Report and analysis of HS2-HS1 demand and potential for other flows avoiding Central London, with access to key nodal points including Stratford International, Heathrow and Old Oak. JRC Report 522.

East and South East London Transport Partnership (ESELTP) requested on Monday 1st October 2012 an urgent report and modelling data from JRC Ltd, by Friday 5th October, relating to:

1. UK international demand modelling for rail.
   - Data to include relevant CAA origin and destination data for passenger flows
   - Guidance on HS2 linkage to Heathrow and demand assumptions

2. UK inter-region demand modelling by rail with the ability to serve Stratford, Ebbsfleet and equivalents in north/west London.
   - demand data on Stratford International and modelling to show feasibility in next 25 year horizon including domestic AND international rail movement
   - potential mode switch to HS rail up to 2055 under various economic and population growth scenarios and an indication of demand for through train services HS2-HS1 and vice versa.

3. Definition of London and Home Counties corridors suitable for new through commuter and orbital services.
   - Data on alternative routing for HS2-HS1 link in London, and modelling to suggest better surface alignments, with capacity implications.
   - Data on connections between HS1 and HS2 and what would make it viable in a 25 to 50 year horizon.

4. Cross-London route specification, with options for short / medium / long term development.

5. ESELTP's key purpose, using JRC's data, is to explore the potential for Stratford International to have a higher profile as a transport hub given that infrastructure is already in situ and post Olympics usage.

6. JRC also asked to comment on HS2 train service patterns at London interchange stops (eg potential for trains via Stratford, fewer stops at Old Oak), and on Crossrail demand eventually requiring an express service via Stratford International.

Data used in JRC report – international numbers

7. JRC used the detailed CAA airport-to-airport passenger travel data set out in the CAA's passenger counts for chartered and scheduled air travel during 2010. A nearby-Western Europe data set was extracted.

8. Published distributional data was used for detailed origins and destinations in the UK, distant from the airports themselves. Proportional allocations by population volume was used where specific O&D data was not available.

9. This distibution is important because air passenger flows when reassigned to rail routes and catchments may use different railheads, not stations at airports.

10. Generally international rail works best on an aggregation of major city to city journey pairs (eg London to Paris). It will take a major, 'World city' to justify more than one international station.

11. Key elements: rail best in up to 3 hours sector, and increasingly in 3-5 hour sector.

12. CAA 2010 data shows 35.7 million scheduled international passengers between UK and nearby Western Europe mainland airports (in Belgium, France, Germany, Luxembourg, Netherlands, Switzerland), and 725,000 charter passengers on this sector.

13. Eurostar carried 9.5 million passengers in 2010 and 9.7 million in 2011. It is reported to have over 70% of the London-Paris market and 65% of London-Brussels. The total Eurostar service volume is about 18,000 trains a year, which is an average of 540-550 passengers per train. Each train currently has capacity for 750 passengers.

14. The short sea market is currently

Modelling of international rail flows – within the UK

15. The primary modelling has therefore looked at major city pairs achieved by combining the existing and proposed UK (HS2 Y) and mainland Europe high speed railway networks, with a reshuffled, rail-based O&D matrix. These give the best chance of rail journey times being attractive to passengers.

16. Five modelling years chosen: 2010 (starting point), 2026, 2035, 2045, 2055.

17. New international rail stations have been assumed on the UK HS network at Old Oak, Heathrow, Birmingham, Manchester, East Midlands, Leeds, Darlington and Newcastle. Access times to those railheads have been simplified.

- In the Greater London area, current air/potential rail passengers are pre-assigned to East/West/South/North London with a quarter market share for each (this also divides Central London into quadrants), eg, a quarter allocated East to Stratford, North to St Pancras, West to Heathrow/Old Oak and South to Gatwick).

18. This allows the merits of different rail linkages to be tested on a level footing, as each catchment then has the benefits of the local and more distant catchments available to it in that compass direction. The London area demand options are:
    - Stratford International substituting for Stansted and providing access to/from East & South East London and East Anglia, with passenger flows assigned either to Heathrow or North of London trains calling at Stratford.
    - Heathrow/Old Oak (including potential for picking up 'aggregation' traffic at Old Oak from other HS2 trains).
    - St Pancras with the potential for additional Kent passengers via Ebbsfleet.
    - Gatwick and a new direct service via Ashford, taking over the Ashford stops and also the potential for additional Kent passengers.
    - Each catchment has a share of the Central London market.

19. A later stage of modelling could allow more substitution between the different quadrants, eg to test the merits of a stronger demand via fewer international rail interchanges. However modelling already addresses two options for ESELTP with Stratford Interchange, by allowing:
    - International services from Heathrow/Old Oak to call at Stratford.
    - International services from Manchester/Birmingham to call at Stratford (this is the strongest North of London corridor for demand).

20. Rail based journey times are derived for UK at various stages of High Speed development, and with time penalties if there are interchanges or if trains are held for regulation.

21. An option is built in to the model to test the demand either for through running trains from North of London, or for an 'aggregation' service starting at Heathrow or Old Oak to pick up passengers, then proceeding via East London.

Modelling of international rail flows – within mainland Europe

22. The following modelling assumptions have been made:
    - It is assumed that the mainland European rail proxy for relevant airports will be major railway stations in the respective city centres.
    - European high speed rail developments will allow use of the existing high speed networks with technically compatible trains. Extension of the French Lignes de Grande Vitesse (LGV) network is already underway to Bordeaux, and future

improvements are also allowed towards Geneva, Spain via Perpignan, Western France and Brittany, and towards Clermont Ferrand.

- Best available journey times are adopted for city pairs by HS rail, and for mainland Europe. These times are adopted as a fixed matrix with a fully developed network assumed operational in 2010. While this isn't the case in reality, it does not affect the modelling outcomes as journey times to the further ends of the French LGV network are too long currently to be attractive for through rail operation. It will require economic and population growth to make the case in later decades.

Future economic and population factors

23. Other key elements are driven from the 'modelling control sheet' and inputs can be varied to test numerous assumptions.

24. **Economic growth between 2010 and 2055**. With the current instability in European financing and projected economic growth rates, this input is left open and users can insert their own projections or expectations. Cut-off dates are set at 2010-2020, 2020-2035 and 2035-2055. No differentiation is made between the UK and mainland European economies as there is so much overlap.
    - In the model as tested and delivered, cautious growth at 1% pa is allowed overall to 2020, and 1.5% pa thereafter.

25. **Differential population growth** in London and Home Counties, the rest of UK, and mainland Europe, to 2035 and after 2035.
    - In the model as tested and delivered, a continuing high growth of 1% pa is adopted for London and the Home Counties, as London saw a cumulative 12% population growth between 2001 and 2011, which is 1.15% compound pa. Fastest growth rates were in Tower Hamlets and Newham, at 26.4% and 23.5% respectively. The London Plan expects continuing fast population growth.
    - The rest of England and Wales saw population growth of 7% on average in ten years, 0.66% pa, generally higher in the Home Counties. This growth is modelled to continue until 2035, which also relies on successful local initiatives for stronger economic growth. HS2 Y and other Government policies are assumed to help sustain this growth outside London beyond 2035.
    - European population growth has slowed dramatically in the last decades, and was only 0.28% in 2010. Largest increases were in France and Italy. This overall modelling is also maintained in the model.[1]
    - Changes in assumptions can be tried, to see what impact this has on the international travel demand.

[1] http://www.telegraph.co.uk/news/uknews/immigration/8705789/Britains-population-growing-at-twice-EU-average.html

26. **The modelling includes an important assumption, that there is a linear relationship between the combination of changes in economic activity and population growth, and demand for international travel**. This is discussed now.
    - There is certainly a multiplier, but the figures for travel through UK airports in the past decade shows the overall effect of external events such as September 11th in 2001 and the economic recession. Overall it is the economy, and competition between different travel sectors to get the passengers' fragile pound into *their* pocket, which have proved the real test for UK aviation in the last decade.
    - UK rail has proved more resilient to economic recession than air modes, with high growth in recent years. For example, since Eurostar moved to St Pancras towards the end of 2007, with the completion of HS1, its passenger numbers have grown by about 17% to 2011.
    - This contrasts with air passenger declines at Gatwick, Stansted, Luton, Birmingham, Manchester and Newcastle in the same period, and only limited growth at Heathrow of 2% (serving all air markets) and 1% at Leeds Bradford. (These declines are based on all flights, so count charter and domestic as well as international scheduled). Most of these airports include short haul Western European flights, so rail may have an opportunity to do better, but this also depends on the effective end-to-end journey times, discussed below.
    - Overall, JRC concludes that the proposed linear relationship for modelling international rail demand linked to economic growth and population growth is a correct basis to proceed for high level assessment. The specific inclusion of population growth, which is high in the UK compared to the rest of Western Europe, will help to compensate for any under-estimation of UK economy-led demand for international rail services where rail has been performing better.

27. The other key drivers in the 'modelling control sheet' are:
    - **overall times between UK and mainland Europe international stations**
    - the **commercial case for running international trains beyond the London-Paris-Brussels triangle**. These two elements are of course linked and are discussed below.

28. Also to note in passing other elements which are also capable of change within the modelling control sheet:
    - A discount percentage for air travel via Amsterdam (Schipol) and Paris (Charles de Gaulle and Orly) to remove passengers flows who are interlining to longer flights rather than having Amsterdam or Paris as the destination.
    - Maintaining or removing an international rail service beyond Leeds to Newcastle, to see if this is an important flow to cater for (HS2 Y is expected to end at or near Leeds, so through running north of Leeds may be less worthwhile).

Overall journey times

29. There are passengers who will never travel by rail regardless of its benefits. The reverse also applies. If an origin or destination is close to an airport, then air may be preferred even if rail is very competitive. At the other extreme, rail's secondary attributes such as uninterrupted time for working or relaxing may hold sway even over very long journeys – though enforced interchange is a disincentive.

30. The 'modelling control sheet' allows these extremes, and the more likely outcomes in-between, by setting limits (which you can adjust):
    - Minimum rail mode share of 10%, applies if rail journey time is 7 hours or more.
    - Maximum rail mode share of 80%, applies if rail journey time is 2 hours or less.
    - A straight-line sliding scale between the mini-max limits, so that for example a journey time of 4 hours would attract a starting position of 52% rail mode share before other factors are applied.

Commercial case for running international trains

31. Eurostar has been cautious about the commercial case for running international passenger trains from further north than London and further south or east of Paris/Brussels.

32. Richard Brown, the former Chief Executive of Eurostar, has commented: "We know we can go to most places in France physically, because our trains are compatible with French infrastructure, but then you've got to look at impact on fleet utilisation, you've got to have a station that's got the spare capacity to have a train stood for a number of hours, for all the security, screening, passport control passes. So it's not possible to go just anywhere. And you've got to be able to get the control authorities to agree that there's a big enough market for it to be worthwhile for them to set up there."[2]

33. Other operators such as Deutsche Bahn (DB) are interested in running to/from the UK but, until current restrictive rules are removed which require any train to be able to be split in half within the Channel Tunnel and drive to safety away from any problem, then there will continue to be barriers to operators with differently designed stock. Since most trains are multiple units, the rules shouldn't be impossible to change. Through trains to Amsterdam, the Ruhr/Frankfurt and other destinations are feasible. DB is now talking of running trains to London in 2015.

