publications.parliament.uk/pa/cm201012/cmselect/cmtran/uc1185-v/uc118501.htm

- Continued development of high quality coach and bus access, particularly for catchment areas not well served by rail.

We can meet these objectives because of the geographic location of Heathrow relative to the national road and rail networks, without having to rely on a single road and rail artery to provide access. No other airport in the UK can achieve such geographic connectivity, delivering the maximum possible public transport surface access mode share in a sustainable manner.

An overview of the key elements of our strategy are given below with the detail and substantiation given in Section 5

4.2 Heathrow Hub

A fundamental building block of our strategy is the creation of a new integrated transport gateway for the airport - Heathrow Hub - which brings a number of unique and transformational benefits to any Heathrow additional runway proposition. It will be located on the Great Western Main Line, where it crosses the M25 motorway, enabling operation of direct rail services to Reading, Bristol, Oxford, Cardiff and Plymouth, as well as other key centres in the Great Western catchment area. It will also provide frequent non-stop services to Paddington, which, together with services from the T5 and T2 campuses, will give unrivalled frequency and capacity to central London. It will also be directly connected to the M25, providing access from the M25 (north) and M4 (West & East) for private cars, taxis and coaches. Arrival at Heathrow Hub will be perceived as part of the airport experience as it will be connected directly to the T5 (5 mins) and T2 (7mins) terminal campuses via a high quality, high frequency (90 second) Automated People Mover (APM) as well as providing check-in and baggage drop facilities.

4.3 Automated People Mover

As well as providing safe, frequent (every 90 seconds) and fast passenger movement between the Hub site and the main terminal areas (T5 and T2 campuses) the APM system will be a ‘landmark’ feature and highly visible. This in turn would lead to a greater passenger experience, not only through the views that could be enjoyed but also the sense of arrival at the Airport.

Given the high number of passengers envisaged on the APM system it will be designed to be as robust as possible in terms of reliability.

While the length of APM system proposed is not typical (approximately 90% of the 40 plus airport APM systems globally are less than 6km in length), it is certainly not unique, and is similar to the following systems.

System Name, Airport	Airside or Landside	In Service Year	Model	Guideway Length, km	Peak Hour Capacity, pphpd	Vehicles per train	Fleet Size	Peak Hour Headway:	No. of stations
AirTrain Newark, Newark Liberty International Airport	Landside	1996	Monorail	5.1	2,100	6	84	2.1	8
OrlyVal, Paris Orly Airport	Landside	1991	Rubber Tired APM	7.3	1,500	2	16	4	3
Skylink, Dallas/Fort Worth International Airport	Airside	2005	Rubber Tired APM	7.9	5,000	2	64	2	10
AirTrain JFK, New York–John F. Kennedy International Airport	Landside	2003	Steel-Wheeled APM/ LIM	13.9	3,780	1	32	4	10
Airport Express Train, Beijing Capital International Airport	Landside	2008	Steel-Wheeled APM/ LIM	28.1	3,780	4	40	4	3

4.4 Highways

Highway modifications required for the scheme have been designed to provide the safest solution for all users whilst increasing journey time reliability. Although a tunnel has been incorporated into the layout, the removal of junctions from the M25 in the vicinity of the tunnel has many safety benefits. The layout proposed ensures there is no need for weaving in the tunnel and that there would be no merging or diverging features anywhere near the tunnel portals. This, combined with high design standards adopted for the tunnel and M25 realignment, would ensure the tunnel would be as safe as practicable. Provision of a dedicated link road to the south of the Airport along with capacity improvements at Junction 13 maintain high capacity and convenient access to Heathrow for every type of road user, i.e. public, staff, drop off/pick up, premium and economy parking facilities.

The scheme has also been designed to minimise the impact on the surrounding road network, keeping to a minimum the local road realignment and maintaining the local road philosophy. The highway box around the airport has been maintained without use of the motorway system and junction locations on the existing roads are similar to before. This approach also helps keep the impact on the surrounding environment to a minimum both physically and by not redistributing traffic on the local road network. Where opportunity has arisen however, improvements have been made to the surrounding road network to safeguard general growth.

Safeguarding of future expansion of Heathrow Airport has been considered in the design process, but whilst junctions have been positioned to accommodate this, road links have been aligned not to sterilise any land for this purpose or take property that is not required at the current stage.

We note HAL's proposal for a new southern road access to the T2 campus and propose to consider this further, whether through conversion of the existing airside tunnel or new infrastructure.

4.5 Rail

Interchange is a major disincentive to passengers using rail, particularly for time sensitive air passengers for whom reliability and convenience are critically important. In many cases, for example, for passengers on the main lines to London from the North, two interchanges are currently required to reach Heathrow.

Our strategy connects Heathrow to the countries key mainline rail routes (GWML, WCML, HS2, MML, ECML, GEML, WAML, SWML) either directly or with a single same-station connection at either Old Oak Common, Farringdon, Clapham Junction or Liverpool Street, significantly reducing both the need to interchange and overall journey times.

Furthermore, our proposals spread rail access to Heathrow across a number of different corridors (Heathrow – Paddington / Crossrail (10tph), Heathrow via Staines to Waterloo (2tph min) and Heathrow Hub (GWML) (30 tph) and Woking/Basingstoke (4 tph), compared with a Heathrow Express/Connect service of only 6tph today to Paddington.

As a result, our strategy provides high levels of resilience & flexibility; minimises the impact of airport demand on the commuter and inter-city networks. Also, we expect no further loading on the Piccadilly line, as the introduction of Crossrail services and the elimination of premium pricing on Heathrow Express will make travel to London via Paddington much more attractive for the majority of passengers than the slower Piccadilly Line route.

The dramatic change in accessibility is demonstrated by the Rail Catchment Isochrones in Figures 4.1 & 4.2 below.

Figure 4.1 Current Rail Catchment Isochrones

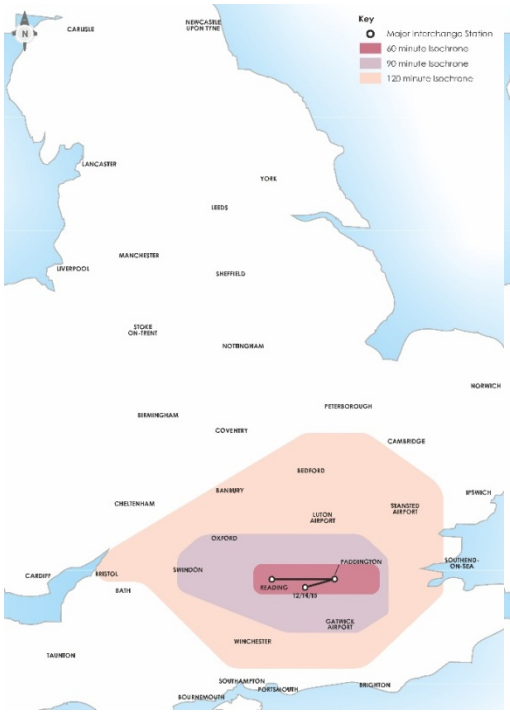
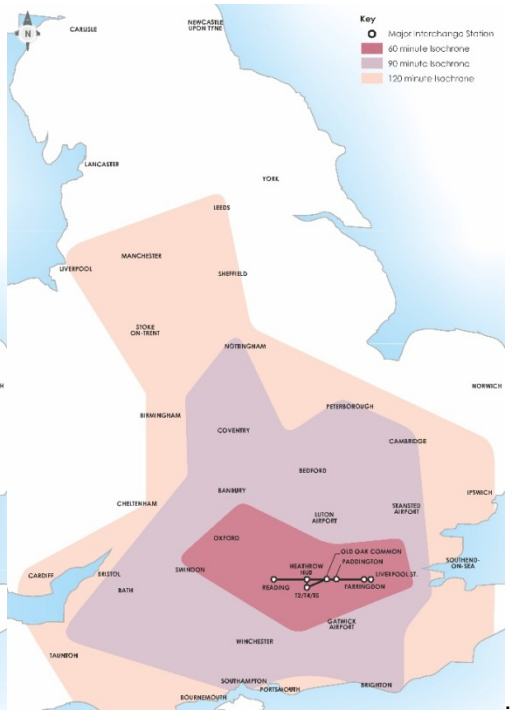


Figure 4.2 HH Rail Catchment Isochrones



4.6 Coach & Bus

Our aim is to grow coach and bus passenger volume and total mode share, complementing our rail strategy, and providing very attractive alternatives to private car and taxi.

We propose to establish the framework for the development of coach and bus services for both passengers and employees that will provide excellent public transport in markets where rail is insufficient, such as:

- Areas of the airport's catchment not served by rail;
- For passengers who find price a key determinant of mode choice, for trips where rail is seen as more expensive than coach;
- Trips early or late in the day when rail is not operating; and
- Where rail services require complex interconnections leaving some passengers particularly valuing a direct journey to the airport by bus or coach.

Our proposals will require some investment in infrastructure and close co-operation with TfL, local authorities, operators and other key stakeholders. This strategy will be a significant contributor to reducing the employee's car mode share down to some 25% by 2030.

4.7 Taxi

Taxi is a very valuable service for air passengers, used by 25% of air passengers in 2013. Our aim is to continue to offer very good taxi services as the airport throughput grows, but to carry out interventions that will cap the number of associated vehicle movements at their current level.

5. OUR PROPOSALS

5.1 Overall

The Heathrow Hub proposal further enhances the case for Heathrow in terms of regional connectivity and extension of economic benefits

Heathrow is set at the centre of comprehensive networks of road and rail links. It is adjacent to the M25 & M4 with access to both the M3 and M40 within 5 miles giving a unique position in terms of connections to the national road network and it already has 2 different rail public transport corridor connections via Heathrow Express and the Piccadilly line. These potentially offer enormous opportunities for connectivity particularly when compared with other airports in the UK, but there are two critical gaps:

- Many parts of the airport's catchment are not currently served by fast, convenient and reliable public transport links. Air passengers and employees are forced to use car and taxi in the absence of any viable alternative; and

- Key part of the networks are already very congested, especially at commuter peak periods but also – in the case of the principal road network used by bus and coach – at other times. So many of the road and public transport links around Heathrow are already being loaded to capacity. For the airport to expand, they will have to accommodate regional growth in population and employment as well as expansion at Heathrow. The approach of just assuming that extra road and airport demand can be channelled through the one of the most congested section of road in Europe is not sustainable.

The gap in rail provision other than from central London is in marked contrast to a number of major European airports, such as Schipol, Charles de Gaulle, Zurich and Frankfurt, all of which have much more comprehensive rail networks serving key parts of the airport's catchment area with direct trains. So while rail has a 48%[15] market share between central London and Heathrow, its modal share is minimal from all other parts of the country, including key catchment areas such as South & South West London, Surrey, Hampshire and Berkshire.

However, there are a number of major public transport schemes that are already committed (Crossrail & HS2) that will have a marked effect on improving connectivity and together with our strategy of bringing the airport to the GWML through Heathrow Hub and rail connections to the south, rail access to the airport will be transformed, as shown in the Figure 5.1 below

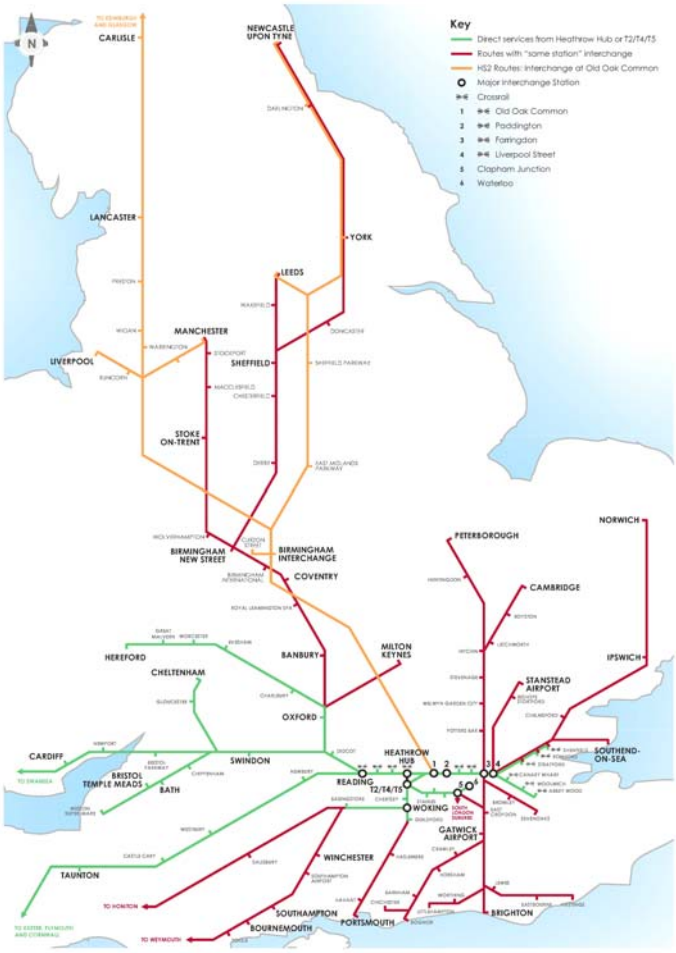
The unique position of Heathrow enables:

- more than sufficient public transport capacity to be provided to London through 4 different corridors (Piccadilly line, Crossrail / HEX, Staines/Clapham Junction/Waterloo and GWML through Heathrow Hub. This dispersion of demand also means that commuter routes will not be stressed by the growth of the airport.

- connection to the countries key main line rail routes (GWML, WCML, HS2, MML, ECML, GEML, WAML, SWML) either directly or with a single same station connection at either Old Oak Common, Farringdon, Clapham Junction or Liverpool Street, bringing an unprecedented 95% of the airports passengers within 120 minutes of the airport by rail.

Figure 5.1 HH Strategy Rail Connections & Journey Time Comparisons

[15] CAA 2012 survey data



Rail Journey Time Comparisons

From	Current mins	RIL with Heathrow Hub mins
Leeds	205	116
Birmingham	155	82
Crewe	170	88
Manchester	200	101
Ipswich	145	122
East Croydon	85	61
Welwyn Garden City	94	77
Reading	65	16
Oxford	95	41
Swindon	92	46
Bristol	133	87
Cardiff	163	110
Plymouth	259	190

note: 20 minutes interchange penalty(interchange + wait ti
assumed where interchange required

No other airport in the UK can or could achieve such geographic connectivity, delivering the maximum possible public transport surface access mode share in a sustainable manner.

5.2 Heathrow Hub

Heathrow Hub creates a new gateway to the airport by integrating the national rail network with the airport, delivering a public transport mode share for the GW corridor of c60%. What makes this even more attractive is it is a deliverable, low risk solution since there is no requirement to make major changes to the rail network or add new services, as the Hub is served by just adding a stop to the existing GW services. An Illustration of the Heathrow Hub Concept is shown in Figure 5.2 below

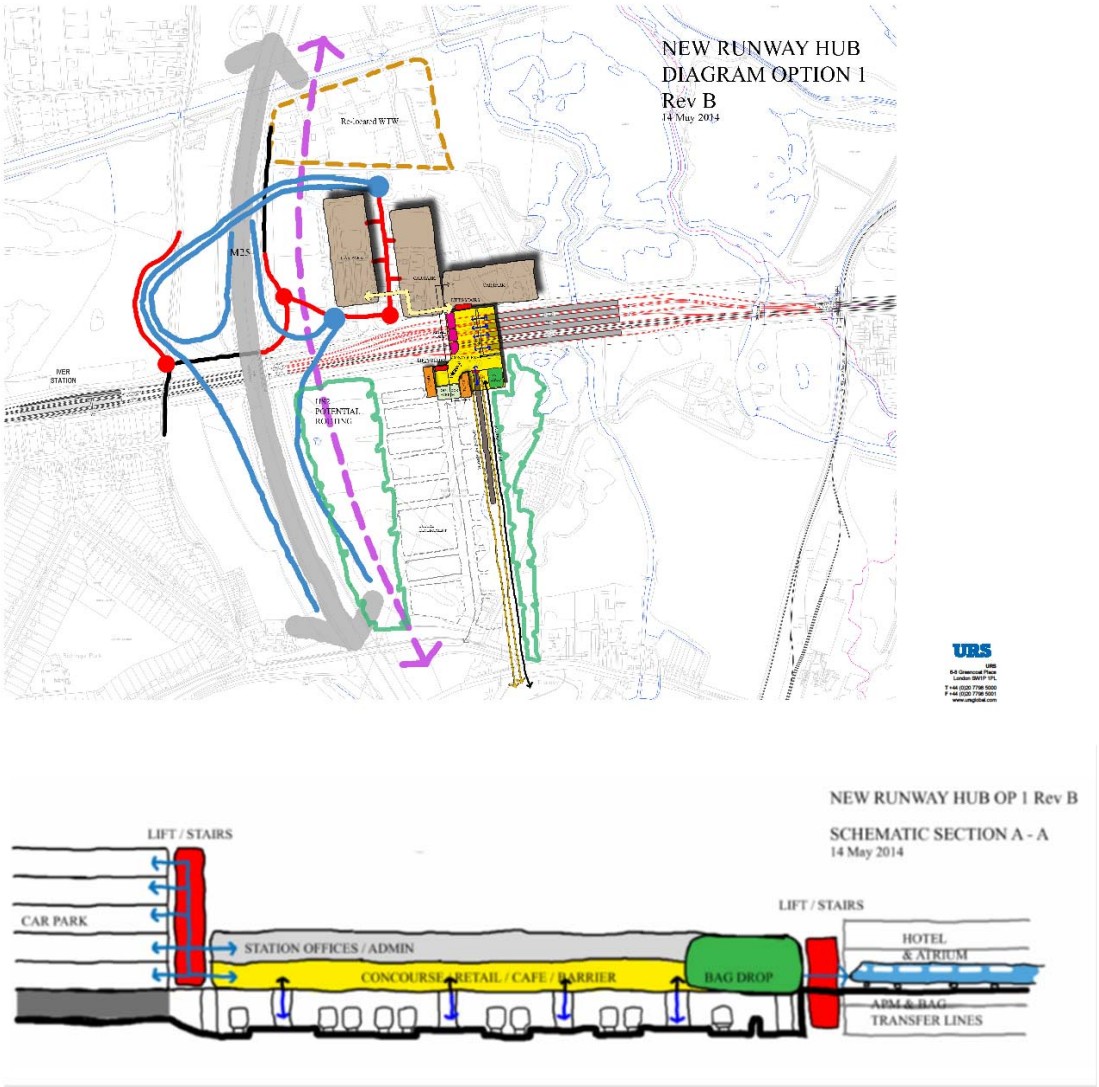
Intercepting the airport traffic from the north, off the M25, before it reaches the M25/M4 junction and the M4 East and West will make accessibility to the airport much more reliable and reduce the loading on the M25. Kiss & fly, taxi and parking facilities giving direct access to the interchange facilities and the APM and will be much closer, more secure and superior to those between current long and medium stay car parks and terminals. Coach / bus facilities will also be provided, as access off the M25 will make the Hub an attractive airport option as they will only have to serve one destination. The passenger experience will be much improved with covered walkways with travellators vs. open air car parks and bus shuttles.

The Interchange will have all the facilities, style and feel of an airport terminal. Bag drop and check-in kiosks will be provided together with waiting areas, shops and catering facilities. Having these facilities at the hub will reduce the scale of facilities required on the main airport site, maximising the availability of space for aviation purposes. A hotel will provide overnight accommodation for passengers catching early morning flights or arriving late in the evening. Conference and meeting facilities will also be provided. The concourse level will be one level above the station platforms which will be accessed by escalators, travellators and lifts and the APM will run every 90 seconds from the concourse level to the T5 & T2 campuses.

In summary, the core functions at Heathrow Hub will be to provide interchange facilities between surface access modes and the airport and will include:

- A rail station served by up to 30 trains per hour
- Escalators, travellators and lifts access directly from platform level to the interchange level with a short distance to connect to the Automated People Mover (APM)
- Multi airline self-service check in machines could be made available for those who have not checked in online
- Secure baggage drop facilities at the interchange level which would connect directly into the airside baggage facilities of the airport.
- State of the art, high quality, fast, landside APM to transport passengers free of their baggage to the main terminals every 90 seconds with a journey time of 5 minutes to the T5 complex and 7 minutes to the T2 complex
- Direct access off the M25 from the north and the M4 with kiss and ride facilities and up to 10,000 car parking spaces, which would have direct enclosed access via travellators to the interchange level
- Airport hotel(s) with approximately 600 rooms providing a range of price points for overnight accommodation for passengers catching early morning flights or arriving late in the evening.
- An express coach station and stops for local buses. The Hub station is likely to be attractive, particularly for longer distance coaches, because they will have easy access from the motorway network and would only need to serve one location for passengers to access all the airport terminals.

Figure 5.2 Illustration of Concept for Heathrow Hub



Looking to the future HH can be developed to accommodate additional airport related functions and passenger processing facilities to optimise the use of space on the airfield for aviation purposes.

Some of these functions are possible today, while the increasing development of technologies such as are highly likely to impact on the design of air and rail infrastructure. The traditional model of airport terminal, for example, may quickly be outmoded. For example IATA suggest that processing facilities may alter from the current 50/50 airside/landside split to 80/20 as the check in and security process becomes increasingly streamlined,[16] allowing smaller, more space efficient terminals and an enhanced passenger experience.

If technology does allow additional processing functionality at the Hub interchange, this could release space within the airfield for additional aircraft stands. The APM could also provide dual airside/landside functionality using a hybrid/shared model similar to that successfully operated

[16] http://www.iata.org/whatwedo/security/Documents/cof-executive-summary.pdf

at Singapore Changi, Hong Kong and Beijing airports. This allows use by both security and non-security cleared passengers with segregation achieved by use of separate vehicles in the same train or alternating secure/non-secure trains running on the same infrastructure. Alternatively, entirely separate landside and airside systems could be used, with the former potentially making use of new and existing Piccadilly Line infrastructure between Heathrow Hub and the T2 and T5 campuses.

In considering planning for a timescale of ca. 2030, sixteen years ahead, it is salutary to look back the same length of time, to 1998, when smartphones were science fiction and less than 3% of the world's population had internet access, compared to almost half today. If current rates of technological progress continue, it is likely that this will allow fundamental change in the planning of airports.

Indeed, transformational technologies are already coming into common use. Smartphone boarding cards, (now being trialled by British Airways), [17] NFC (Near Field Communication), RFID (Radio Frequency Identification), augmented reality [18] and biometric tools such as facial recognition 19 are highly likely to have a significant impact on airport design. This creates the potential for physical infrastructure (station and terminal facilities), and virtual infrastructure, (eg: ticketing, security and baggage) to be seamlessly integrated across air and rail modes – of critical importance to the passenger experience since no journey begins or ends at an airport.

Our proposals provide flexibility as technologies develop between today and the date at which the design would be developed. We will continue to develop our proposals in discussion with IATA, airlines and manufacturers.

5.3 APM System

5.3.1 Overview

A generally above ground solution was felt most desirable for the APM system, as this would offer the best passenger experience - even reducing the perceived trip length - whilst the risks associated with tunnelling would be minimised. The only tunnelled section would be adjacent to the proposed M25 tunnel using the same ‘cut and cover’ techniques. Certain sections of the APM system would be elevated, most notably the section over the airfield that connects to the stations at the terminals, see Attachment 5-1 (drawings 47067372/TL/GA/23-24) for geometric information for the whole alignment. See also an example of an APM in figure 5.3 PHX Sky Train™ supplied by Bombardier Transportation.

[17] http://www.britishairways.com/en-gb/information/checking-in/mobile-boarding-pass
[18] http://www.sita.aero/content/copenhagen-airport-launches-a-world-first
[19] http://www.futuretravelexperience.com/2013/06/facial-recognition-system-deployed-at-edinburgh-airport/

Figure 5.3 - Illustrative APM (Phoenix)

The system needs to possess a high level of proven reliability which is envisaged to be incorporated by a variety means including: vehicle redundancy, provision of routes and backup power supplies. While the exact specification of system reliability would be developed at a later stage of the design process, it is expected that any loss of system availability would result in minor reductions in offered capacity and not the complete closure of the system.

Although the APM system has a high level of in built resilience against failure, and can be backed up to some extent by the rail/underground network, a road vehicle based standby bus system would also be provided in the extremely unlikely event of failure to this degree. The standby bus link would connect the Hub terminal to the new motorway southbound slip road north of M4/M25 junction. Buses for T2 campus would use new slip roads and M4 corridor/Heathrow motorway link. Buses for the T5 campus would use the same route as for T2 and then continue on to T5 using the Northern perimeter road and A3044 diversion

5.3.2 Station Locations

The proposed station locations are the Hub, T5 and T2a and are shown on 47067372/TL/GA/01 in Attachment 5-1. This results in interstation straight-line distances between Hub - T5, and T5 –T2a of 5.3km and 2.6km, respectively. For planning purposes, it has been assumed the entire system will be designated landside at this stage.