[2] http://en.wikipedia.org/wiki/Eurostar#cite_note-196#cite_note-196, quoting Richard Brown. The Wikipedia article includes extensive discussion about the potential for through trains between the UK and other mainland European destinations.

34. Apart from the safety case rules there are two other factors

35. **UK's opt-out from Europe's Schengen open border scheme**. The current position requires segregation of UK international trains at platforms within the UK and (sometimes) elsewhere, unless a different operating system is considered acceptable by UK immigration authorities. This imposes major constraints on which types of passengers can be carried within the UK, and inhibits internal domestic travel on Eurostars and their equivalents, so reduces the commercial case for services. Essentially, until the UK position on Schengen is relaxed or alternative operational arrangements are accepted, modelling for these trains within the UK can only be based on international passenger flows.

36. **How far and where is it commercially worth serving, beyond the 'golden triangle' of London-Paris-Brussels?** This is partly linked to the train design topic for Channel Tunnel operations, but is more generally linked to the extra numbers of National Railway Authorities within whose administrations trains might pass, and to the incremental costs of extra track access charges and staffing and working time directives, and railway technical requirements of different States. Unlike a short-haul jet, where easyJet or Ryanair aim to secure 4 return flights a day on short haul flights, a train taking 4-5 hours to do what a jet can in 1½ hours, will struggle to achieve more than 1 long and 1 short round trip in a working day, and possibly less than that, while paying more access charges along the way.

37. If Eurostar is any indicator, it struggled to be profitable until after HS1 opened, and its passenger loadings are (as we noted) now averaging 540-550 per train in 2011. A longer journey with higher operating costs, points to the need for extra passengers above, say, 500 passengers per train as an absolute baseline. We have set the baseline as 550 for testing purposes.

38. Planes' worth's, measured as 150-250 passengers per plane, are not a hopeful start for rail to compete on frequency. The train will need to offer convenience, high journey quality and other positive attributes such as price.

39. In the modelling that JRC has developed, we have sought to give commercial flex to the rail operator and to permit modellers to see for themselves at which point it starts to become advantageous to operate commercially worthwhile train services.

40. By using a 550 passengers per train yardstick in the 'modelling control sheet' (based on the Eurostar experiences), this aims to provide a clear differentiation by combination of UK and mainland Europe high speed route, on which flows may be most commercially attractive - and when, by decade. (But you can try to be tougher or gentler on the commercial objective, by changing the 550 to another figure…)

41. To allow that commercial flex, JRC has not insisted that every one of those [550] passengers have to be guaranteed from the CAA 2010 air passenger database or the economy/population multipliers through to 2026-2055. Instead we have added a marketing risk element – that an operator will be willing to take commercial risk to yield-manage and fill profitably the gap in passenger numbers that an international train needs to be profitable.

42. **We have allowed a percentage** of that [550] **to be at yield-management risk to the operator**. For the purpose of this test for demand assessment, JRC has used a 75/25 ratio – that the operators should yield-manage 25% of the demand needed to run a train, with 75% coming from the adapted CAA figures.

43. This also addresses another commercial demand topic – are there are new sources of passengers other than by seeking to divert air passengers to rail? The most obvious possible sources are the short sea ferries via Dover, and Eurotunnel with its Le Shuttle services, on top of any new 'stimulus marketing' that will be undertaken.

44. In 2011, short sea via Dover handled 12.8 million passenger journeys, and Eurotunnel handled 19 million (of which 9.7 were via Eurostar). So there are about 22 million passenger journeys to focus on, 60% as many as the scheduled air passengers on near-Western Europe flights. [3]

45. People take car and coach across the short sea for many reasons, and not all are capable of attraction to rail, eg taking family and luggage all together on holiday, or high rail fares, or meetings nowhere near international rail interchanges. The yield marketing proposed above does allow market testing of other products and brands within the commercial gap, and so can help to stimulate transfer from short sea and Eurotunnel.

46. However it would be unwise to pin commercial nirvana on large scale transfer, as generally rail would have to offer many new advantages to leverage new flows, and possibly at low net profit to begin with. Setting a 25% marketing yield is therefore a plausible test of other flows that may be capable of being stimulated, and shows what international rail services may be achievable with a degree of optimism, over several decades.

Outcomes of initial modelling tests

47. Based on the modelling and inputs described above, JRC has run several options for of UK international rail passenger demand. ESELTP can reproduce those outcomes and indeed try other modelling variations as they consider appropriate.

[3] http://assets.dft.gov.uk/statistics/releases/sea-passenger-statistics-2011/sea-pass-2011.pdf

48. **Input the variable data in the modelling control sheet, and the outcomes in terms of worthwhile UK international trains, one-way per half-day, appear on the right hand side, and – further to the right – the main European cities worth serving.**

49. Worthwhile flows are summarised below: (**trains per half-day, one-way**).
NoL = North of London, aggregate = flows aggregated via a London interchange (OOC from 2026, if all HS2 trains stop there)

Option: Year:	Stratford + Heathrow/OOC	Heathrow/OOC/NoL aggregate (+Stratford)	Stratford + WMids/Mcr	WMids/Mcr direct (no Stratford)	Yorks/NE direct (+EMidlands)
2010	0	0 (2)	0	0	0 (0)
2026	1	2 (4)	1	0	0 (0)
2035	3	4 (7)	2	0	0 (0)
2045	5	(1 if no.ag) 5 (8)	3	1	0 (0)
2055	6	(2 if no.ag) 7 (9)	6	1	0 (0)

Based on this modelling, any case for EMids/Yorks/NE international trains can only be made by aggregating with other flows at Birmingham Interchange or at a London Interchange.

50. In **2010** (and therefore in 2012), if it were possible to combine Heathrow/West London and Stratford International passengers, and also to aggregate from North of London into trains'-worth's, there would be commercial merit in having two trains per half-day, one to the Low Countries (Brussels/Amsterdam), another to Paris.

51. In **2026** it is only Stratford with its extra passengers that makes a immediate case for a half-day international frequency from Birmingham (and possibly Manchester) to the Low Countries. Note though that the modelling doesn't allow for NE/Yorks passengers also to change onto a train from Birmingham, which they could at Old Oak or Birmingham Interchange. (The modelling in its present design only tests a direct service from each Y leg, not aggregating Y's two flows onto one train, except onto a Heathrow/Old Oak starter).

52. Similarly, by attaching the 2026 Stratford passenger flow to OOC originating flows (Heathrow HS2 won't be open then), there is a case for a half-daily service to the Low Countries with *that* starting origin. By combining Stratford with OOC starters which are intended to aggregate flows from North of London, creates scope for up to 4 trains per half-day each way, 1 towards Paris, 2 to Brussels/Amsterdam and 1 towards Geneva.

53. It is possible that by then Deutsche Bahn or another third operator will be running trains from St Pancras to Brussels/Amsterdam and Koln/Ruhr (and possibly could have been encouraged to call intermediately at Stratford), so influencing passenger demand from London interchange stations positively or negatively. However there is still clear additional demand to Paris and Geneva as a minimum in 2026.

54. The options broaden in **2035**. There is no clear merit in running international trains on their own from the (new) Yorkshire HS line, though this may be worthwhile in

combination with aggregation of flows from other sources such as Stratford, as the addition of Stratford also assists the case for West Midlands/Manchester trains.

55. The core options, as before, focus around allocation of Stratford demand to either or both of the West Midlands and Heathrow/OOC origins for international trains. Stratford + Heathrow/OOC on their own, with no aggregation from NoL, support three half-daily trains each way. Allocating Stratford demand to Birmingham/ Manchester flows justifies 2 trains per half-day each way. Heathrow/OOC support 4.

56. As in 2026, the strongest international train volume in 2035 is achieved by aggregating flows at Old Oak from NoL, and from Heathrow and then calling at Stratford. The combined demand supports 7 trains half-daily each way, 2 to Paris, 2 to Brussels/Amsterdam, 1 to Koln/Ruhr, 1 to Frankfurt/Munich and 1 to Geneva/Lyon.

57. This is beginning to look like an hourly (or so) international service over HS2-HS1. It is now 9 years after the line would have had to have been built and opened, based on the current HS2 Ltd specification, and is likely by then to have incurred a large deficit and negative BCR in this part of HS2's business case. (The current HS2-HS1 project costs are now approaching £1½-1¾ billion with mitigation work in Camden.)

58. However total reliance on aggregation via Old Oak will negate the political desire for direct international trains from North of London, though aggregation is the commercially safest option.

59. Therefore a more likely combination of services is a mix of flows from North of London underpinned by Stratford passengers, plus Stratford passengers also being accommodated on some Heathrow/OOC originating trains (though potentially fewer in total than the full aggregation option).

60. By **2045**, the economic and population growth is now stronger. Both Birmingham/ Manchester, and Heathrow/OOC now justify 1 through train each per half-day in their own right without reliance on aggregating passenger volume or calling at Stratford.

61. Adding Stratford flows to Birmingham/Manchester supports 3 trains per half-day, while adding the same Stratford numbers to Heathrow/OOC supports 5 trains before aggregation is considered. Aggregation lifts the total throughput by another 2-3 trains per half-day. There is no clear case for international trains from the Leeds/East Midlands directions, though judicious aggregation at Old Oak or by adding Stratford demand could assist.

62. Cumulatively this is still no more than about an hourly service, though timings of passenger demand may require two trains running per hour, at peak periods for international travel demand.

63. By **2055**, passenger demand is as high as 8-9 international passenger trains per half-day, combining the aggregation plus Stratford options, or by sharing Stratford demand among North of London and Heathrow/OOC services.

64. Overall, the test modelling demonstrates that, on present demand assumptions, there is increasing opportunity from 2035 onwards for trains to call at Stratford, and increasing freedom of choice about how to allocate those stops between different train service groups.

Can Stratford be served within 25 years?

65. There is a limited market basis in 2026. Actions which could strengthen the case for Stratford and elsewhere via HS2-HS1 are:
    - **Discussions with another train operator about the basis for serving London**, and whether access to Heathrow HS2 from 2033 (but initially as far as Old Oak in 2026) could stimulate a new service. Modelling points to Paris, Brussels/Amsterdam and Koln/Ruhr and Lyon/Geneva as early mainland European options for successful train operations.
    - **Similarly, behave as an airport owner does if negotiating with Ryanair**, and find ways of incentivising a train operator to serve the station at their commercial risk. If this isn't attractive to Eurostar then find another operator and commence talks. Deutsche Bahn may be the next entrant to the UK international rail marketplace, and is already a large-scale operator of passenger and freight services in the UK.
    - Other options are cost-focused:
        - **Lowering international train operating costs by rationalising the multiple and conflicting track access charges** that different National Railway Administrations levy on trains. These are different between States in their formulation, which is a disincentive to through operations. This issue would need to be addressed at an EU level.
        - **Reducing train costs by removing the separate rules for Channel Tunnel operations** that are imposed by the Inter-governmental Safety Authority. Switzerland is now operating similar length new 'base tunnels' under the Alps (the Loetschberg is open, partially as a single track tunnel, and the Gotthard is under construction) and unusual train specification is not required there.