A single station at each of the T5 and T2 campuses will be connected to the arrivals and departures areas by escalators and travellators

5.3.3 *Capacity*

Estimates for capacity requirements are outlined below for both departure and arrival passengers. While the aggregate numbers of departure and arrival passengers are expected to balance, transit capacity is concerned primarily with satisfying the peak loads to avoid passengers waiting for more than one service.

5.3.4 *Departure Demand*

Since the system is proposed at this stage to be a landside system, the peak departure demand is expected to come from departing passengers travelling from the Hub to the T5/ T2 campuses. as outlined in table 5.1 below.

Table 5.1 Estimate of APM Peak Departure Demand

Maximum number of trains stopping per hour	15	
Estimate maximum number of people alighting per train	100	people
Peak demand	1,500	pph
Car parking spaces	10,000	cars
Average number of people per car	1.5	people
Average stay per car	9	days
Hours of usage, 06:00-22:00	16	hours
Average demand	104	pphpd
Total average hourly demand	1,604	pphpd
Assume peak hourly demand is average daily demand	2	
Estimated peak hourly demand	3,208	pphpd

5.3.5 *Future Capacity Provision*

While the exact future capacity requirements are unknown at this stage, experience of other airport systems has shown that ultimate capacity, over the life time of the system (e.g. 50 years), is likely to be significantly greater than initial requirements. Therefore any transit systems will need to be both extendable in terms of length and/or number of stations, as well as expandable in terms of fleet size and capacity.

5.3.6 *Trip Time*

In order to ensure that the Hub is well utilised, the transit time between the Hub and T5/ T2a is required to be in the region of 5-7 minutes. In addition, since passengers regard waiting time as much more onerous than travel time, the time interval between services is to be kept to a minimum.

5.3.7 Transit Selection

Typical airport conveyance technologies include; moving walkways, buses and automated people movers (APMs). Given the interstation distances and need for journey times to be less than 7 minutes, moving walkways, buses and cable pulled APMs are not considered further, primarily due to their low speeds.

Suitable conveyance technologies that meet the system performance requirements are self-propelled APMs which are fully automated, driverless vehicles operating on fixed guideways along an exclusive right of way. Self-propelled vehicles or trains use either a rail guideway system with rubber tires on concrete or steel wheels on steel rails. Depending on the supplier, system maximum speeds range between 80 and 100 kph.

While the option of a self-propelled APM system is clear at this stage, the option between technologies (rubber-tired, monorail, steel wheeled) is less clear since the factors affecting the decision making are in early development.

While the length of APM system proposed is not typical (approximately 90% of the 40 plus airport APM systems globally are less than 6km in length), it is certainly not unique, ranking similar to the following systems.

- AirTrain Newark, Newark Liberty International Airport
- OrlyVal, Paris Orly Airport
- Skylink, Dallas/Fort Worth International Airport
- AirTrain JFK, New York–John F. Kennedy International Airport
- Airport Express Train, Beijing Capital International Airport

5.4 Highways

5.4.1 M25 – Engineering/Design

We have chosen an offline tunnelled diversion scheme as the preferred solution – see main submission for details. The tunnel format is that of four separate bores each with 3 running lanes and a hard shoulder. There would be two northbound bores and two southbound bores giving six full time lanes in each direction as per existing. Junctions 14 and 14A have been totally removed from the highway. This removes the need for merge and diverge features close to the tunnel portals and eliminates the need for weaving of vehicles in the vicinity. The removal of these potential hazards for drivers ensures the safest possible operation of the tunnel.

The layout as described above can provide high levels of resilience to a tunnel bore closure both in planned and unplanned scenarios. Weaving lengths south of the tunnel would be nearly 3km long, close to the recommended maximum. Weaving would generally not be required north of the tunnel and vehicles would be recommended to ‘Stay in lane’ with the appropriate signage and markings.

The whole of the M25 diversion, including the tunnelled length, would meet desirable minimum design standards of the DMRB guidance at a design speed of 120kph, giving naturally high levels of safety, allowing the tunnel to be as self-managing as possible. The vertical alignment of the M25 has been designed with a fall throughout the tunnel ensuring any fluids spilt within the tunnel can easily flow out where they would be safely dealt with. The vertical alignment is

also such that the tunnel is only partly in the existing ground to help with resilience against closure in respect of any drainage system failures.

Junction 13 of the M25 would be converted to a small 'Cyclic' free flowing junction using typical 'loop' type geometry and may also require relaxations in standards for design speed and gradients. The highway network is shown 47067372/TL/GA/01 in Attachment 5-1.

5.4.2 Demand/Capacity

This layout has the ability to intercept traffic from the North before M25 Junction 15 therefore reducing its impact on both the M25 south of junction 15 and the M4 east of the same junction. Traffic drawn to the Hub site from the M4 corridor uses dedicated slips from within the junction and will not therefore load the M25. Traffic from the North and West destined for the T4, T5 & T6 area could travel South on the M25 to Junction 13 before returning North along the dedicated link road.

Future increased capacity requirements for the diverted section of the M25 would be achieved via the use hard shoulder running as part of a wider managed motorway network. Capacity of the A30 connection would be improved, although some minor movements to the West would no longer be allowed.

5.4.3 HA Engagement

Throughout the scheme development to date the views of the Highways Agency have been sought. Feedback from the initial meetings about a tunnel solution alerted us to several problems around the Junction 14/14A area of the M25, including the T5 access roundabout at the end of the Junction 14A link. Preliminary drawings were deposited with the Highways Agency for review by their engineers. The comments received from this review were duly incorporated into the design.

Concept modelling of the scheme is described in Attachment 2-1 and indicates that with credible patronage of the hub, stress on key highway links is reduced with this strategy. This Attachment also contains a note comparing the traffic with other estimates.

The highway layout was revisited towards the end of this design phase and on the basis of feedback from the Highways Agency to date, and with a strong focus on safety and journey time reliability, the design team decided to adopt a layout that would have otherwise been a future phase of airport expansion.

5.4.4 Access from N/S/E/W

Direct motorway access to the Hub site is provided for the M25 north traffic and M4 East and West traffic with dedicated slip roads integrated into the northern half of Junction 15 on the M25. New slip roads and modifications to existing slips can be designed to DMRB standards, using similar geometry to existing. The layout is compact, utilising space immediately adjacent to the existing motorway corridor wherever possible. A heavily skewed bridge & viaduct structure would be employed on the east side of the M25 to reduce impact on the adjacent lake. A loop-type junction located to the North of the GWML has been utilised to minimise impact on the Richings Park residential area. Weaving between junction 15 and 16 would be unaffected as it would still be far greater than the maximum 3km. There would be a simple signage policy from North as there would be 3 successive diverge slip roads, spaced apart more than the recommended minimum, for 3 destinations - namely Heathrow Hub Site, M4 East, and M4 West in that order.

Direct access to the Hub site from the M25 South is not provided for as this traffic will be encouraged to use existing facilities around the airport. Access to the airport from the South

would be via the improved Junction 13 of the M25 and a new dedicated link road that spurs off an improved section of the A30.

5.4.5 Local Road Modifications

A section of the A30 east of Junction 13 would be widened and slip roads constructed to connect the new dedicated Southern link to the Airport. The layout shown on the masterplan (drawing 47067372/TL/GA/01/Rev6) in Attachment 5-1 may not provide enough weaving length even as an 'urban' design. This could be improved by moving the slip road locations further east, adjacent the reservoir. Alternatively, partial traffic signal control of the merging flows could be provided with by-pass lanes for the traffic that does not need to weave (for Long Section see drawing 47067372/TL/GA/26) Attachment 5-1.

Due to the need for a longer A4 bridge for crossing the M25/APM system the opportunity would be taken to construct a wider bridge to allow dualling of the A4 between the Lakeside Road and A3044 junctions. Bath Road would be diverted up to the A4 and connected to the Lakeside Road junction West of the realigned M25. This arrangement would reduce the attraction of 'Rat Running' along this route whilst still maintaining connectivity of Brands Hill, Colnbrook and Poyle and any associated bus routes.

The A3044 Stanwell Moor Road would be diverted into a tunnel adjacent the M25 tunnel and would also complete the 'Perimeter road' box around the Airport (for Long Section see drawing 47067372/TL/GA/27). Attachment 5-1.

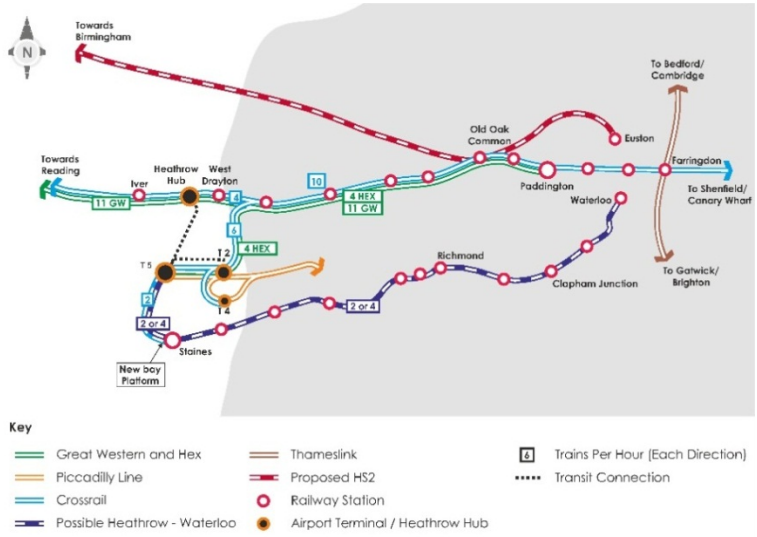
Road connections will be provided to the Hub for local traffic, this access will be controlled to limit the possibility of rat running.

5.5 Rail proposals

Our surface access strategy not only caters for the additional demand into London without overstressing the rail network for commuters and inter-city travellers but will transform public transport accessibility across the regions by connecting to the country's key main line rail routes (GWML, WCML, HS2, MML, ECML, GEML, WAML, SWML) either directly or with a single same station connection at either Old Oak Common, Farringdon, Clapham Junction or Liverpool Street. This will bring an unprecedented 95% of the airports passengers within 120 minutes of the airport by rail.

5.5.1 Firm proposals

Figure 5.4 Heathrow Hub Connections – Firm proposals



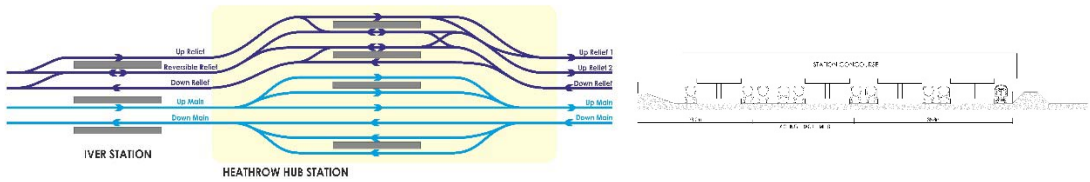
5.5.2 Heathrow Hub

The proposed configuration of Heathrow Hub station is designed to provide maximum flexibility and operational resilience. The Great Western Main Line between Paddington and Reading is a four track route, with two tracks primarily used by InterCity services (the “Main lines”) and two primarily used by Commuter services (principally Crossrail services from 2019) and freight (the “Relief lines”). For the main lines, we propose two platforms in each direction, which will allow successive trains to stop without reducing route capacity; we also propose a high speed through line in each direction without a platform. For the Relief lines, we again propose four platforms in total, to allow Crossrail trains to terminate there if required. We also provide for loops, useable in either direction, to allow maximum length (775metres) freight trains to be looped and overtaken if required.

The station layout has been designed to a level at which Network Rail are satisfied that the layout can cater for all necessary rail operations including freight and is “fit for purpose”. The station layout is shown on PBA drawing 30021/002/SK011 Rev C (in Attachment 5-2) and the station and track work modification fit within the existing constraints of the M25 and West Drayton High Street and retain the existing Colnbrook freight branch connection. Turnouts have been designed to allow unrestricted operation of IEP at normal braking and acceleration curves.

The design of the station enables the new relief line platforms to be built without impacting on the current GWML and once they have been built services would be transferred onto the new alignment whilst modification were being made to the existing relief lines. It should be noted that the GW Main line alignments are unaffected by these proposals apart from tie-ins to the new tracks, which minimises disruption to services during construction. A schematic layout of the station is shown below in Figure 5.5 and the geometric layout is included in & PBA drawing 30021/002/SK012 Rev B (Attachment 5-2). The estimated cost of Heathrow Hub station is £500m, as set out in Section 6.

Figure 5.5 HH Station Schematic Layout



We envisage fifteen trains an hour in each direction calling at Heathrow Hub. The InterCity services (11 trains an hour each way) would provide fast, direct and regular services on routes to Exeter, Plymouth and Cornwall; Swindon, Bath and Bristol; Bristol Parkway, Cardiff and Swansea; Cheltenham and Gloucester; and Oxford and Worcester.

Almost all of these trains would also call at Reading, providing a frequent service with a journey time of around 16 minutes, compared with the current scheduled coach journey time 40 to 60 minutes (depending on the time of day) and giving excellent interchange opportunities for other routes, as well as serving Reading itself.

Services to Oxford can also be extended to Milton Keynes using the new, strategic East – West Rail link. This will provide a direct connection between Heathrow and this dynamic, rapidly expanding area.

Crossrail services would serve intermediate stations between Reading and Paddington, providing a vital link for airport employees as well as air passengers. We have assumed current line capacity. Once the GWML is resignalled with ERTMS, Network Rail suggest that additional capacity may be possible. [20] Some examples of comparative journey time today and with Heathrow Hub are given below in table 5.2

Table 5.2 Current & HH journey times comparison examples

From	Current (min)	RIL with Heathrow Hub (min)
Reading	65	16
Oxford	95	41
Swindon	92	46
Bristol	133	87
Cardiff	163	110
Plymouth	259	190

[20] http://www.networkrail.co.uk/aspx/12275.aspx

5.5.3 Heathrow Express

We envisage continued operation of Heathrow Express, operating non-stop between the T2 campus and Paddington. However, whilst we will continue to maintain its key features as a service specifically tailored to the needs of air passengers, we would propose that it should cease to be a premium fare service, to ensure that usage is maximised in relation to the Piccadilly line and Crossrail. This approach will provide the widest possible choice for passengers, and in particular help reduce the proportion of rail passengers carried by the stressed Piccadilly Line.

We would also propose integration of Heathrow Express with the Woking – Heathrow service. In addition to ease platform occupation at the Heathrow stations, this provides an alternative route from Woking to central London, relieving the already overcrowded main line into Waterloo.

We also propose that the possibility of through operation to Crossrail is explored. This option does raise potential performance issues, and would require a rolling stock configuration suitable for operation in the Crossrail cross London tunnel and a new grade separated connection between Main and Relief lines west of Paddington, but would maximise the benefits to air passengers and provide very significant capacity relief to the increasingly congested SWML into Waterloo (and the onward LUL network).

5.5.4 Crossrail

We anticipate 6 (possibly 8) Crossrail trains an hour throughout the day, with 2 an hour extended through to Staines (see section 5.5.1.4), both to provide improved connectivity, giving better connectional opportunities for Ascot, Bracknell and Wokingham, and also to ease platform occupation at the T5 station. We have developed an illustrative timetable which shows that this level of service is practicable, whilst maintaining capacity for freight Attachment 5-3).

We note that HAL Ltd envisage the closure of Terminal 4 in the medium/long term, allowing all services to operate through to Terminal 5. We fully support this approach, which is consistent with our overall strategy for the airport.

5.5.5 Southern access: Waterloo

We propose construction of a Southern connection to Staines, with introduction of a service of 2/4 trains an hour to Waterloo via Richmond and Clapham junction, together with the extension of 2 Crossrail trains an hour to terminate at Staines. This would not be a dedicated airport service but would be fully integrated with the current suburban commuter service on the route.

As well as providing a key link to major South West London suburbs, the service would provide same station interchange to the entire South London rail network at Clapham Junction, and connect into fast trains to East Croydon Gatwick Airport, Brighton and the South Coast.

The operation of this service has been fully discussed with Network Rail and TfL who both accept that this is practicable and desirable.

The estimated cost of the link to Staines is £400m, as set out in Section 6.

5.5.6 Rail Freight

Our proposals protect the critically important freight capacity on the Great Western Main Line. We have identified regular freight paths in our illustrative service patterns for the relief lines, including for the Crossrail Express option, and provided the ability to loop long (775 metre) freight trains in either direction as part of the development of our track layout proposals for the Iver – West Drayton section, including Heathrow Hub itself. We have discussed our proposals with Network Rail, who accept that they deliver good functionality, capacity and flexibility.

Our plans also secure continued operation of the important freight only Colnbrook branch, and allow for the possible development of an intermodal strategic rail freight interchange, potentially serving the airport, the local area and the Thames Valley. This could include a rail connection with the proposed Slough International Freight Exchange if planning permission is granted..[21]

5.5.7 Interchange to HS2

The interchange to HS2 at Old Oak Common is particularly important in a national context. We propose 6-8 trains an hour from the T5 and T2 campuses to Old Oak Common with journey times of approximately 20 minutes, providing frequent connections with HS2 services to the Midlands and the North.

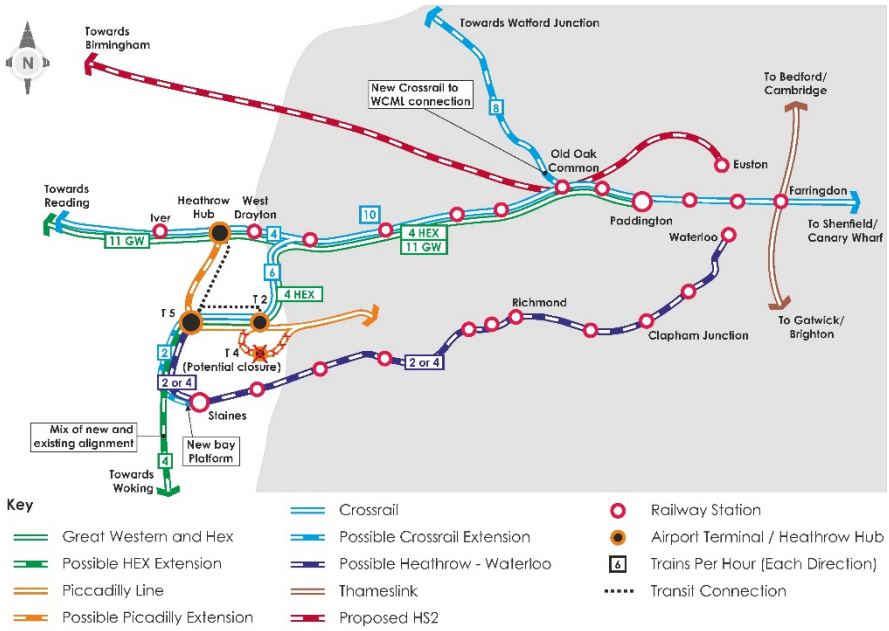
We note that Gatwick claim that their plans will provide shorter journey times via HS2, but we find this difficult to understand. Even assuming that trains only called at East Croydon between Gatwick and Clapham Junction, which would almost certainly require a reduction in Victoria services, the minimum journey time from Gatwick to Old Oak Common (assuming diversion of the West London Line and construction of a new station) would be 40 minutes, with at the most only two trains an hour.

We understand that the Airports Commission are not considering the issue of a direct connection between Heathrow and HS2, and Government has deferred any consideration of a proposal for a spur (branch line) connection until the Commission has issued its final report in Summer 2015. We note the successful experience of integration between high speed rail and airports at Charles de Gaulle, Schiphol and Frankfurt, and the benefits that result from a direct connection on through lines. We do not believe a spur would provide the optimum connection, and note the experience of Brussels Zaventem airport where a spur was converted at high cost to a through alignment. However, if taken forward, an HS2 spur could terminate at Heathrow Hub, reducing the cost of a longer tunnelled alignment to the T5 campus as well as improving the interchange between HS2 and GWML/Crossrail services.

[21] http://www.consultation-online.co.uk/sife/

5.5.8 *Proposals under discussion*

Figure 5.6 Heathrow Hub Connections – Full Strategy

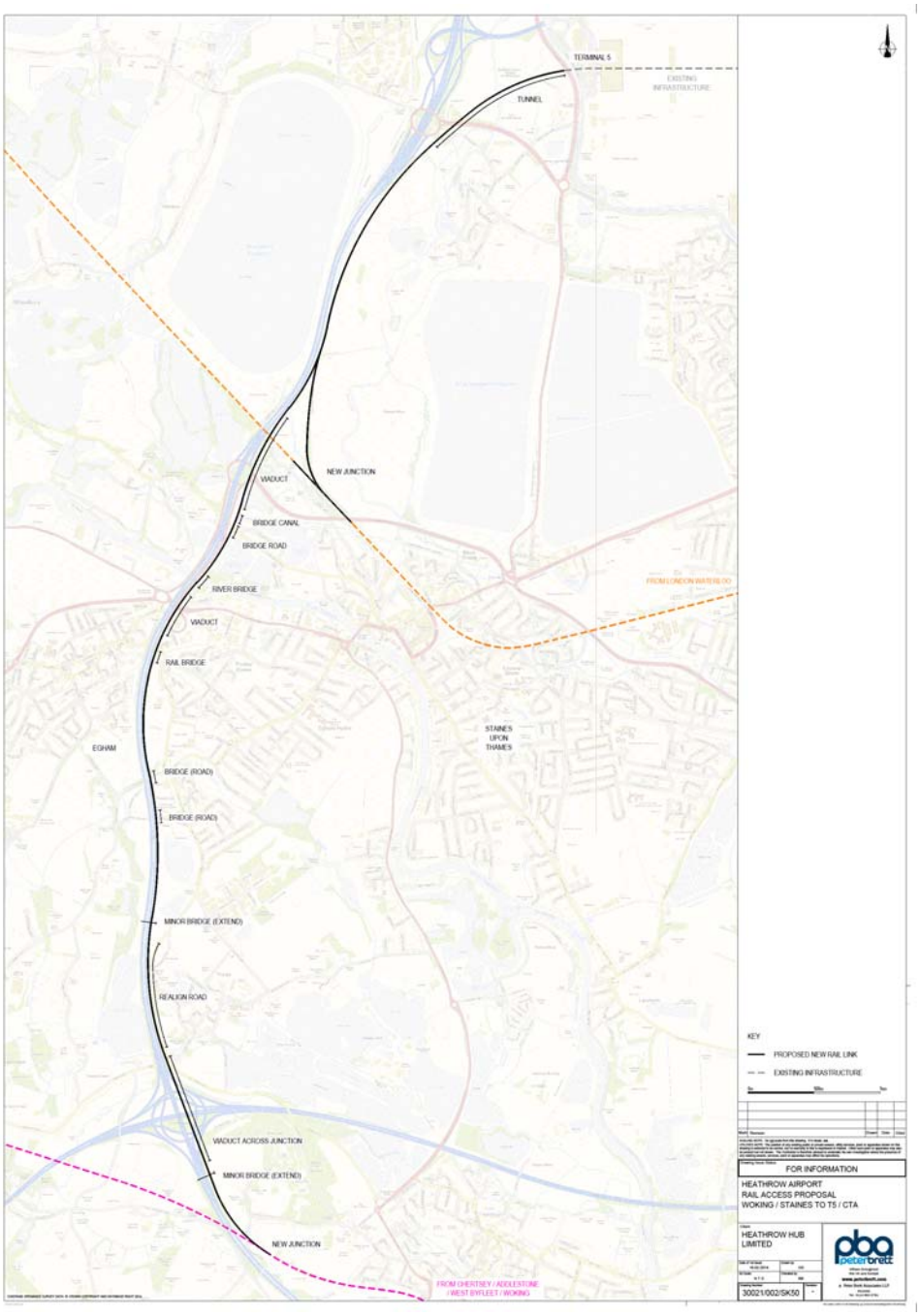


5.5.9 *Southern access: Woking*

We propose construction of a new rail alignment between the junction with our proposed Staines connection and the existing Virginia Water – Weybridge route north of Chertsey. The new route would run at grade or elevated alongside the M25. This alignment would not only enable fast journey times to Woking (c16 minutes compared with at least 40 minutes by coach) but would also avoid increasing barrier downtime at level crossings in the Egham area; this emerged as a major problem for the previous "Airtrack" proposal.

The alignment for the proposed new route is shown below in Figure 5.7 and in Attachment 5-2.