66. As a sensitivity test for 2026, lowering the effective passenger loading requirement from 550 to 500 passengers (but keeping the 75/25 rule for commercial yield management) would support, as before, 1 train per half-day from

Birmingham/Manchester if it called at Stratford. However there could be up to 6 trains per half-day starting at Old Oak (with aggregation of flows) and then serving Stratford, which is an extra 2 paths (50% more) than in the 2026 base case.

67. If operators were incentivised to take higher risk on commercial yield, say up to 33% of the required capacity, then applying this on a 550-passenger baseline achieves the same extra paths as reducing costs to 500. This suggests there is some scope for different commercial stances between rail operators, if the cost base and the incentive/risk base allows some flexibility.

Biggest obstacle is HS2-HS1 itself

68. However the biggest obstacle is the current specification for HS2-HS1 itself. If it cost, say, £1.6 billion to build, ie, Arup's original £900m for the single-track tunnel between Old Oak HS2 and Camden Roundhouse, and another £700 million for additional mitigation in the Camden area with capacity for existing freight and North London rail services (which is discussed in Section 2), then the construction interest charges alone over 5 years could cost £200 million if funds were borrowed at 5%, plus an annual interest bill starting at £80 million in 2026. This is a total capital cost of £1.8 billion. The financial servicing costs, paying off the capital at say 3.5% pa and the annual interest bill, would be £143 million pa.

69. It is not credible that these costs could be supported by the general railway industry, nor allocated generally to the public debt, nor charged pro rata per train using the link. For example, use the base modelling of 550 passengers and a 25% passenger load commercial risk for rail operators, with the (best volume) aggregate option of 16 trains per day in 2026: 4 each way per half day. If x350 for yearly flows, and on average 550 passengers per train, the £143m annual charge is a tariff to use HS2-HS1 of £46 per passenger in its first year of operation, before any operating, maintenance and depreciation costs are counted in.

70. The financing charges would eventually come off in the 2050s, but would still be over £10 per passenger in the final years, if 36 international trains were then running daily. Averaging the interest charges over the years, would create a first to last year spread of £35 to £15 per passenger. This is not supportable, for a small part of an entire passenger journey to distort the fares charged so massively.

71. St Pancras would be the only other international station accessible in London via Stratford if the present proposals for HS2-HS1 were rejected by Parliament during the HS2 Hybrid Bill proceedings.

72. Therefore defining an improved and affordable HS2-HS1 link is a key part of liberating the international rail service opportunities throughout UK regions and at London Interchanges.

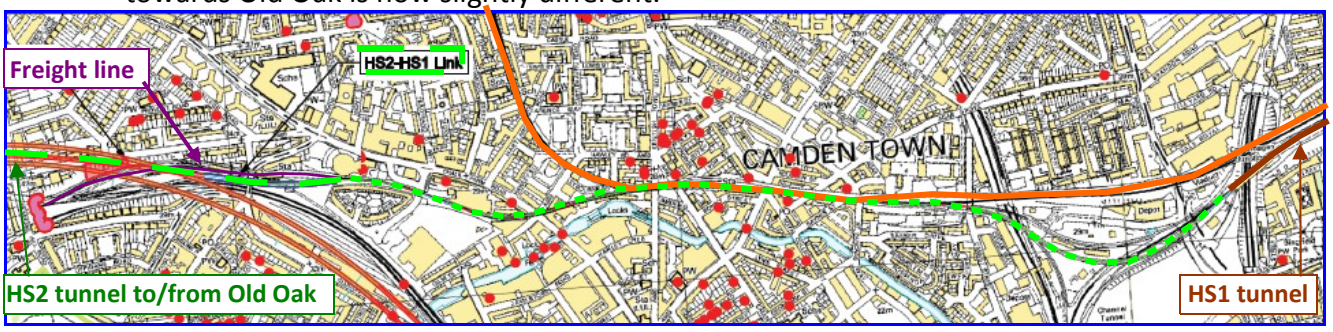
Section 2 Redefining HS2-HS1

Current scheme for HS2-HS1

73. The government's objectives were set for HS2 Ltd in Transport Secretary Justine Greening's statement to Parliament on 10 January 2012:
"The Government is signalling its commitment to providing 21st century infrastructure and connections – laying the groundwork for long-term, sustainable economic growth. High Speed 2 (HS2) is a scheme to deliver hugely enhanced rail capacity and connectivity between Britain's major conurbations…"
"The HS2 Y network will provide direct, high capacity, high speed links between London, Birmingham, Leeds and Manchester, with intermediate stations in the East Midlands and South Yorkshire. There will also be direct links to Heathrow Airport **and to the Continent via the HS1 line. It will form a foundation for a potentially wider high speed network in years to come**."

74. The design of HS2-HS1 is conceived by HS2 Ltd within its own remit, a spur line to the Continent, not with wider cross-London capability nor for future generations of passenger and freight rail growth around London and the Home Counties, nor as a domestic Intercity corridor between London Interchanges, the East and South East, and Midlands / Northern / Scottish cities and vice versa. As a proposed single-track link, HS2-HS1 will struggle to form **a foundation for a potentially wider high speed network in years to come**, because the present tunnel is viewed by HS2 Ltd as the most that can be offered at Old Oak as tunnels have to be defined and bored by Phase 1.

75. HS2-HS1 is proposed as a single-track tunnel between Old Oak HS2 interchange and Camden Roundhouse. This on its own is limiting as a piece of infrastructure intended to last until the 22nd Century, but to compound matters the proposed line is then routed via existing North London Line tracks through Camden Road, before branching off on a spur to HS1. A 2010 map is shown below, the tunnel alignment towards Old Oak is now slightly different.



76. Transport for London and Network Rail have assessed the operability of this proposed link, and advise that there is only capacity on the existing railway for one HS2 train per hour. This is inadequate for the design life of the project. Network Rail

has reviewed options for an extended tunnel, or viaduct widening for additional track through Camden Road. The viaduct option appears more likely, with extra track to allow some separation between the HS2 and freight/Overground trains. However costs for HS2-HS1 are now thought to be in the range of £1½-1¾ billion, for a link which is still largely single-track, limited in utility for anyone other than HS2 Ltd, and looking financially unsustainable (see calculations above).

77. The link has to be built at the same time as HS2 Phase 1, because of the engineering complexities at Old Oak HS2 station where tunnelling eastwards is from the future below-ground level HS2 station box. Tunnelling machines have a delicate task to mine under the Crossrail depot tracks and the Grand Union Canal before heading deeper.

78. So we face a project which is too expensive and has negative worth in its early years, yet in later decades could become an operational millstone if later governments continue to desire a wider level of connectivity to make HS2 the next phase of a joined-up UK HS network and want to use **this foundation for a potentially wider high speed network in years to come**, not just a modern day equivalent of a stand-alone Victorian main line from a Central London terminus.

79. HS2-HS1 is some help for Stratford International if train operators think it worth their while using the link with such high per-passenger access charges. However as shown above, the link is financially vulnerable and is likely to detract from commercial international services rather than aid them. At the same time it creates problems for Transport for London and Network Rail, and has limited benefit for anyone else in London and Home Counties.

A new remit for HS2-HS1

80. The solution proposed by JRC is to review the remit of the link, and possibly its ownership, and look at cross-London capacity opportunities from the other end of the telescope.

81. There HS2-HS1 represents a demand for *X* slots per hour in the fullness of time though few to start with, and where there are <u>other</u> flows that can be identified to offer commercial and time benefits. These can advantage the wider economy of London Interchanges and other key economic growth and regeneration areas along main rail corridors – sooner than HS2 international trains and not just limited to HS2 and HS1.

82. The unavoidable infrastructure costs can be shared among more passenger and freight flows. Indeed the design and costs of the link need to be challenged on *why* they are being proposed, for *whose* benefit and *when* they will start to add net value to the national, regional and London and Home Counties economies?

83. The new remit is therefore not exclusively about HS2-HS1 but about creating new strategic capacity across London for multiple rail operators and various passenger flows and freight clients.

84. **This remit is better handled** by Network Rail, Transport for London, HS1 or the Department for Transport, or a combination of those, rather than by HS2 Ltd. HS2 Ltd can then buy slots offered to agreed capacity and performance standards from the operator of the new link. Similarly the link needs to be rebranded to give it more relevance – *East West Express* or *North London Express* are examples. (The author also likes more radical renaming such as *Project Geronimo* – 'with one bound we broke our constraints'…)

Redefining the cross-London route – initial options for new capacity

85. There are two ways to approach the topic: top-down assessment of overall capacity available and bottom-up opportunities for new flows. It is proposed to:
    - Start by looking at the initial options for new capacity from within existing networks, since this is partly a cost containment exercise.
    - Then identify potential flows that can use existing or released capacity, and the benefits and opportunities created by such flows.
    - Then return to assess what other changes in capacity might be feasible or necessary to achieve and facilitate these flows, or if hard choices have to be made between different rail options.

86. We are looking at the general east-west corridors, north of Central London.

87. Economic growth and better connectivity is desired at many locations, but the railway stimulus for change is in the west, with HS2, so we start at HS2's proposed new interchange with Crossrail and GW routes at Old Oak.

88. HS2 at Old Oak Interchange forecasts high volume passenger transfer with Crossrail, roundly 30-35% of all HS2 passengers to or via London. A further 6-10% is expected to/from orbital Overground services, if the business case for an Overground Interchange is accepted by the Department for Transport.

Crossrail passenger projections

89. Combined with area redevelopment in the Old Oak catchment, all these changes are expected to require a <u>full</u> Crossrail service extended west as far as Old Oak, instead of 14 of Crossrail's peak 24 trains per hour (tph) reversing from the east at Paddington.

90. Network Rail studied short and long term route capacities in the London and Home Counties areas up till 2031, in a July 2011 report which was called the London and South East Route Utilisation Strategy (RUS). [4]

91. The RUS included assessment of Crossrail and its relationship with the increased passenger demand forecast on the Great Western Main Line from Paddington to Reading and beyond, in Chapters 7 and 8. It concluded that there was a strong requirement by the 2020s for Crossrail to take over all the local GW suburban services as far as Reading, and for Crossrail to take over all peak time passenger services to Heathrow including Heathrow Express. This is currently the subject of discussions involving BAA who own the Heathrow Express service. [5]

92. A further expansion of Crossrail is currently being considered by TfL and Network Rail in association with HS2, DfT and the Old Oak interchange project, to take up to 8 Crossrail tph beyond Old Oak Common towards Watford, Tring and Milton Keynes and take over the local commuter services that currently run out of Euston. This is linked to projected commuting forecasts, and to relieving Euston terminus as part of the HS2 project. This is also covered in the RUS Chapters 7 and 8. If this project were taken forwards, it would need to be completed ahead of HS2 serving Euston in 2026.

93. Cumulatively, the proposed changes cause Crossrail to be working at high passenger volume throughout West and North West London, from the 2030s if not the 2020s. Crossrail is designed with passive provision for increases in train service levels in Central London to 30 tph with 12-car not 10-car trains (a 50% increase in capacity, and including more trains through Stratford). However this is intended to accommodate further Central London growth, with a notional design capacity to 2076. Consequently an upgraded east-west corridor north of Central London may be very useful in being able to absorb other growth in passenger demand from the 2020s onwards.

Spare capacity on London's western approaches

94. Mapping the western approach routes, we find :
    - A busy Crossrail.
    - A busy GW main line.
    - A busy HS2.
    - But, from Willesden eastwards, an under-used 4-track West Coast Main Line heading towards Primrose Hill tunnels, Camden and Euston.

[4] London & South East Route Utilisation Strategy, Network Rail, 28 July 2011, Chapter 7. http://www.networkrail.co.uk/browseDirectory.aspx?dir=%5CRUS%20Documents%5CRoute%20Utilisation%20Strategies%5CRUS%20Generation%202%5CLondon%20and%20South%20East

[5] Personal meeting with BAA officials.

- It is the intention that the WCML fast tracks will be re-filled with new service layers, but this cannot be the case on the WCML slow lines if Crossrail diverts local commuter services near Willesden from as far out as Tring/Milton Keynes.

95. Turning this situation on its head, it is here that the opportunity presents itself to create new east-west capacity from existing railway routes, rather than build a new line all the way from Old Oak to Camden for the HS2-HS1 link.

96. Not only can there be capacity on the WCML slow tracks through Primrose Hill tunnel, but there are two other single track tunnels which are grossly under-used on the WCML corridor. These are the 'DC' local lines tracks with Euston-Watford stopping trains, running at 3 tph each way.

97. This is a total of 2 to 4 under-used lines between the Old Oak-Willesden area and the Camden side of Primrose Hill. So why build a fifth, limited capacity 4 mile single track tunnel in the form of the current HS2-HS1 design, itself for no more than 3 tph each way, and indeed never more than 3 tph each way because of the single track?

A *North London Express* corridor

98. Surely it will be better value, and will create more service options, to integrate HS2-HS1 as part of a more broadly based *North London Express* corridor, derived from the existing networks? Some of the new WCML fast line services might themselves usefully to point towards Stratford and east, as well as options from Old Oak.

99. There are three other infrastructure elements to address, with some technical notes set out in an Annex.
    - **Access to HS1**: Because of the location of the HS1 tunnel mouth north of Kings Cross, JRC considers that promoters should incur the cost of additional capacity and environmental mitigation when following the NLL route through Camden Road station (JRC understands this is ca. £700 million or so).
    - **Lower cost connections with Old Oak**: The cost above places a premium on keeping down the overall cost of other parts of the HS2-HS1 scheme, for example by replacing the Oak Old-Camden Roundhouse 4 mile tunnel with options for use of the WCML/DC corridor as far as Queens Park, then a 1 mile new tunnel to Old Oak for HS2 services.
    - To access Old Oak regional station, JRC's proposal is to create a new above-ground link in the Willesden Junction area, where there are routeing options available, eg via the existing NLL/WLL high level bridge across the WCML. Designs for both HS2 and regional links should build in margins to assure high reliability for operational performance.
    - **Adapting for GC (European large loading gauge) trains**: A technical modelling study is required to assess when GC-gauge should be created along the existing North London tracks for different passenger and freight requirements (a business

case might not be justified at once). An engineering study is also required to assess which of several options using the WCML/DC lines, would be best value and best operability, to adapt one or more existing tunnels under Primrose Hill to European gauge.

100. Subject to these provisos, the way is open for a *North London Express* corridor from Old Oak/Willesden Junction as far east as Camden and the HS1 tunnel (north of Kings Cross). This leads, via HS1, to Stratford International and beyond, and via the existing NLL 2-4 track corridor through Camden, to Highbury & Islington and Stratford 'Regional'.

101. The approach is to re-define this corridor from Old Oak/Willesden Junction as far as Stratford, by assessing the available opportunities to re-specify capacity along the route. This enables creative use of spare train slots between North/West London, via WCML/DC, towards the two Stratfords (International and Regional).

102. It is not a 'free-to-use' main line with no constraints, however if used intelligently this route can open up capacity for another 6-10 trains per hour in each direction. This will radically reduce the per-train and per-passenger charges, because of lower total infrastructure costs and higher total throughput. This will benefit all users, including UK international trains which are a welcome but minority user within the new remit.

New services via HS1

103. Checking the HS1 train capacity, the following information is available:

- Information from HS1 (advised by HS2 Ltd) that HS1 can accommodate up to 18 tph.
- This is confirmed by the current train service pattern that is feasible on HS1, which can support up to 9 tph per half-hour plus one 'white space' for performance/service recovery.
- JRC has previously modelled journey times from a range of Eastern and South Eastern origins, to Birmingham via HS2 with a change en route, and has identified the following flows which merit further study:
    - Southend via Grays and a new flying junction at Aveley with HS1, where c2c and HS1 cross each other, to West London via Stratford International. This would also relieve forecast overcrowding on the c2c line.
    - Kent via Stratford International to West London.
    - The West London options could be Old Oak or Heathrow or WCML, modelling was undertaken via Old Oak.

- HS1's current half-hourly sequence of peak services is shown below in a simplified form, in the London-bound direction:

1	*white space before non-stop 186 mph trains*
2	Brussels hourly or less (? future Koln/ Amsterdam/other cities in other slots)
3	Paris (can be half-hourly intervals)
4	
5	North Kent/Ebbsfleet @ 140 mph
6	
7	
8	North Kent/Ebbsfleet @ 140 mph
9	East Kent @ 140 mph
10	North Kent/Ebbsfleet @ 140 mph

104. With a Stratford International stop, other international services could conform to the 3 minute headway on HS1 among other domestic services. In the short term, this could be achieved by inserting a Southend service, with the shortest distance on HS1, before the next international train (which might alternatively be a domestic HS service to/from the Midlands/North).

105. In a more favourable operating environment allowing international trains to carrying domestic passengers, the same train could undertake both functions, permitting up to a half-hourly combined domestic+international service. However if segregated, an hourly limit may initially be set for each function.

106. To maximise HS1 line capacity in the medium term, new second generation 'Javelin' trains would be required to have a top speed of 186 mph, to follow closely behind preceding international/Domestic HS trains. A possible timetable revision for a half-hourly sequence is shown below, if such trains are provided:

1	*white space before non-stop 186 mph trains*
2	Brussels-St Pancras hourly or less (? future Amsterdam/Koln/other cities in other slots)
3	Paris-St Pancras (can be half-hourly intervals)
4	Kent-Stratford-OOC/LHR/WCML @ 186 mph
5	North Kent/Ebbsfleet-St Pancras @ 140 mph
6	HS2 international or Domestic HS (140 mph W of Ebbsfleet)
7	North Kent/Ebbsfleet @ 140 mph
8	Southend-Stratford-OOC/LHR/WCML @ 140 mph
9	East Kent @ 186 mph (140 mph W of Aveley)
10	North Kent/Ebbsfleet @ 140 mph

107. This preserves similar intervals as now between North Kent/Ebbsfleet trains, and achieves a 12/18 minute separation between through London & Home Counties trains via *North London Express* (so offers a 'walk-on' service between Stratford and West London). There is at least 6 minutes between those trains and the potential HS2 international or Domestic HS trains, for pathing across North London.

108. Overall, use of HS1 for the *North London Express* offers capacity for up to 6 tph, with scope for up to 2 tph long-distance international trains and/or Domestic HS, as well as 4 tph London & Home Counties express services.

New capacity and services via North London Line (NLL)

109. There are two main users of the North London Line, the London Overground orbital network which is experiencing rapid growth in passenger demand, and the cross-London freight flows. Freight is discussed first, as this has dynamic demand particularly from Haven Gateway and Thames ports, which require planning for long term access.

Demand for rail freight paths via NLL

Future demand from Haven and Thames catchments

110. MDS Transmodal Ltd reported in October 2011 to the Rail Freight Group and the Rail Freight Operators Association with the latest projection of rail freight flows between 2010 and 2030. [6]

111. The key flows which affect potential use of cross-London rail capacity are those via the North London Line's (NLL) Hampstead tunnel and the West Coast Main Line's (WCML) Primrose Hill tunnels. Both routes are used heavily by freight, and by the London Overground passenger services.

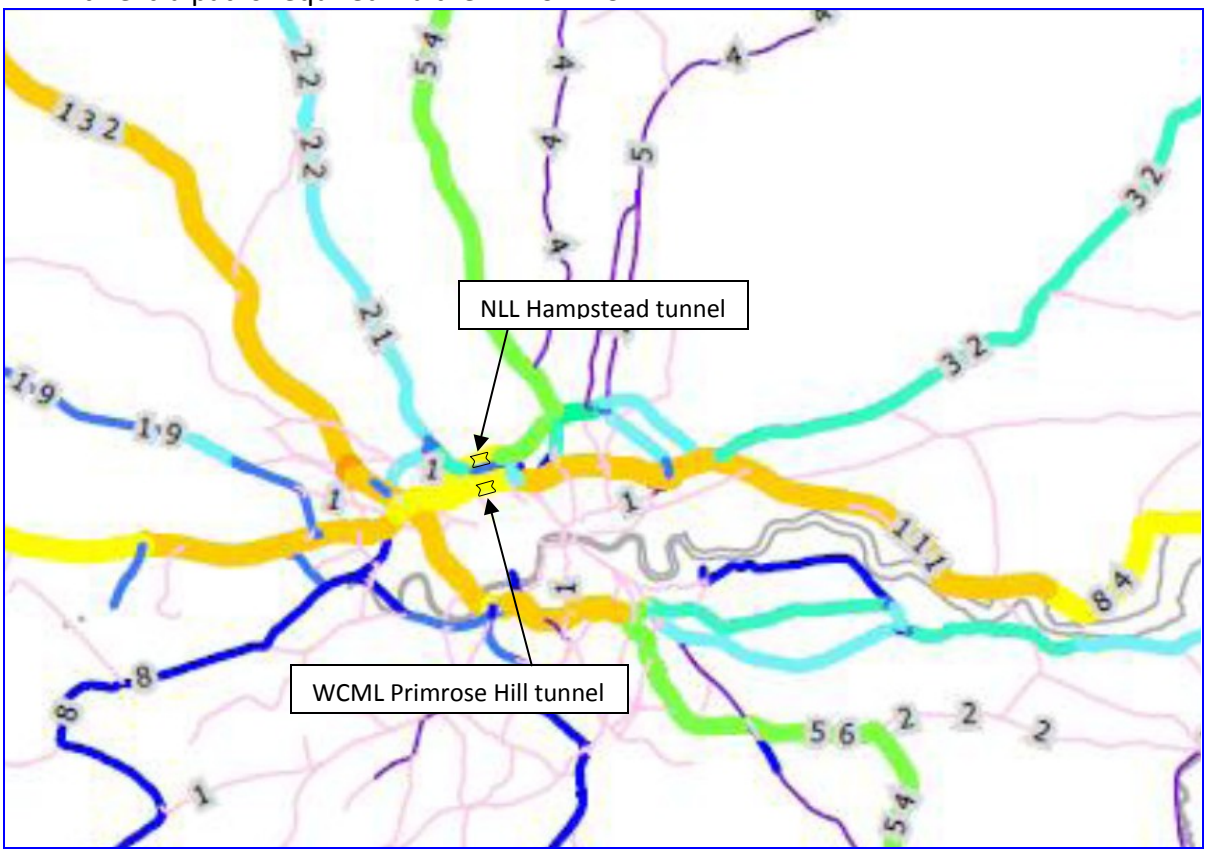
112. Both routes are projected to have a two-way flow of 75-100 freight trains per day by 2030 (ie, up to 50 each way, or an average of 4 per hour each way over a 12+ hour traffic day excluding peaks), stimulated largely by maritime container flows to/from Haven and Thames Estuary ports and some domestic industrial flows. This assumes some productivity improvements with longer UK freight trains, so that the increase in demand for rail freight timetabled paths is manageable.