Figure 5.7 Layout T5 – Woking / Staines



South of Chertsey, the Heathrow – Woking trains would use the existing Virginia Water – Weybridge route as far as Addlestone Junction, then use the existing grade separated junction to access the South Western Slow lines at Byfleet Junction.

Whilst there are no major capacity constraints on the slow lines, Network Rail are concerned about both platform and junction capacity at Woking, which is already a pinchpoint on the

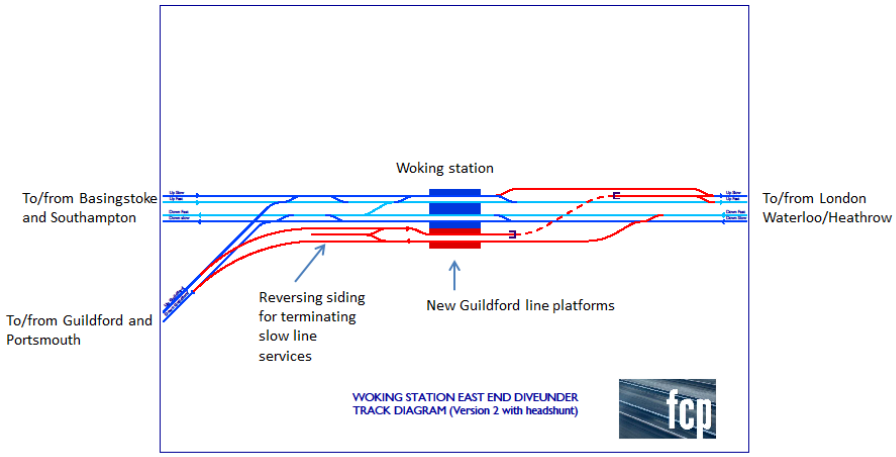
South Western Main Line. We have therefore developed initial outline designs for the Woking area which indicate that it would be possible to provide a grade separated junction and additional platform capacity to reduce existing conflicts between services on the Guildford and Basingstoke routes and to provide additional capacity for Heathrow services.

A schematic plan for a dive-under at the east end of Woking is shown below in Figure 5.8; we have also developed an outline scheme for a west end dive-under.

In order to maximise connectivity and to provide relief to the overcrowded South Western Main Line, we envisage the Woking service operating through to Paddington (and possibly through to Crossrail as discussed above), with 2 trains an hour starting from Guildford and 2 trains an hour from Basingstoke.

The estimated cost of the link to Chertsey is £420m as set out in Section 6.0. This is the incremental cost over and above the Heathrow – Staines link. The cost of the potential works at Woking, which would also provide significant congestion relief to the South Western Main Line, unrelated to Heathrow, are estimated at £230m.

Figure 5.8 Woking station – option for east end grade separated junction



Notes:
1. The layout provides grade separation for trains to and from Guildford, and the facility to terminate trains without conflict with the fast lines
2. The proposal can be built within existing Network Rail boundaries

5.5.10 Old Oak Common

We propose that main line platforms should not be provided at the proposed Old Oak Common interchange station with HS2. Calls at Old Oak Common for long distance services will increase journey times for London bound passengers whilst providing little connectional value; the great majority of journeys from the West of England and South Wales to the Midlands and the North are better served by direct cross country services which will have cheaper fares, will not require interchange and in many cases will still have shorter journey times. Furthermore, Old Oak Common will not now provide an interchange for European services via HS1, following the Government's decision to drop the HS2/HS1 link.

Modelling by both TfL and Network Rail suggests that many passengers wishing to interchange from GWML services to Crossrail would do so at Old Oak Common, as the interchange is potentially easier than that at Paddington. However, it is still the case that the

majority of passengers will not transfer to Crossrail and will therefore have a journey time disbenefit of ca. 5 minutes as a result of the Old Oak Common stop.

Good connections will still be available from HS2 to Heathrow, provided that there are frequent limited stop Crossrail services to the airport (eg calling only at Ealing Broadway). We have developed an illustrative service pattern which achieves this while maintaining existing service levels for intermediate stations and safeguarding four freight paths an hour (Attachment 5-3).

Elimination of the main line platforms at Old Oak Common represents a significant capital cost saving and will reduce the disruption necessary to construct the station. We conservatively estimate that this change would save capital costs of at least £100m for the HS2 project, given the serious constraints at the Old Oak Common site, including the requirement to demolish the existing maintenance depot for Heathrow Express and Heathrow Connect.

We are continuing discussions with Network Rail and TfL on the case for omitting the main line platforms at Old Oak Common.

5.5.11 West Coast Main Line connection to Old Oak Common

The Chairman of HS2 Ltd, Sir David Higgins, has put forward a strong case for construction of connection from the West Coast Main Line (WCML) to Crossrail via Old Oak Common.

This would have four significant benefits:

1. Diversion of WCML suburban trains would provide better central London distribution for passengers than the current terminus at Euston, giving direct services to the West End, the City and Canary Wharf. At present, the majority of Euston commuters have to make an onward Underground journey to their final destination.

2. The reduction in the number of peak services to and from Euston would greatly reduce the impact on both commuter and long distance services during the extended period of reconstruction of the station for HS2.

3. The already overcrowded Underground lines from Euston would be significantly relieved, as most Euston commuters would use services going through Crossrail

4. Interchange at Old Oak Common would provide greatly improved rail access to Heathrow from key WCML stations such as Watford and Hemel Hempstead.

We fully support this proposal although this is not included in our cost estimates.

5.5.12 Piccadilly Line

With the closure of Terminal 4 in the medium/long term, we envisage all Piccadilly Line services would operate through to Terminal 5 and the existing Terminal 4 loop would be closed.

Whilst not necessary for the effective operation of our airport proposals, there may be a business case for extending the Piccadilly Line through to Heathrow Hub, giving connectivity for the line's catchment area to this important transport node, including access to the Great Western corridor. However, this extension does not form part of our core proposal.

5.5.13 Demand v Capacity

Capacity to central London

From analysis of the most recent CAA survey data, rail has a 45% mode share of travel to and from central London, split between the Piccadilly Line (29%) and Heathrow Express/Heathrow Connect (16%), with Heathrow Express load factors averaging only around 30%, despite the current relatively low seating density of the trains. Crossrail will provide a major increase in capacity to and from the airport, with four trains an hour currently planned, and our proposals raise this to six, or possibly eight. In addition, Crossrail will provide a step change in connectivity for travel from Heathrow via Paddington. The attraction of the Paddington route will therefore significantly increase, mitigating the risk of the growth in air passenger numbers putting unsustainable pressure on the Piccadilly Line. We also consider that Heathrow Express should cease to be a premium fare operation, with the trains possibly reconfigured to a higher density, to ensure that the most effective use is made of the available capacity.

This strategy increase capacity on the Paddington route by more than 100%. Given the step change in capacity achieved with Crossrail, and the proposed higher capacity and lower fares for Heathrow Express, coupled with its current low load factors, we are confident that the rail capacity to central London delivered by this strategy is fully able to meet the growth in demand, both from the growth in air passenger numbers and increased rail mode share; we are also confident that this can be achieved without putting additional pressure on the Piccadilly Line.

TfL is preparing plans for a Piccadilly Line upgrade that will provide substantial additional capacity. The Underground will remain a very convenient way to travel from central and South West London to T4 and the other terminals. However, we expect a reduction in the Heathrow air passenger mode share of the Piccadilly Line to arise as a result of the committed and our proposed enhanced services via Crossrail and Heathrow Express.

Great Western Main Line

We recognise that there are existing crowding issues on Great Western Main Line long distance services at peak periods, although these mainly occur only between Reading and Paddington. However, the electrification of the Great Western Main Line and the associated increases in service frequencies, together with the introduction of the new, higher capacity “InterCity Express” trains will mitigate any increase in overcrowding, and airport demand is spread across the day, unlike regular commuting demand which is heavily concentrated.

Overcrowding between Reading and Paddington may also be eased by the possible operation of “Crossrail Express” services, calling only at a limited number of stations; we understand that this is under examination by Network Rail following the decision to extend Crossrail to Reading earlier this year. Whilst “Crossrail Express” services would have slightly longer journey times than fast long distance trains, there would be no need to interchange at Paddington to access central London Crossrail stations, so such a service would be attractive for a significant proportion of Reading commuters. We have developed a notional timetable for Crossrail Express for discussion with Network Rail; the pattern provides for a half hourly service from Reading, calling only at Twyford, Maidenhead, Slough, Heathrow Hub and Old Oak Common (Attachment 5-4). This is made possible by both the layout of the Heathrow Hub interchange, allowing Express services to overtake stopping trains, and the station’s location approximately mid-way between Reading and Paddington. Passengers from intermediate stations may also derive journey time savings by the cross platform interchange that would be possible between Crossrail Express and stopping services.

Our proposals mean that Crossrail could provide competitive journey times between Reading and London, only 8 minutes slower than GWML fast services and avoiding the need for

interchange at Paddington. Passengers would also be far more likely to find a seat than joining already busy long distance services at Reading, and likely to value the utility of a service that, avoiding interchange, took them directly to central London destinations. We assume Crossrail would also be integrated into TfL's integrated fare structure, increasing its attractiveness to commuters. Indeed, this could be used as a deliberate measure of diverting peak commuter traffic off GWML services.

It would also be possible to make tactical adjustments to the timetable at peak periods to minimise overcrowding on Great Western Main Line services, for example by not stopping all trains serving Heathrow Hub at Reading and vice versa.

Heathrow – Waterloo

We envisage this service would be fully integrated with the existing commuter services on the route. However, we do not anticipate substantial numbers of passengers using the trains throughout to Waterloo, hence we would not expect operation to the airport to significantly increase peak loadings into and out of London. Whilst the service will be an important link to the airport, air passenger numbers are spread relatively evenly across the day, so we would also not expect crowding problems into and out of Heathrow itself.

Heathrow – Woking

Again, this service will be an important link to the airport. However, air passenger numbers are spread relatively evenly across the day, so we would not expect crowding problems into and out of Heathrow itself. Further work would be needed to assess the likely level of commuter peak loadings on the potential Woking – Heathrow – Paddington service, particularly if it proves possible to extend this service through central London via Crossrail, It should also be noted that this service would potentially relieve already overcrowded SWML direct services into Waterloo, and where very significant background growth is forecast on both the SWML and the LUL network connecting with Waterloo

5.5.14 Forecasting / Mode split

We have carried out an initial evaluation of our proposals on mode share for air passengers and rail passenger numbers, using CAA survey data. Given the time and resources available, and the limitations of the data, these are necessarily provisional, but as would be expected they show a major increase in rail's mode share, from 29% to 40%, with the total public transport share rising to at least 50%. For areas served by the Great Western Main Line, rail's mode share increases from 8% to 38%. The evaluation results for the Great Western corridor are summarised below in Figures 5.9 & 5.10:

Figure 5.9 2030 Surface Access by Mode GW Target (Numbers)

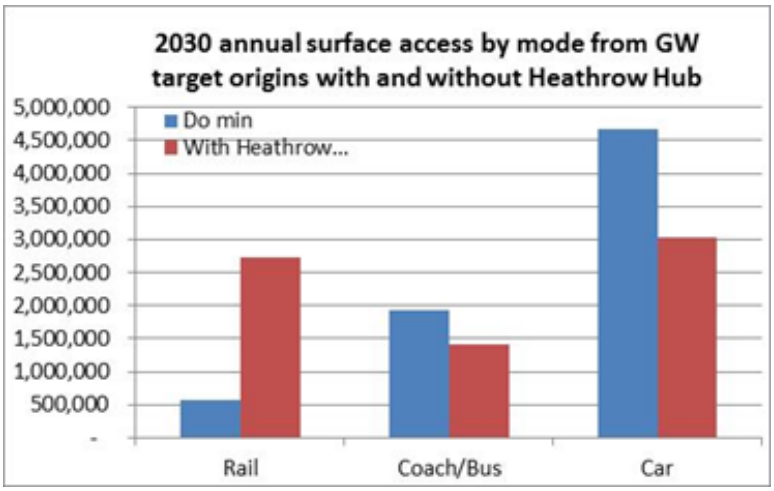
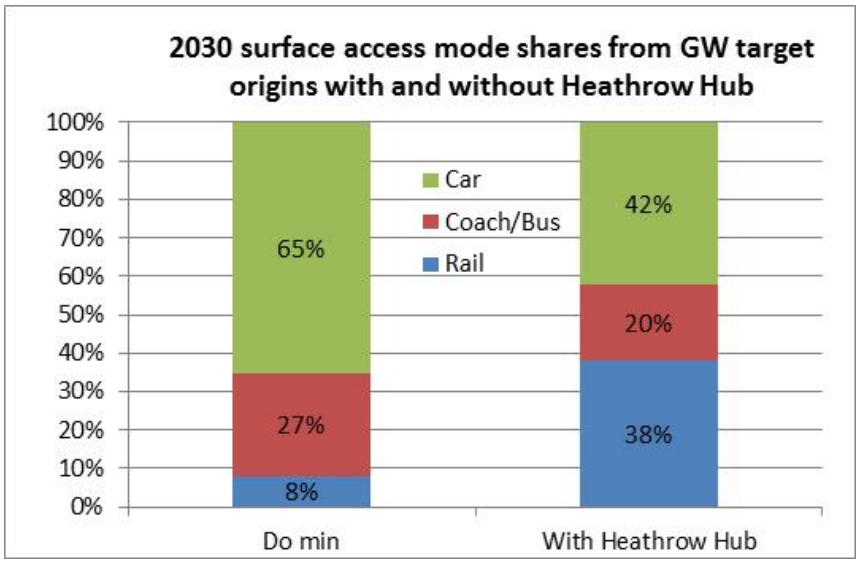


Figure 5.10 2030 Surface Access by Mode GW Target (Share)



Furthermore, we believe that our assessment of mode shift to rail is inherently conservative. The use of public transport is relatively more attractive for journeys to Heathrow than for equivalent journeys other than to central London, but rail access is currently poor except from central London. In contrast, coach currently has an unusually high mode share (for example, 27% compared with 8% for rail for the Great Western corridor), which strongly suggests that many air passengers choose the best public transport option for journeys to Heathrow in preference to driving. The strong market position of coach is also shown by the significantly higher fares charged by National Express for journeys to Heathrow compared with its fares to central London.