113. An additional two-way daily flow of 34 trains (ie, about 17 each way) is projected via Primrose Hill tunnel and the WCML in a 'worst case' scenario of Felixstowe-West Midlands flows continuing to run via London, if various factors are important such as electric haulage.

114. 2030 Channel Tunnel train flows are assumed to include more direct services from the Continent directly to rail-linked distribution parks than at present, with 54-56 two-way trains per day. However these are all projected over the West London Line, rather than make any allowance for some coming via HS1 and transiting

[6] Rail freight demand forecasts to 2030, MDS Transmodal Ltd, October 2011. http://www.rfg.org.uk/updated-2011-forecasts-show-strong-prospects-growth

London via the NLL or WCML tunnels. This situation may change in later decades, with extra paths required via the NLL or WCML.



From MDS Transmodal report, 2011. Light yellow represents 75-100 two-way freight trains per day in 2030.

115. Overall the freight flows in the MDS Transmodal report via London are higher than discussed in TfL's projections for 2030 [7], where for example Tilbury/ London Gateway flows were estimated at 50 each way per day in 2030 (100 two-way). As shown in the diagram above, that two-way volume is now estimated at 111 per day.

New rail projects and their impact on rail freight

116. Electrification of the Midland Main Line (MML) and an electric freight spine from Southampton via East West Rail and the MML have now been announced by the Government in the July 2012 High Level Output Statement which covers rail investment during 2014-19. These may reduce some flows within London via the MML, which may in turn release some paths on the Gospel Oak-Barking line for additional freight via the NLL Hampstead tunnel to the WCML and Great Western lines.

117. However the projected MML flows in 2030 via London are only 21 two-way per day (up from 14 currently) with many of those crossing West London via Dudding

[7] http://www.tfl.gov.uk/assets/downloads/corporate/Item05-RUP-12-July-2011-HLOS2-recommendations.pdf

Hill, not to/from East London and the East of England, so the capacity relief would be small.

118. At present there is a freight 'standstill' within the London commuting area between ca. 7AM and 9:30AM, and again in the evening commuter peak. Then, passenger trains have route priority. This is an inevitable consequence of catering for heavily peaked passenger flows on a network with limited capacity at major junctions.

119. The MDS report does not foresee it as necessary by 2030 to open up parts of the London rail network to peaktime freight flows. However in further decades this may become desirable, at least for 18/6 rail freight (the ultimate being 24/7), to smooth flows and increase overall rail freight capacity and rail market share.

120. While peak capacity is not thought possible on the Great Eastern main line, where planners are trying to devise ways of getting 28 tph in peaks into Liverpool Street, there might be peak capacity opportunities on the Gospel Oak-Barking Line (GOBLIN) if this was modernised and electrified. This would assist freight flows for Thames-side industry and the new London Gateway port.

121. The current funding impasse for GOBLIN electrification – with disagreement between DfT and TfL about who should pay for it – will have to be resolved in due course. TfL also has the objective of being able to run GOBLIN passenger trains through to West London via Hampstead Tunnel.

122. As noted earlier, the go-ahead for HS2 planning and a Hybrid Bill, given by the Government in January 2012, also creates scope for additional route capacity for freight and passenger flows on the WCML, once WCML InterCity trains are largely transferred to HS2 from 2026 (this is the Government's current project timetable).

123. For freight, the crucial objective is to secure adequate capacity on the NLL and on the WCML's London sector. This will avoid a situation where the available new WCML paths for freight to/from the West Midlands, the North West and Scotland could end up at a London capacity barrier.

124. Hence addressing junction and pathing limitations on the NLL at Camden Road, and GOBLIN electrification, are fundamental objectives. The HS2-HS1 capacity mitigation scheme being proposed by Network Rail for the Camden area is welcomed by JRC as a vital part of the *North London Express* proposal.

125. JRC would prefer that this scheme fully restores 4-tracking through Camden Road station, and then a new 4-track route over Kentish Town Road, to create parallel flows for HS1-Primrose Hill-West London and NLL-Hampstead Tunnel routes,

with crossovers to enable freight and passenger trains to traverse between the NLL eastern section from Stratford and the Primrose Hill route.

126. If Crossrail can free up paths in inner London on the WCML slow lines between Camden and Willesden Yard, by taking over 6-8 tph stopping trains to Tring/Milton Keynes, then the present outer suburban passenger services using the WCML slow are currently no more than 4-5 tph in peak periods. Set alongside the present 3 tph through the Euston-Watford 'DC' line tunnels, means that it would be possible to absorb a large number of freight flows via *North London Express* on the WCML/DC corridor through the present Primrose Hill tunnels, to Willesden Yard and other routes via West London.

Demand for passenger train paths via NLL

127. Transport for London in its proposals for HLOS investment during 2014-19 prepared a detailed assessment of passenger growth and capacity requirements on London Overground services to 2021. [8]

128. Its proposals for Overground capacity were primarily to lengthen existing services from 4-car to 5-car trains by 2021, along with electrification of GOBLIN, plus lengthening to 8-car trains on some West London Line services.

129. JRC considers that further Overground capacity can be achieved in later decades, if required, by lengthening steadily towards 6 and 8-car trains, though this may incur some high station reconstruction costs either to accommodate passenger volumes and/or to avoid long station boarding/alighting time if Selective Door Operation were required at some stations.

130. The *North London Express (NLE)* 'walk-on' services via Stratford International to/from West London will provide some additional capacity relief, though this will be limited to major hub interchanges such as Stratford, Queens Park, Willesden Junction and/or Old Oak (depending on which onwards West London route is used).

131. If track arrangements were favourable at the upgraded Camden Road station, it might be possible to include a *NLE* stop there as well, possibly linked by underground walkway or travolator to the northern end of the Northern Line's Barnet branch platforms at Camden Town, which are only 300 yards distant. This would create a large new North London catchment for the Overground and *NLE*. Currently the Overground on its main orbital NLL route has no interchange anywhere with the Northern Line.

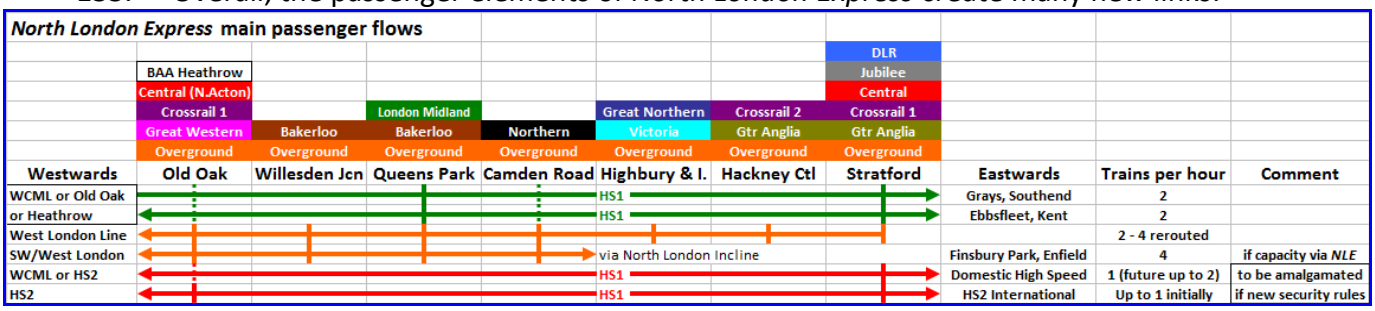
132. JRC also proposes three additional Overground components to be investigated as part of *North London Express*:

[8] http://www.tfl.gov.uk/assets/downloads/corporate/Item05-RUP-12-July-2011-HLOS2-recommendations.pdf

- **Re-route 2-4 tph of the current Stratford Overground service**, via Queens Park rather than Hampstead. This strengthens the hub interchange at Queens Park with the Bakerloo and, potentially, some of the Euston outer-suburban trains (giving further relief of Euston terminus). Use the proposed link at Willesden Junction between the DC line from Queens Park and the High Level platforms towards Richmond/Hounslow/Clapham, to return these trains to the WLL.
- **Use the paths released on the NLL via Hampstead to extend GOBLIN trains** to Willesden and West London at 4 tph. This will add passenger capacity and accessibility to the existing Overground system, and free-up cross-London capacity for travel to/from main London Interchanges including Stratford.
- **Assess the passenger demand and line capacity for a non-HS1 new Overground corridor** which ties in more of North London via major interchanges: West London-Queens Park-Camden Road-North London Incline-Finsbury Park-Enfield.
- Current passenger volumes through major stations that could be served by this 4 tph service are already high, and potentially encouraging for a new service.
- This in turn would help to defray further the infrastructure costs originally to be charged against relatively few international trains on the HS2-HS1 link.

North London Express network

133. Overall, the passenger elements of *North London Express* create many new links:



134. Instead of under 1 tph foreseen for the early years of HS2-HS1, with funding and value for money headaches, there could be up to 28 trains two-way in some hours with the completion of works on *North London Express*, creating large scale benefits via London Interchanges.

135. The cumulative impacts can be measured in terms of:
- Place Shaping in London's suburbs via main 'London Interchange' locations.
- Affordable HS2 International services.
- New HS2/restructured WCML domestic High Speed trains serving a larger catchment and fast-growing economic hubs in London & Home Counties.
- Orbital travel growth and new E-W capacity avoiding Central London.
- Assist Inner and Outer London accessibility, and relief of London termini.