The opening of Crossrail in 2019 will provide greatly enhance connectivity, both as a result of its direct services to the West End, the City, Docklands and the Eastern suburbs to Shenfield, and also through “single interchange” connections with London Underground lines and the National Rail network in the East of England such as Cambridge, Peterborough, Bedford via Farringdon and Colchester, Ipswich and Norwich via Liverpool Street. We believe that there will be a significant increase in rail mode share as a result of Crossrail with a modal shift from car or taxi to rail for journeys to Heathrow, as public transport becomes faster and more convenient. We approached TfL to ask if they had carried out an analysis of the impact of Crossrail on rail demand to Heathrow; they advised us that they are unable to isolate this from other assumed changes.

We have also carried out an initial analysis of the impact on passenger numbers and mode share of through services to Waterloo via Richmond and Clapham junction, and to Woking. The results of this analysis should be treated with considerable caution, as there are limitations in the data and, given the time and resources available, some methodological issues with the analysis. In particular, it is possible that the impacts on the areas directly served are overstated; however, we have not at this stage evaluated the benefits from a single interchange to a direct train to Heathrow at either Woking or Clapham junction – the latter is likely to be particularly significant in giving direct access from the dense airport catchment south of central London..

Nevertheless, the results indicate significant modal shift, principally from car, and are intuitively reasonable, with rail’s mode share increasing from 19% to 42% as shown in Figures 5.11 & 5.12 below:

Figure 5.11 2030 Surface Access by Mode Southern Access Target (Share)

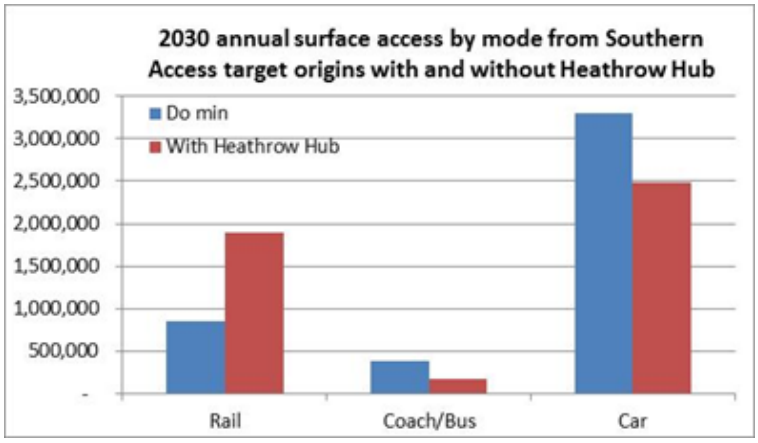
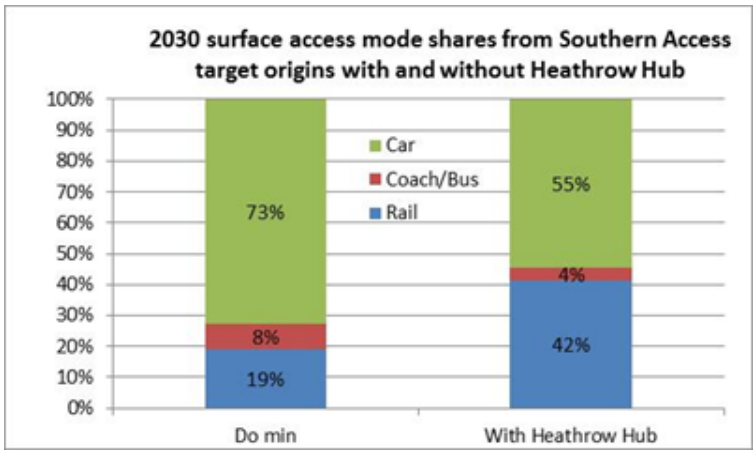


Figure 5.12 2030 Surface Access by Mode Southern Access Target (Share)



Our analysis of the Heathrow – Woking option does not take into account the potential strategic benefits of this scheme in grade separation at Woking and relieving both the South Western Main Line into Waterloo and the Underground lines there, as the Woking – Heathrow services can be extended through to central London by integration with Heathrow Express

The transformation of rail access provided by Heathrow Hub will make rail the dominant public transport mode, particularly for catchment areas directly served (the Great Western corridor, Woking and beyond, South London and Sussex via Clapham Junction, and the North and Midlands via Old Oak Common and HS2), and we believe it is likely that the actual modal shift from both car and coach will be significantly higher than indicated by our analysis.

We set out our mode share methodology and estimates in Attachment 5-5.

5.5.15 Business case

Our evaluation of the changes to mode share are set out below in table 5.3:

Tables 5.3 HH Surface Access Strategy changes in Mode Share

2012 figures							
Area	Bus-Coach	Car	Rail	Grand Total	Bus-Coach	Car	Rail
Greater London area	974,347	9,501,295	9,740,561	20,216,203	5%	47%	48%
Great Western area	1,175,369	2,860,385	368,033	4,403,787	27%	65%	8%
Southern Access area	255,651	2,024,234	530,160	2,810,046	9%	72%	19%
Rest of Country	2,773,085	11,284,866	2,219,519	16,277,470	17%	69%	14%
Grand Total	**5,178,452**	**25,670,781**	**12,858,273**	**43,707,506**	**12%**	**59%**	**29%**
2030 figures - no schemes			Growth to 2035	163%			
Area	Bus-Coach	Car	Rail	Grand Total	Bus-Coach	Car	Rail
Greater London area	1,588,185	15,487,112	15,877,114	32,952,410	5%	47%	48%
Great Western area	1,915,852	4,662,427	599,894	7,178,173	27%	65%	8%
Southern Access area	416,711	3,299,502	864,161	4,580,375	9%	72%	19%
Rest of Country	4,520,128	18,394,332	3,617,816	26,532,276	17%	69%	14%
Grand Total	**8,440,876**	**41,843,373**	**20,958,985**	**71,243,234**	**12%**	**59%**	**29%**
2030 figures with rail schemes - no adjustment for Greater London area							
Area	Bus-Coach	Car	Rail	Grand Total	Bus-Coach	Car	Rail
Greater London area	1,588,185	15,487,112	15,877,114	32,952,410	5%	47%	48%
Great Western area	1,428,457	3,022,011	2,727,706	7,178,173	20%	42%	38%
Southern Access area	174,054	2,505,465	1,900,855	4,580,375	4%	55%	42%
Rest of Country	3,781,030	17,778,724	4,972,522	26,532,276	14%	67%	19%
Grand Total	**6,971,726**	**38,793,311**	**25,478,197**	**71,243,234**	**10%**	**54%**	**36%**
2030 figures with rail schemes including adjustment for Crossrail for GLA						10%	to CR
Area	Bus-Coach	Car	Rail	Grand Total	Bus-Coach	Car	Rail
Greater London area	1,588,185	12,191,870	19,172,355	32,952,410	5%	37%	58%
Great Western area	1,428,457	3,022,011	2,727,706	7,178,173	20%	42%	38%
Southern Access area	174,054	2,505,465	1,900,855	4,580,375	4%	55%	42%
Rest of Country	3,781,030	17,778,724	4,972,522	26,532,276	14%	67%	19%
Grand Total	**6,971,726**	**35,498,070**	**28,773,438**	**71,243,234**	**10%**	**50%**	**40%**

We have not at this stage sought to quantify the financial performance of the proposed rail services, but we expect these to be generally positive:

- Great Western Main Line – we conservatively estimate an additional 3 million air passengers a year will use Heathrow Hub for journeys to and from Reading and beyond, , in addition to shorter distance travel, including by employees, and domestic travellers using Heathrow Hub as a railhead. These journeys will be relatively evenly spread across the day and will therefore not impose any significant operating cost, or requiring additional

rolling stock. This pattern can be expected to generate a significant improvement to Great Western's profitability, in marked contrast to WRAtH, which will require significant additional operating and rolling stock costs, with lower additional revenue than for Heathrow Hub – WRAtH services will be poorly loaded as they will effectively only carry airport passengers, and be less attractive to passengers than Heathrow Hub, both because of longer journey times and the need for most passengers to interchange.

- While stopping the majority of long distance trains at Heathrow Hub will lengthen journey times to Paddington by c5 minutes, we are confident that the additional revenue generated by serving Heathrow Hub will more than compensate for this; rail's competitive position for central London is very strong, and will be further strengthened by reduced journey times with electrification and the introduction of new "IEP" trains, as well as the likely deterioration of road journey times as a result of general increased traffic volumes. Furthermore, the base case for HS2 has all GWML services stopping at Old Oak Common, a stop which is not required with Heathrow Hub (see section 5.5.2.3) – so in practice there will be no journey time penalty for GWML London passengers with the Hub compared with the HS2 scheme.

- We are pleased to note the Airports Commission's recommendation that DfT place greater weight on airport surface access in the decision-making process. [22] We hope that this would include a reassessment of the relative values of rail journey time savings and the economic benefits of airport access.

- In considering this, it is relevant to note the experience of other countries where airport stations have all trains stopping. Frankfurt, Amsterdam Schiphol and Paris Charles de Gaulle, all with lower passenger volumes than Heathrow even today, are all served in this way and the wider connectivity benefits are seen as more than outweighing the small disbenefit of a slightly longer journey time for non-airport passengers. European experience also demonstrates that airport stations located on through lines maximise passenger volumes and network capacity. Brussels Zaventem airport was formerly served by a branch line requiring dedicated airport services. Project Diabolo created new infrastructure to allow new through services. [23] Koln/Bonn airport remains on a loop off the main Koln-Frankfurt high speed line requiring dedicated airport services reliant on air passenger demand alone, and has seen a steady decline in service frequency since construction. [24]

- The proposed changes to Heathrow Express may reduce overall revenue for this service because of the removal of the premium fare, but this will be at least in part be compensated by modal shift from the Piccadilly and road, particularly taxi, hence significantly higher rail volumes.

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[22] *"Clearly, the needs of other users of the transport network must be considered, and we have taken them into account in reaching our recommendations, which in many cases would deliver substantial and wider positive impacts and benefits. However, for the foreseeable future, some greater weight should be placed on the needs of existing airports and their users when taking decisions on transport investment"* – Letter from Sir Howard Davies to the Chancellor of the Exchequer, 26th November 2013

[23] *"Conversion of the existing underground terminus station to a through station is crucial for the development of Brussels airport"* - Project Diabolo, Infrabel Mobility Projects 2009

[24] *"The relative underutilisation of the Cologne- Bonn Airport railway station by long-distance trains is particularly deplorable, as about € 360m have been invested in this project for both the subterranean station and the airport rail loop"* – Experiences with Advanced Air/Rail Passenger Intermodality, Wolfgang Grimme, German Aerospace Centre http://www.dlr.de/fw/Portaldata/42/Resources/dokumente/paper/GRIMME-NR206.pdf

- We would expect the Southern access to Waterloo to generate revenues significantly higher than its operating costs, given the revenue from airport traffic is additional to the base commuter and off-peak traffic on the route. It is likely that the operating profit for this service will cover a substantial proportion of the capital costs of the Heathrow – Staines connection.

- We would also expect the revenues of the Woking – Heathrow service to more than cover its operating costs. Whilst we would not expect the service to cover its capital costs, we anticipate that this scheme can be shown to be a cost effective way of providing relief to the South Western Main Line

5.5.16 Network Rail/TfL engagement

We have had, and will continue to have, significant engagement with both Network Rail and TfL in developing our rail strategy. Notes of meetings are attached at Attachment 5-6. We have also had informal meetings with a number of Train Operating Companies.

5.6 Coach & Bus

5.6.1 Coach and bus stations

We propose a different approach for express coach and local bus stations. For express coach we propose a concentration of activity in one location. For local bus we propose a continuation of the existing dispersed arrangements. Four key features of our airfield, highway and rail proposals for the expanded Heathrow drive the opportunity for change in the arrangements for coach and bus at the airport:

- Additional air passenger processing capacity will be provided both in the T2 campus (current Central Area) but also particularly at the T5 campus. In the medium term, T4 is likely to close;

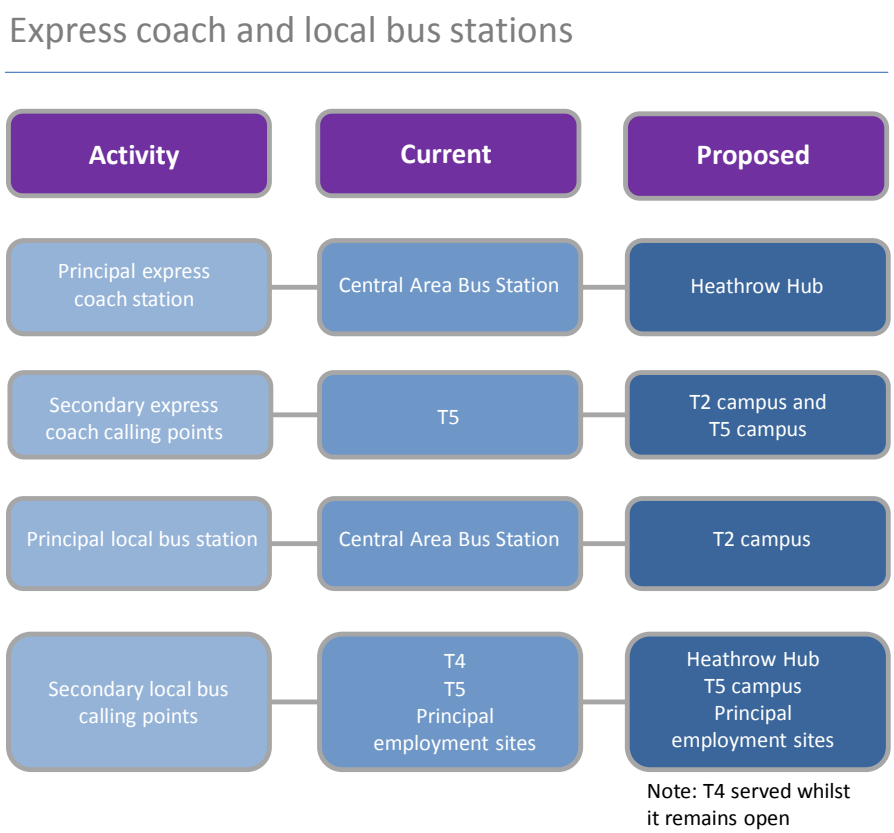
- Very fast, high frequency land-side transit link will connect the terminals through the airport and the new main line and Crossrail railway station at Heathrow Hub;

- Demand for coach and bus travel will grow so additional capacity will be needed in and around the airport to provide for it; and

- Highway alterations will be made in the area of the new Heathrow Hub rail station, M25 and T5 - essential to provide the footprint of the expanded airfield and to ensure free flowing of traffic on the principal routes around the airport. These will make serving the rail station very attractive to coach operators so that, for many express coach journeys, a call at the Heathrow Hub integrated rail, coach and bus station could effectively replace of the existing arrangements where coaches call at both the Central Area bus station and T5.

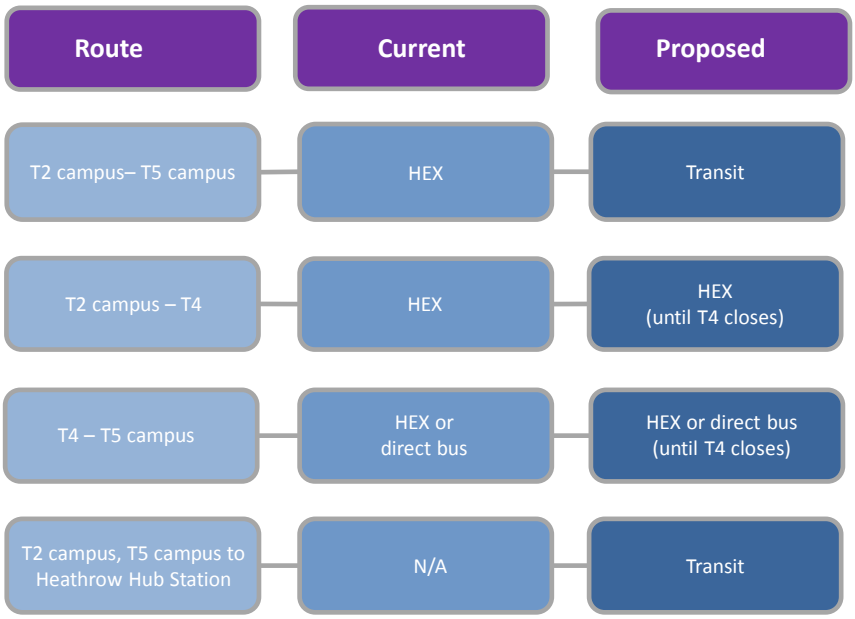
The current arrangements, where a Central Bus Station is placed at the busiest point of demand for air passenger and staff travel, will not apply in the expanded Heathrow. With the major increase in air passenger processing capacity to be provided around T5, the 'centre of gravity' of demand within the airport will shift westwards. Whilst the T2 campus (the current Central Area) will remain very busy, it will no longer be the obvious principal location for coach and bus terminations. We envisage the transit system within the Airport to be of such speed, convenience, high capacity, quality and ease of use that the majority of express coaches will only serve one destination in the airport.

Figure 5.13 below shows the current and proposed location of express coach and local bus stations in the Airport area.



The new fast transit system will, for the first time, make land-side trips between terminals very easy by public transport. All transit journeys will continue to the new main line railway station. Figure 5.14 below shows the current and proposed 'land side' routes around the airport for air passengers, visitors and employees.

Air passenger and employee routes – 'land side' movements



Coach services will need to increase in number to handle the demand associated with an expanded Heathrow. The excellent new road links and space available for a coach and bus station adjacent to the airport transit at the Heathrow Hub main line railway station, make this the preferred location for the focusing the additional capacity for express coach activities. The large footprint of the Heathrow Hub station site allows the road passenger transport part of it to offer significant space for coaches and buses together with passenger facilities. Advanced state-of-the art passenger and information facilities would be an integral part of the Heathrow Hub. These would incorporate Real-Time Information features. The additional capacity will enable a considerable expansion in express coach services and enable an increase in local bus service frequency above what is currently possible. With growing demand, more areas could have a bus service to Heathrow than is possible now.

We believe that the Heathrow Hub's express coach and bus terminal must be as ground-breaking and important as will be the rail element of the Hub. For express coach services the Hub station site will be crucial, providing unparalleled numbers of routes and coach journeys direct to Heathrow Airport from many different parts of Britain. However, it will also provide coach-to-coach transfer between express services that link to each other enabling many different cross-country journeys to be made avoiding London. It will also give smooth coach-to-rail transfer to enable fast journeys to and from central London linking into express coach networks at Heathrow Hub. We would expect the management and facilities of the Heathrow Hub coach and bus terminal to be multi-operator, although we anticipate National Express to be very significantly the major operator. The multi-operator facility at Stansted Airport, where there are a number of different operators on some corridors would be something of a template for this. For those express coaches that continue to serve the T2 and T5 campuses, stops will be equipped with real time travel information. There will be information and ticket sales offices in the Terminals.

We expect that while some local bus services would also use the Heathrow Hub station, most of them would continue to serve other areas of the Airport (including the employment locations around the perimeter) so that dispersed sites in the Heathrow complex could be directly reached by public transport.

5.6.2 Priority lanes and controls for public transport within Heathrow

Priorities for buses and coaches within Heathrow, and connecting the Heathrow Hub to the other Terminal areas, will enable a seamless road-based public transport offering within the airport. It is envisaged that they will include bus-priority roads, bus and coach activated entry and exit gates, and bus and coach activated traffic lights.

5.6.3 Express coach services

The principal role of our strategy for development of express coach services will be to provide the airport infrastructure to accommodate a step change in demand. We expect the additional express coach capacity to be principally delivered through increases in frequency over broadly the existing route network – enhancing existing services and serving more places rather than opening large numbers of completely new routes. Enhancements to services to Portsmouth and Brighton are examples of this. We support the view of Heathrow Airport Ltd in its submission to the Commission, that a number of additional express coach routes could be initiated by 2030, including routes to Luton (via Watford), East Midlands (via Milton Keynes) and High Wycombe. However, we also see potential for new express coach services from the south and south east of London, towns just off the M25 or adjacent to trunk roads which themselves have good links to the M25. Examples might be towns near the A21, such as Tonbridge, and Tunbridge Wells, or Maidstone.

5.6.4 Impact of potential closure of Victoria Coach Station

The freehold of much of Victoria Coach Station is owned by Grosvenor, which is keen to turn the 10-acre site in Buckingham Palace Road into a new “city quarter”. While Transport for London owns the departure hall we understand it only has a lease on the rest of the coach station. Work is underway to find an alternative site for the station, and the possibility of a new coach superhub has been mooted. While, to an extent, the focus of London development has been moving eastward, Heathrow Hub may have a role as a west of London subsidiary coach hub. It would provide excellent, fast, frequent rail connections to central London, and it will allow new cross-country coach services to be created which avoid central London by utilising the motorway network, particularly the M25, while providing very high-quality links to and from London’s heart.

5.6.5 Local bus services

We are impressed by the work carried out between Heathrow Airport Ltd., TfL, local authorities and the operators to develop Heathrow local bus network. Local bus services will continue to service the T2 campus and be increased at the T5 campus to meet increased demand from air passengers and employees at the west end of the airfield.

We expect the range of services to increase with demand for air passengers and employees and support HAL’s proposals to incentivise more employees to use public transport. Additional all night bus links will be developed. Local buses will be able to use the new Southern access tunnel if it is built. They will also be able to serve the new Heathrow Hub station.

The process for development of local bus services depends on detailed planning of services in a way that allows them to serve both airport and non-airport markets. In particular, airport employees have shift patterns that require bus services to run early and late, every day of the week. Our plans assume a continuation of the active development of these services, in partnership with TfL, local authorities and the operators.

5.6.6 Mode share, number of departures, and destinations served by coach and bus in 2030

We would expect the number of express coach departures to increase in proportion to demand together with an increase in the destinations served. We would expect the growth in local bus services to be nearly as large as the growth in Heathrow's workforce. This would lead to both higher frequencies on existing routes and the introduction of more local destinations directly served by bus from Heathrow Airport. One feature is that we would expect is an increase in the number of large London fringe suburban centres served by direct bus, or by a significantly more frequent bus than now.

In 2013 coach and bus carried 13%[25] of the total surface access demand which equates to approximately 5.7m passengers. We expect total demand by coach and bus to increase to approximately 7.3m passengers as Heathrow expands but, as a result of the dramatic improvements in rail services to the airport, the coach and bus mode share will reduce. Improvements in local bus will be a major contributor to the reduction in employee car use.