Section 3 Domestic demand for new rail services

London & Home Counties demand

136. The effect of London and nearby counties as the powerhouse of UK's economy, and its recent and continuing population growth as noted in Section 1, means the key question is how to make best use of limited rail capacity to offer more effective rail services in London & Home Counties. If offered, a really useful train service will fill itself over time, eg if it links major interchanges and has fast journey times.

137. Cross-London services provide the rail equivalent of an M25. Services which extend into the hinterland of London's commuting areas can therefore also yield strong passenger results. The DfT decided in July 2012 to support reopening of the orbital East West Rail corridor to new, electrified passenger trains by 2019, initially between Reading/Oxford and Milton Keynes/Bedford, and (stakeholders hope) eventually to Cambridge. This makes the point that inter-urban travel between economic centres in the Home Counties is a potent source of passenger demand.

138. The suppressed demand for orbital rail travel on the Overground network in London is not yet fully understood even by Transport for London, which reported on its current level of knowledge to TfL's Rail and Underground Panel in November 2011 [9]. At present demand has grown from a pre-Overground franchise equivalent volume of 39 million passengers pa in 2007, to 116 million pa in early 2012, a three-fold increase.

139. In conditions of suppressed demand or a previous gap of direct rail services, JRC considers that it is safest (most cautious) to focus on the volume of travel already observed at the major interchanges and travel hubs, and take a view on the change of travel volume that would be required to fulfil reasonable loadings on the new service, and whether foreseeable additional flows would adequately fill such trains.

140. The services we are reviewing are limited in options by the route structure that the potential network permits. The demand is reviewed at stations along the following corridors:

1. Southend c2c line via Grays as far west as Purfleet.
2. Thanet and North Kent lines via Ebbsfleet.
3. Thanet and East Kent lines via Ashford International
4. Stratford Regional and Stratford International.
5. Great Northern Lines via Finsbury Park and key stations on North London Line.

141. Demand at stations in West and North West London, and further afield, is not assessed (except Heathrow separately), because they are subject to major change in

[9] London Overground Impact Study Item05-RUP-16-11-2011-

the next 10-15 years with introduction of Crossrail on the GW route, electrification of the main GW commuter and InterCity lines, and service reshaping on the West Coast Main Line.

142. Provision of up to 4 tph London & Home Counties services via *North London Express*, if those are justified on the East and South East London corridors, can be assigned on a best value basis to the GW and/or WCML networks as part of the service evaluation for those routes. The potential demand at Old Oak Common is relevant to that planning. In broad terms, JRC expects Old Oak to grow with locally generated development towards usage numbers comparable with Stratford or Clapham Junction. There will be extensive interchange as well.

143. **Stratford is already a very busy cluster of stations**. Cumulatively, they handled 54.6m passengers in 2010-11 as entry-exit. This excludes interchange *within* each rail operator (National Rail operators counting as one), but double-counts passengers who changed *between* operators. JRC's provisional view is that Stratford may have handled ca. 25-30 million O&D passengers in 2010, **putting it in the top 30 station O&D clusters in Britain** on JRC's estimates (a cluster may be more than one station). For example 'Central Edinburgh' includes Waverley and Haymarket stations and handled 26.3 million O&D passengers in 2010-11, so Stratford is in the same league.

144. In the modelling below, current Office of Rail Regulation annual station usage estimates are contrasted with potential linear change in demand using multipliers as adopted for the HS2 demand modelling.

145. JRC wishes to state its concerns about the reliability of the current ORR station usage data. This was set out by Jonathan Roberts in a technical article in Modern Railways July 2012 [10]. There is clear evidence of undercounting by ORR in the London area, including on Greater Anglia and London Overground services. The figures shown below may therefore be underestimates.

146. In the modelling for this report, trains are normally only allocated as stopping at stations with ca. 2 million or more passengers, as this is an *express* or *semi-fast* service. However there are exceptions where there are low usage reversing stations (eg, Shoeburyness on c2c, and Gordon Hill in North London).

147. Where there are other significant stations in the catchment which are not served, eg Southend Victoria and Basildon on Route 1, then 10% of those stations' O&D is allocated to the notional demand forecast for *NLE* trains (eg, Basildon goes to Pitsea, Southend Victoria to Southend Central). This provides a test of the demand consequences of passengers diverting to new, faster or more convenient services.

[10] 'Stations Count', Jonathan Roberts, in Modern Railways, July 2012, pp. 71-75.

148. The modelling shows changes in demand (using growth proportions adopted for HS2 modelling) between 2010, 2026, 2035, 2045 and 2055. No allowance is made for further generative growth in travel caused by the addition of the new *North London Express* services, although these could be attractive to people who currently commute by car using the M25 or North Circular Road.

Route 1: Southend c2c line via Grays

149. This models changes in demand on the c2c line between Shoeburyness and Purfleet, at stations served in various forecast years. The table is shown below.

150. There is a good initial demand level in 2026, considering that these are average loadings per train so peak periods will be up to twice as busy, or more on a heavily peaked line such as c2c. c2c has been forecast to have overcrowding on trains by the 2020s, in TfL's modelling for HLOS 2. One option proposed by TfL has been to suggest use of high density trains with fewer seats.

151. Because c2c's Fenchurch Street terminus is limited to 4 platforms, there are physical limits to further capacity expansion, while c2c passengers like their seats! Creation of a *North London Express* route could be very helpful both for capacity and for accessibility, by opening up fast links for Southend to a wider range of economic growth centres in London and the Home Counties.

Station Name	ORR 2010-11 annual passenger journeys, entry+exit		Year 2026	Year 2035	Year 2045	Year 2055
Travel volume by year **XXXX**, with HS2 economy & population multiplier:			38%	66%	102%	142%
Total all stations:	**24,948,187**		**34,438,477**	**41,501,309**	**50,377,874**	**60,496,859**
***NLE* Southend option:**	**13,604,309**		**19,333,636**	**23,597,497**	**29,644,571**	**37,186,011**
Shoeburyness	653,194	reversing station	901,669	1,086,588	1,318,995	1,583,930
Thorpe Bay	797,256		1,100,532	1,326,235	1,609,899	**1,933,266**
Southend East	**1,875,125**		**2,588,423**	**3,119,270**	**3,786,440**	**4,546,991**
Southend Victoria	**3,746,115**	10% of boxed stn	**5,171,137**	**6,231,662**	**7,564,530**	**9,083,954**
Southend Central	**1,808,059**		**2,495,845**	**3,007,706**	**3,651,014**	**4,384,362**
Westcliff	985,366		1,360,199	1,639,156	**1,989,750**	**2,389,414**
Chalkwell	1,457,014		**2,011,262**	**2,423,743**	**2,942,148**	**3,533,113**
Leigh-On-Sea	**1,857,356**		**2,563,894**	**3,089,712**	**3,750,559**	**4,503,903**
Benfleet	**2,886,164**		**3,984,061**	**4,801,134**	**5,828,031**	**6,998,659**
Basildon	**2,486,796**	10% of boxed stn	**3,432,773**	**4,136,785**	**5,021,587**	**6,030,232**
Pitsea	**1,066,514**		**1,472,216**	**1,774,146**	**2,153,612**	**2,586,190**
Stanford-Le-Hope	949,022		1,310,030	1,578,698	**1,916,360**	**2,301,283**
East Tilbury	318,354		439,456	529,582	642,852	771,977
Tilbury Town	800,328		1,104,773	1,331,346	1,616,102	**1,940,715**
Grays	**2,834,606**		**3,912,890**	**4,715,367**	**5,723,920**	**6,873,636**
Purfleet	426,918		589,318	710,178	862,076	1,035,233
Route 1: *NLE* Southend option:			Year 2026	Year 2035	Year 2045	Year 2055
***NLE* trains/year (2tph x364 days x18hrs)**	**Gain in passenger demand from 2010:**		**5,729,327**	**9,993,188**	**16,040,262**	**23,581,702**
26,208	**New passengers on *NLE* trains (avge):**		**219**	**381**	**612**	**900**
If extra station added to *NLE* service, difference between year with service and previous year without service is included in *NLE* volume						

152. **Outcome**: JRC supports creation of a new Aveley junction by 2026 between HS1 and c2c, to allow 2 tph between Southend, Stratford and West London routes.

Route 2: Thanet and North Kent via Ebbsfleet

153. This models changes in demand on the North Kent line towards Thanet, between Ebbsfleet and east of Margate, at stations served in various forecast years. The table is shown below.

154. There is a similar total travel volume to Route 1, demonstrated in this modelling. However demand is weak between Faversham and Thanet, while between Strood and Maidstone there is a 'community railway' local stopping service (not shown below). All three main Maidstone stations are combined as one station for this analysis.

155. **Outcome**: The modelling points to a further 2 tph being worthwhile from North Kent via Stratford. Trains from Maidstone (non-stop to Strood) would either combine there with trains from Faversham, or run at 1 tph on each leg east/south of Strood. The latter option would be less attractive for passengers.

Station Name	ORR 2010-11 annual passenger journeys, entry+exit		Year 2026	Year 2035	Year 2045	Year 2055
Travel volume by year **XXXX**, with HS2 economy & population multiplier:			38%	66%	102%	142%
Total all stations:	**22,166,428**		**30,598,537**	**36,873,853**	**44,760,668**	**53,751,371**
***NLE* Thanet & North Kent option**	**15,250,393**		**20,700,638**	**24,756,801**	**31,047,341**	**38,836,585**
Ebbsfleet International	717,312		990,177	1,193,249	1,448,468	1,739,410
Gravesend	**2,647,486**		**3,654,590**	**4,404,093**	**5,346,068**	**6,419,889**
Higham	193,048		266,483	321,135	389,822	468,122
Strood	**1,057,254**		**1,459,433**	**1,758,742**	**2,134,913**	**2,563,735**
Rochester	1,067,946	10% of boxed stn	1,474,193	1,776,528	**2,156,503**	**2,589,662**
Chatham	**2,883,930**		**3,980,977**	**4,797,418**	**5,823,520**	**6,993,242**
Gillingham (Kent)	**2,409,294**		**3,325,789**	**4,007,861**	**4,865,087**	**5,842,297**
Rainham (Kent)	**1,703,536**		**2,351,561**	**2,833,832**	**3,439,950**	**4,130,904**
Newington	135,438		186,959	225,301	273,490	328,424
Sittingbourne	**2,050,928**		**2,831,101**	**3,411,719**	**4,141,439**	**4,973,295**
Teynham	133,592		184,410	222,230	269,762	323,947
Faversham	1,468,446		**2,027,043**	**2,442,760**	**2,965,233**	**3,560,835**
Whitstable	745,678		1,029,334	1,240,435	1,505,748	**1,808,195**
Chestfield & Swalecliffe	142,774		197,085	237,505	288,304	346,213
Herne Bay	778,582		1,074,755	1,295,171	1,572,191	**1,887,983**
Birchington-On-Sea	266,722		368,183	443,692	538,592	646,774
Westgate-On-Sea	178,458		246,343	296,865	360,360	432,743
Margate	605,626		836,006	1,007,459	1,222,941	1,468,582
Broadstairs	553,912		764,620	921,433	1,118,515	1,343,181
Dumpton Park	35,296		48,723	58,715	71,273	85,589
Maidstone Barracks+MEast+MWest	**2,391,170**		**3,300,771**	**3,977,711**	**4,828,490**	**5,798,348**
Route 2: *NLE* Thanet & North Kent option:						
***NLE* trains/year (2tph x364 days x18hrs)**	**Gain in passenger demand from 2010:**		5,450,245	9,506,408	15,796,949	23,586,192
26,208	**New passengers on *NLE* trains (avge):**		**208**	**363**	**603**	**900**
If extra station added to *NLE* service, difference between year with service and previous year without service is included in *NLE* volume						

Route 3: Thanet and East Kent via Ashford International

156. This models changes in demand via East Kent towards Thanet or Dover, at stations served in various forecast years. The table is shown below.

Station Name	ORR 2010-11 annual passenger journeys, entry+exit		Year 2026	Year 2035	Year 2045	Year 2055
Travel volume by year **XXXX**, with HS2 economy & population multiplier:			38%	66%	102%	142%
Total all stations:	**10,809,152**		**14,920,953**	**17,981,024**	**21,826,921**	**26,211,113**
***NLE* Thanet & East Kent option**	**5,160,283**		**7,065,333**	**8,526,210**	**11,426,673**	**14,733,104**
Ashford International	**3,123,070**		**4,311,086**	**5,195,227**	**6,306,415**	**7,573,132**
Canterbury East	1,158,433	10% of boxed stn	1,599,101	**1,927,053**	**2,339,224**	**2,809,084**
Canterbury West	**1,921,370**		**2,652,259**	**3,196,199**	**3,879,822**	**4,659,130**
Sturry	61,440		84,812	102,205	124,066	148,986
Minster	71,636		98,886	119,166	144,655	173,710
Manston Ramsgate Parkway	planned		?	?	?	?
Ramsgate	1,052,622		1,453,039	1,751,037	**2,125,560**	**2,552,503**
Dumpton Park	35,296		48,723	58,715	71,273	85,589
Broadstairs	553,912		764,620	921,433	1,118,515	1,343,181
Margate	605,626		836,006	1,007,459	1,222,941	1,468,582
Folkestone Central	1,004,630		1,386,791	1,671,202	**2,028,649**	**2,436,127**
Folkestone West	286,703		395,765	476,930	578,939	695,226
Dover Priory	934,414		1,289,865	1,554,398	**1,886,862**	**2,265,861**
Route 3: *NLE* Thanet & East Kent option:						
NLE trains/year (2tph x364 days x18hrs)	**Gain in passenger demand from 2010:**		**1,905,050**	**3,365,926**	**6,266,390**	**9,572,821**
26,208	**New passengers on *NLE* trains (avge):**		**73**	**128**	**239**	**365**
If extra station added to *NLE* service, difference between year with service and previous year without service is included in *NLE* volume						

157. **Outcome**: There is weaker demand from East Kent and Thanet/coastal Kent, compared to the North Kent corridor. Ashford is enlarging as a growth town, but with only 2 tph available to allocate to Kent for *NLE* London & Home Counties services, an East Kent service is not supported for further development and the priority should be given to North Kent. Building up passenger demand for the existing Javelin service to St Pancras is felt to be a higher priority for East Kent.

158. However, up to 2 tph have been allocated in *NLE* for Domestic High Speed and/or HS2 International services via Stratford towards Ebbsfleet and Ashford. This is an important potential service development for Ashford, opening up its capability to be a Domestic High speed railhead as well as attracting more UK international trains. Domestic HS trains could also serve Ebbsfleet as an M25 railhead, and see higher loadings as that part of the Thames Gateway acquires more housing and jobs.

Route 4: Stratford Regional and Stratford International
Route 5: Great Northern inner Lines via Finsbury Park, and key NLL stations

159. These two models are taken together as they provide a different, urban perspective on passenger demand for the *North London Express* proposal. The main focus is on the huge scale of passenger travel within Greater London, exemplified by Underground and Overground flows at major stations, and in some cases by National Rail demand as well (Overground is included within NR figures). The table is shown overleaf.

160. Stratford has large Greater Anglia travel volume, although Stratford International is weaker because of the station's perceived remoteness from the main interchange platforms. However DLR has since opened as a link between the Regional and International station, and Westfield has also opened. Consequently the estimates for Stratford Regional and International do not represent the current situation.

161. **Outcome**: the size of changes in total travel volume in the catchments identified for *NLE* routes 4 and 5, between 2010 and later decades, is so great that the case for better *NLE* connectivity is self-evident. *NLE* will allow fast direct journeys at 'walk-on' frequency between major interchanges. Stations worth serving are shown in **bold**.

162. *NLE* is not the only transport project that can be offered, for example Crossrail 2 is a high priority proposal in its own right, though it is in the £ double-digit billions domain. However *NLE* is in the 'must do now' category, because of the urgency attached to decision-making on the HS2 project.

Station Name	ORR 2010-11 annual passenger journeys, entry+exit		Year 2026	Year 2035	Year 2045	Year 2055
Travel volume by year **XXXX**, with HS2 economy & population multiplier:			38%	66%	102%	142%
Total all stations:	**54,596,322**		**75,364,763**	**90,820,982**	**110,246,353**	**132,390,621**
NLE Stratford Regional + International	***27,298,161***	*< if 50% i'change>*	***37,682,381***	***45,410,491***	***55,123,177***	***66,195,311***
Stratford DLR	**6,890,351**		9,511,441	11,462,099	13,913,686	16,708,412
Stratford LUL	**29,819,454**		41,162,774	49,604,662	60,214,423	72,309,194
Stratford National Rail	**17,479,020**		24,128,039	29,076,350	35,295,385	42,384,876
Stratford International HS1	407,497		562,509	677,871	822,859	988,139
Route 4: *NLE* Stratford Regional & International:						
	Gain in passenger demand from 2010:		**10,384,220**	**18,112,330**	**27,825,016**	**38,897,150**
Total all stations:	**128,059,041**		**176,772,700**	**213,026,214**	**258,589,621**	**310,530,368**
***NLE* Great Northern inner Lines & NLL:**	**57,836,102**		**79,836,955**	**96,210,355**	**116,788,440**	**140,246,763**
Willesden Junction ORB+LUL	**3,137,257**	*< if 50% i'change>*	**4,330,669**	**5,218,826**	**6,335,062**	**7,607,533**
Queen's Park (Gtr London) ORB	**4,396,837**	*< if 50% i'change>*	**6,069,393**	**7,314,138**	**8,878,532**	**10,661,889**
Camden Town+Camden Rd ORB+LUL	**21,655,731**	*< if 5% i'change>*	**29,893,571**	**36,024,308**	**43,729,417**	**52,512,981**
Finsbury Park NR+LUL	**15,399,306**	*< if 50% i'change>*	**21,257,201**	**25,616,745**	**31,095,818**	**37,341,776**
Harringay	**1,714,512**		**2,366,712**	**2,852,090**	**3,462,113**	**4,157,519**
Hornsey	**1,763,421**		**2,434,226**	**2,933,451**	**3,560,876**	**4,276,120**
Alexandra Palace	**1,839,684**		**2,539,500**	**3,060,314**	**3,714,874**	**4,461,050**
Bowes Park	1,196,352		1,651,445	1,990,132	2,415,794	2,901,035
Palmers Green	**2,451,189**		**3,383,621**	**4,077,553**	**4,949,686**	**5,943,888**
Winchmore Hill	**2,033,363**		**2,806,854**	**3,382,499**	**4,105,970**	**4,930,702**
Grange Park	459,529		634,334	764,427	927,927	1,114,312
Enfield Chase	**1,882,522**		**2,598,633**	**3,131,575**	**3,801,376**	**4,564,926**
Gordon Hill	**1,562,282**	reversing station	**2,156,574**	**2,598,857**	**3,154,717**	**3,788,378**
New Southgate	835,293	**Excluded via**	1,153,038	1,389,509	1,686,707	**2,025,501**
Oakleigh Park	1,437,979	**New Barnet,**	**1,984,986**	**2,392,078**	**2,903,711**	**3,486,955**
New Barnet	1,615,256	**route less busy**	**2,229,699**	**2,686,978**	**3,261,687**	**3,916,834**
Hadley Wood	518,244	**than via Enfield**	715,384	862,099	1,046,490	1,256,690
Potters Bar	1,599,666	**Excluded via**	**2,208,179**	**2,661,044**	**3,230,206**	**3,879,030**
Brookman's Park	203,654	**Potters Bar,**	281,124	338,778	411,239	493,841
Welham Green	160,884	**more suitable**	222,084	267,631	324,873	390,128
Hatfield	1,928,032	**for outer**	**2,661,455**	**3,207,281**	**3,893,275**	**4,675,285**
Welwyn Garden City	2,431,948	**suburban trains**	**3,357,061**	**4,045,545**	**4,910,833**	**5,897,231**
Route 5: *NLE* Great Northern inner Lines & NLL:						
NLE trains/year (4tph x364 days x18hrs)	**Gain in passenger demand from 2010:**		**22,000,853**	**38,374,253**	**58,952,338**	**82,410,661**
52,416	**New passengers on new 4 tph trains (avge):**		**839**	**1,464**	**2,249**	**3,144**
If extra station added to *NLE* service, difference between year with service and previous year without service is included in *NLE* volume						

UK inter-regional demand modelling with East & SE London particularly in mind

163. As shown earlier, the CAA publishes very detailed point-to-point flow data for each airport to airport route. This is in the public domain even though almost all passenger flights are with private sector operators with no Government subsidy.

164. For UK rail usage, no such detailed point to point data is published for National Rail, even though private sector rail operators are mostly in receipt of subsidy from taxpayers via the UK Government and local or regional authorities. (Transport for London does however release O&D data for individual travel modes under its control.)

165. So with a short time horizon for research, we must rely on what national information is immediately available. The Office of Rail Regulation (ORR) publishes aggregate region-to-region proportions on National Rail, and these have been used alongside a JRC-generated table of total National Rail station O&D volume in each region, for 2010-11.

166. This permits high level judgement about the proportion of inter-regional travel capable of being assigned pro rata to each station. In turn this helps one to form a view about the importance of certain key London Interchanges and main regional stations, in defining options for new Domestic High speed or indeed any inter-regional services that might avoid Central London. The table below shows the overall proportion of inter-regional rail journeys to/from East London in 2010-11:

% entry/exit data in 2010-11 to apply to model East London travel demand at National Rail stations outside London	
EAST OF ENGLAND	2.718%
EAST MIDLANDS	0.933%
NORTH EAST	0.437%
NORTH WEST	0.185%
SCOTLAND	0.051%
SOUTH EAST	2.166%
SOUTH WEST	0.722%
WALES - CYMRU	0.201%
WEST MIDLANDS	0.380%
YORKSHIRE & HUMBER	0.247%

167. With the railway geography in East London, Stratford is the only location capable of offering a comprehensive 'hub and spoke' network and being the sub-regional InterCity railhead. Almost all parts of East London have direct or one change only travel to Stratford. So these percentages are applied as if all such journeys could be channelled via Stratford.