5.7 Taxi and Mini-bus

We propose the provision of taxi facilities at the T2 and T5 campuses and the new Heathrow Hub station. Taxis will be able to continue to serve T4 until it closes. In 2013 taxis carried 11.2 million air passenger access journeys, 25% of the total demand. Most taxis make only a single direction journey to the airport so, like 'kiss and fly' private car access trips, the empty legs of vehicle access journeys consume a large amount of road capacity around the airport. They also have a disproportionate impact on CO2 emissions. [26]

Our approach to taxi and mini-bus access will be that we will plan to cap the number of daily access journeys at current levels through a combination of our initiatives and those already proposed by Heathrow Airport Limited. These include:

- improvements in rail, coach and bus services to the airport, providing excellent public transport alternatives to taxi and mini-bus;
- additional seating capacity on the Heathrow Express rail service to Paddington, ensuring that it remains a very attractive alternative to the taxi to the West End; and
- interventions to reduce empty taxi movements through 'backfilling' and to make better use of the capacity of taxis through some form of taxi sharing.

Although we are not able to analyse the impact, we believe that a cordon charge "the stick" for access to the airport will be inevitable in the future and would be entirely compatible with the

[25] HAL Taking Britain Further Part 4 Figure 4.20

[26] *"As part of a strategy to reduce the carbon impact of surface access, the reduction of "Kiss and Fly" journeys would have a significant impact on reducing overall carbon emissions since it is the most inefficient form of surface access, requiring four trips per return flight. Estimated landside CO2 emissions (2005) from "Kiss and Fly" (passenger drop-off, including passengers using minicabs)* equals 70% of estimated CO2 emissions" - BAA 2008-2012 Transport Vision http://www.baa.com/assets//B2CPortal/Static%20Files/LHR_SAS.pdf.pdf

dramatically improved public transport provision “the carrot”, this would be particularly effective in helping to cap taxi journeys and reduce kiss and fly.

5.8 Employees

Employee travel is an important element of surface access to Heathrow. Our estimates of future employee numbers are similar to those of HAL and therefore with the same interventions, levels of road traffic will also be similar. HAL has been very successful in reducing the level of single occupancy car access over the last 10 years and plan to reduce this further to approximately 25% by 2030 and this is important to limiting growth in road traffic.

Public transport will play a key part in this but reinforcement of other measures such as personalised travel planning, expansion of discounted travel and reducing available employee parking spaces will also be important.

These interventions on employee trips, together with an increase in public transport options in our proposals (and therefore the increased likelihood of achieving a public transport mode share of 50-60%) are anticipated to offset those generated by the increase in passenger trips.

6. COSTS

Our previous [Heathrow Expansion] submission was accompanied by a related cost estimate for airport specific facilities. This surface access paper contains the specific associated elements of the cost estimate for the following elements;

- Heathrow Hub (including related surface access infrastructure)
- Southern Rail Access – T5 to Staines via M25 junction 13
- Southern Rail Access – M25 junction 13 – Ruxbury Road (junction with Virginia Water-Weybridge line) to Woking + Woking station

The Heathrow Hub costs are based on the station layout drawings and the illustrative concept drawing for the hub which identifies the constituent elements. Given that the intention of the Hub is to be seen as an integral part of the Airport experience an allowance has been made for a signature station and interchange facility.

In addition to the HH interchange/station building, costs have been included for the associated roadworks, including access off the M25, the APM from the HH to the T5 & T2 terminal campuses and the baggage transfer system connecting the HH to the existing on airport system.

The Southern Rail Access from T5 – Staines includes the alignment from T5 adjacent to the M25 to connect to the existing Windsor – Staines line near M25 junction 13. It also includes for a new turnback platform at Staines which requires the replacement of the existing station building.

The Southern Rail Access from the M25 junction 13 – Ruxbury Road junction is a new alignment running along the east side of the M25 and the costs include for the structures along this section. The costs also include for a dive under on the east side of Woking station and modifications to the station.

Separately within each section provisions are made for;

- Phasing Allowance
- Fees (Professional, Planning & Building Control)
- Contingency
- Notes & Exclusions
- Basis of Estimate

It should be noted that ‘Other Development Costs’ (including Land Acquisition) are included within the Heathrow Expansion (Airport) section as submitted with our previous submission.

The cost plan responds to the level of detail available for respective elements of the scheme. The following bullet points express the basis for costs included against indicative substantive scope items:

- Overall gross area allowances for ecology/environmental; enabling works; utilities
- Spot Allowances for major scope items (without design at this stage) e.g. Relocation of Water Treatment Works

- Facility/Elemental level benchmark rates where design scope evident e.g. linear rate for rail permanent way, area rates for facility construction such as rail station development, car parks and other buildings/infrastructure
- Factored provisions for specific known enabling costs such as Network Rail possessions
- Percentage based allowance for preliminaries and on costs
- Risk factored into cost plan through individual assessment of each area of cost (indicated in columns throughout). Range of risk provision associated with respective elements.

Summaries of the costs for each element are given below in Figures 6.1, 6.2, & 6.3 with the detailed breakdown being given in Attachment 6-1 to 6-3.

Table 6.1Summary of Heathrow Hub Cost Estimate

Element	Estimated Cost £m
Heathrow Hub	850
Associated Roadworks	180
APM	500
Baggage Transfer System	403
Phasing	40
Other development costs including land	excluded
Fees	295
Contingency (HH, Roadworks, APM, Baggage system)	552
Inflation	excluded
Optimisum Bias	excluded
Estimated Total Cost (2nd Q 2014)	**2,820**

Table 6.2 Summary of Southern Access T5 – Staines Cost Estimate

Element	Estimated Cost £m
Construction	270
Phasing Allowance	10
other development costs including land	excluded
Fees	42
Contingency	80
Inflation	excluded
Optimisum Bias	excluded

Element	Estimated Cost £m
Estimated Total Cost (2nd Q 2014)	**2,820**

Table 6.3 Summary of Southern Access M24 Junction 13 - Woking Cost Estimate

Element	Estimated Cost £m
Construction	460
Phasing Allowance	10
other development costs including land	excluded
Fees	70
Contingency	111
Inflation	excluded
Optimisum Bias	excluded
Estimated Total Cost (2nd Q 2014)	**651**

Funding

Our objective is to develop a surface access strategy capable of delivery with as close as possible to a neutral impact on public finances. We have discussed with Network Rail the following possible offset costs -

- WRAtH assume capital cost of £0.7bn of which £0.5bn provisionally committed by Government. [27]
- Old Oak Common main line platforms and associated station concourse/overtrack development – say £0.1bn, (reflecting the very constrained island construction site between the HS2/Crossrail station immediately to the north and the IEP North Pole depot to the south)
- Crossrail semi-fast services, for which new infrastructure may otherwise be required to optimise the benefits of the service extension to Reading – say £0.2bn
- Woking grade separation (which may be a CP6 commitment 2019-2024) – say £0.2bn

The above total ca. £1.1bn of potential offsers, suggesting that our rail enhancement proposals (excluding the Heathrow Hub interchange itself) could effectively be cost neutral.

Our proposals also provide significant benefits (to both airport and non-airport passengers) by providing additional network connectivity, capacity and resilience. They would also deliver very substantial new revenues to the railway.

[27] https://www.thamesvalleychamber.co.uk/uploads/Policy/SBCpresentationSep09.pdf

In addition, our proposals, if implemented in full, may delay or avoid SWML capacity enhancements that would otherwise be necessary.

Whilst the road and rail elements of the Heathrow Hub interchange could be funded through the airport's RAB, we suggest that there is an opportunity to instead consider a privately funded and developed mechanism, similar to that used at, for example, Southend Airport, Stratford on Avon Parkway, Coleshill and Warwick Parkway stations. We are carrying out further studies into this opportunity, which could also use revenues from airport cordon charging, as previously proposed by HAL, as part of a privately financed development separate from the airport RAB. This could additionally provide the opportunity for competition in the supply of some airport related facilities and services.

7. DELIVERABILITY & PHASING

7.1 Heathrow Hub Site

The Hub site provides full functionality only when the APM system is complete and this cannot realistically be achieved until late in the project. However, early functioning of the Hub would remove much of the need to access the T5 frontage area for road traffic arriving from the North, East & West. This in turn would make construction of the works easier in the T5 frontage area. Early functioning of the Hub site could be achieved by utilising the back-up bussing facility for the APM.

The road links from the M25/M4 interchange are reasonably straightforward to construct as they are generally offline but adjacent to the motorway/interchange. The most challenging aspect would be constructing the new bridges over the live M25 & M4 motorways and those over the Great Western railway line. For the motorway bridges lane provision would be maintained with the use of hard shoulder running and local temporary widening whilst central piers are built. It is envisaged that the decks would then be constructed adjacent the site and lifted into place. The narrower rail corridors would lend themselves to having single span decks, making deck placement simpler. The bridge over the M4 West to the M25 North link could be constructed with a temporary diversion that would utilise the newly built on slip to the M25.

The design of the station is such that the construction of the new relief line platforms can be constructed first off line without having to disturb the existing Relief lines and as the Main lines are not moved there will be little disruption to services except when the tie ins are constructed.

7.2 Highways (South of M4 corridor)

An approach to phasing the construction of the highways around Heathrow Airport is outlined below and illustrated on drawings 47067372/TL/GA/31 to 37 in Attachment 7-1. For clarity of illustration, these illustrate the development of the airfield only in Phase 6. Development of the airfield would take place in line with demand once the main roads have been diverted away from the airfield site.

7.2.1 Phase 1

The majority of the highway works would be constructed during this phase. The key feature of this phase is the upgrade of Junction 13 to provide increased capacity to Terminal 5 in preparation for removing Junction 14. The full list of works included in Phase 1 is:

- Upgrade Junction 13 and construct a new southern link road
- A new section of offline motorway and APM corridor
- Local road modifications to the northwest of the airfield
- Decommission Junction 14

Junction 13 of the M25 would be converted to a small cyclic interchange. This requires adjacent widening of the corridor and three new bridges over live carriageways. The compact layout however would allow retention of a large proportion of the existing junction and make construction somewhat easier. The two bridges adjacent to the northern junction bridge could be built by diverting A30 eastbound traffic up to Junction 14, continuing along the south of the airport and also using the A3044 corridor.

A short section of the A30 would be widened and a new link constructed to provide high capacity connectivity to the south of the airport. This would require a new bridge over the A30 and two new bridges over the railway branch line. Construction techniques for these bridges would be similar to above.

A diverted section of M25 would be built significantly offline to west (minimising impact on the existing motorway) and a new tunnel constructed using 'cut and cover' techniques. The new tunnel would include the APM and diverted A3044 routes. The APM construction would begin in the airfield. Impact on apron operations during this work is not expected to be too adverse. Where piers are being built adjacent to the stands the spans would be constructed on the airfield before being manoeuvred and lifted into place at off peak times. Temporary narrowing of the stand may be necessary.

A new bridge to serve A4 would be built adjacent to the existing over the live M25.The A4 would be diverted onto this bridge whilst the existing bridge is modified to form a dual carriageway for the A4 and provide spans suitable for the M25 diversion and APM corridor. The construction techniques for these bridges would be similar to above. To the west end of the A4 improvements a replacement link would be constructed to provide access to Colnbrook. To the east end of the A4 improvements an upgrade to the A3044 link – together with a new roundabout and spurs - would provide a route onto the future A3044 diversion and other local routes.

At the end of Phase 1 T4 and cargo traffic from the south would be moved onto the southern link road from Junction 13. Junction 14 would then be decommissioned along with the original link road to the south of the airport.

7.2.2 Phase 2

During this phase a new offline link and tunnel (using 'cut and cover' techniques) would be constructed to provide access to Terminal 5 and the proposed Terminal 6. A temporary access road to the roundabout immediately northwest of Terminal 5 would also be constructed.

At the end of this phase all T5 motorway traffic arriving from the south would use the new link road from Junction 13. Junction 14a would then be decommissioned.

7.2.3 Phase 3

During this phase the M25 diversion would be connected into the existing motorway network making the original section of M25 redundant. At the end of this phase the main line section of motorway around the old J14/J14a would be decommissioned in preparation for Phase 4.

7.2.4 Phase 4

During this phase the remaining sections of A3044 can be constructed. The APM route would also be completed – all except for the area between Terminal 5 and the proposed Terminal 6.

At the end of this phase the local traffic around the airport would use the new A3044 diversion. The original A3044 would then be decommissioned in preparation for Phase 5.

7.2.5 Phase 5

During this phase the APM route and stations would be completed. Terminal 6, the hotels, multi-storey car park and associated local access roads would also be constructed in line with passenger demand.

At the end of this phase the APM would be commissioned enabling the Hub to operate at full capacity. All road access to Terminal 5 is now provided for via the new tunnelled link road. The original southern access road to Terminal 5 would now be decommissioned.

7.2.6 Phase 6

During this phase the runway, taxiways, apron and remaining infrastructure would be completed. At the end of this phase the all the remaining components of the scheme would be commissioned.