168. From West London, such railheads are not yet so coherently defined, as many railways cross or miss each other. However the proposed investment in Old Oak will bring many West London railways into connection with each other, while Heathrow Airport will also be more of a national interchange once schemes such as Airtrack 'Lite' and the new western access rail project are undertaken. If seeking to establish new direct, avoiding Central London rail flows, then Old Oak would be relevant for travel West via the GW Main Line and North via HS2.

169. History shows that there have been previous attempts in British Rail's days to establish new avoiding London routes, eg those begun in London in 1986, via Kensington Olympia. Slowly they were removed as passenger volume failed to be worthwhile, the survivor being the London & Home Counties service between MK/Watford and Clapham/Croydon, rather than the InterCity services which have been withdrawn. The table below points to the passenger volume explanation as to why this has been the outcome: there is stronger absolute demand for travel across London and the Home Counties.

170. We start with a similar numerical problem for East London on its own. Combining the data as described above, generates the following 2010-11 rail flows between East London and other regions (excluding the rest of London), shown in annual volume and on the basis of an hourly train each way:

Total Entry/Exit rail volume, East London to/from rest of Britain, 2010-11	Total all rail flows	Chiltern / Metro.	Crossrail / GW >Reading	ECML south of Doncaster	South Eastern not N/E Kent	Southern	South West Trains	Thameslink / Great Northern	Great Western Main Line	WCML / LonMid S of Birmingham	WCML Birm & north	Midland Main Line	South Eastern N/E Kent	ECML Doncaster & north	Greater Anglia + c2c
TOTALS	14,198,651	424,597	340,787	178,873	352,490	1,652,540	2,526,055	1,705,611	1,025,954	580,417	803,564	318,612	1,073,380	331,163	2,884,609
Equivalent passenger journeys per train if 364 days, 16 trains each way per day (~1 tph)	609	18	15	8	15	71	108	73	44	25	34	14	46	14	124
NB flows must be divided by two to change from O&D to single journey															
East	4,733,562	34,603		110,821				1,237,214		379,668		86,647			2,884,609
East Midlands	347,684	418		68,052						27,754	19,495	231,965			
North East	85,219													85,219	
North West	359,584										359,584				
Scotland	83,868										83,868				
South East	7,398,373	369,883	340,787		352,490	1,652,540	2,438,040	468,397	562,053	140,805			1,073,380		
South West	456,670						88,016		368,655						
Wales	92,348								79,800		12,548				
West Midlands	395,399	19,694							15,447	32,190	328,069				
Yorkshire & The Humber	245,944													245,944	

171. Combining all flows looks positive, however individual flows aren't. The strongest existing flows are for travel around London and the Home Counties, the best being:

- Greater Anglia with direct trains via Stratford; and 'South West Trains-land'.
- The combined Southern and Thameslink corridors north and south of the river.

172. Seeking to establish a long distance service via the Great Western, West Coast or East Coast main lines from East London does not create viable demand on its own in 2010-11. So what can be addressed to improve matters?

173. Can we combine these East London flows with West London flows via Old Oak interchange? National Rail inter-regional journeys to/from West London are only half the volume of East London (7 million vs 14 million). However there are far more

tube-generated journeys in West London which are not reflected in the National Rail figures, so using a passenger volume equivalent to Stratford is reasonable. There is also the travel generative effect of major developments already taking place at Stratford and foreseen by planners at Old Oak.

174. Putting such numbers together on a per hourly train basis gives the following volumes on notional trains serving each possible corridor. The table looks ahead also to area generation and economic growth projects in both the Stratford/wider Docklands zones, and in Old Oak/Park Royal. HS2 modelling volumes for forecast years in 2026, 2035, 2045 and 2055 are also set out, on an averaged UK basis. The GWML and HS2 corridors are highlighted for particular consideration.

Total Entry/Exit rail volume, East London to/from rest of Britain, 2010-11	Total all rail flows	Chiltern / Metro.	Crossrail / GW >Reading	ECML south of Doncaster	South Eastern not N/E Kent	Southern	South West Trains	Thameslink / Great Northern	Great Western Main Line	WCML / LonMid S of Birmingham	WCML Birm & north	Midland Main Line	South Eastern N/E Kent	ECML Doncaster & north	Greater Anglia + c2c
Passenger numbers per hourly train									GWML		HS2 Phase 1 potential			HS2 Y potential	
At Stratford	609	18	15	8	15	71	108	73	44	25	34	14	46	14	124
Similar volume at Old Oak	609	18	15	8	15	71	108	73	44	25	34	14	46	14	124
East London inter-regional travel as a % of all London-linked National Rail journeys = 1.326%															
Generated by local development at both interchange catchments (Stratford + Old Oak) over 20+ years development															
Applied at 50% rate in 2026 and 100% rate in 2035															
100,000 jobs @ 750 jnys/year	994,500														
40,000 homes @ 700 jnys/yr, 2.3 pop	640,458														
Converted to passenger numbers per hourly train:															
In fully developed state if 2010/11	140	4	3	2	3	16	25	17	10	6	8	3	11	3	28
TOTALS in 2010-11	1,219	36	29	15	30	142	217	146	88	50	69	27	92	28	248
Averaged UK economy & population multipliers to forecast years (average of London and rest of UK) based on HS2 forecasting:															
2026 = 35%	1,740	52	42	22	43	202	310	209	126	71	99	39	132	40	353
2035 = 61%	2,187	65	52	28	54	254	389	263	158	90	124	49	166	51	444
2045 = 94%	2,634	78	63	34	65	306	469	317	190	108	149	59	200	61	535
2055 = 131%	3,139	93	75	40	77	365	559	378	227	129	178	70	238	73	637

175. With a constant multiplier across all flows, the strongest volumes are still Stratford to/from corridors within London and the Home Counties. This potential demand should be investigated further, particularly to/from South West Trains and Southern/Thameslink beyond Greater London, where modelling is saying that direct rail links are important in absolute numbers.

176. Looking at InterCity-type flows, demand for hourly through Domestic High Speed trains towards HS2 is over 200 per train by 2045 when combining HS2 Phase 1 and HS2 Y (possibly splitting at Birmingham Interchange into 'catchment trains'). This volume would be improved by diversion of domestic air travel and motorway-based car travel (not assessed here in detail). Therefore this represents an indicative date for commercially worthwhile direct InterCity services, focused only on the Domestic InterCity market. To achieve this passenger volume, trains would need to call at both Old Oak and Stratford International.

177. The nominal GWML volume isn't very different, and diversion from M4 travel is a good possibility for extra rail travel on that corridor. However this includes flows aggregated from both South Wales and the South West, so would require 'catchment trains' to combine at Bristol Temple Meads or Bristol Parkway.

178. There may be an earlier business case for either (1) less frequent services, eg 2 hourly from 2026 or 2035, or (2) achieving an hourly service by combining other destinations in Kent, particularly at Ebbsfleet and Ashford International. This would

require validation by further modelling. The potential scale of developments in Thames Gateway outside the London area, and at Ashford, may support this proposition.

179. Overall, it is not a simple 'plug and play' proposition to define a new layer of inter-regional Domestic High Speed services which serve Stratford directly.

180. However a case emerges by combining with at least one more sub-regional stop in London, at Old Oak. The potential for London Interchanges to be both economic growth zones and long distance railheads needs to be argued holistically, if it is to result in new direct rail services.

181. **The modelling above also demonstrates clearly that the combined business case for UK international through trains, and Domestic High Speed services, would be much easier to achieve if UK international trains could be allowed to carry Domestic passengers within Britain.**

182. Splitting these flows because of security rules means that neither groups of services are easily affordable or justified, which is damaging to UK domestic links and to international connectivity. The numbers above, if added to the HS2 International modelling, would make an early case for reasonably frequent through trains using the *North London Express* route, and serving Stratford International and other key interchanges.

Services to Heathrow Airport

183. The modelling above excludes flows within London and to/from Heathrow on the BAA-owned Heathrow Express. (These are not counted by ORR as National Rail).

184. London Underground handled 13.2 million passengers entry/exit at its three Heathrow terminal stations in 2010, and a further 2.8 million at Hatton Cross on the fringe of the airport and used by airport staff. BAA's Heathrow Express figures are not published but are understood to be ca. 8-9 million per year.

185. This is a total rail volume of 24-25 million passengers, split between air passengers and airport and airline staff. Heathrow also provides an interchange for outer west London, for example with National Express coaches and local buses. The traffic complexities around Heathrow and the selective pricing for many rail fares via Heathrow will however deter some otherwise' natural' London and Home Counties use of this interchange.

186. As noted elsewhere, plans are emerging for Crossrail to take over all BAA Heathrow services. The London & South East Route Utilisation Strategy included assessment of Crossrail and its relationship with the increased passenger demand

forecast on the Great Western Main Line from Paddington to Reading and beyond, in Chapters 7 and 8. It concluded that there was a strong requirement by the 2020s for Crossrail to take over all the local GW suburban services as far as Reading, and for Crossrail to take over all peak time passenger services to Heathrow including Heathrow Express. This is currently the subject of discussions involving BAA who own the Heathrow Express service. [11]

187. Although it isn't a precise mathematical relationship between air passenger numbers and the total rail passengers handled at Heathrow's 4 stations, there is clearly some linkage between demand for one and use of the other – shown recently in a negative way on the Stansted Express rail service, with the reduction in total use of Stansted Airport.

188. Heathrow handled 69.4 million passengers in 2011, of which about 65% were point to point rather than transferring between planes, so about 45 million passengers entry/exit at the airport. Expressed as a simple ratio of rail to air passengers, the annual rail volume is about 55% of the local air passengers number. However this ignores the aviation staff and other rail passengers, and also the rail-air coach services.

189. Heathrow Airport has planning permission to increase its passenger throughput to 91 million passengers (combining point-to-point and transfer passengers). Much of this may be by means of larger aircraft, while mixed-mode use of both runways may also grow volume by 10%.

190. Overall, even without the widely-debated Runway 3, it is possible to plan for rail passenger volumes at Heathrow rising to 33 million passengers, before the further impact of Crossrail, Heathrow western rail corridor, Airtrack 'Lite', and anything else that is intended such as the HS2 spur during the HS2 Y stage. Achieving over 40 million rail passengers a year appears a plausible medium term objective.

191. In respect of the HS2 scheme, HS2 Ltd is proposing only about 2 tph to/from the Midlands and North of England. Their timed divergence from the main HS2 corridor near Denham, might in turn permit up to 2 tph HS2 international trains simultaneously which could begin at Heathrow and re-fill the same HS2 slots heading east towards Old Oak, Stratford and the European mainland. This is currently HS2 Ltd's ambition in terms of train slot planning, though the commercial case for using those slots is a matter for consideration, as shown in Section 1 of this report.

[11] Personal meeting with BAA officials.