Department for Transport

Supplement to the October 2013 Strategic Case for HS2

Technical Annex: Demand and Capacity Pressures on the West Coast Main Line

November 2015

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Contents

Executive summary

Purpose of this report

1 "The Strategic Case for HS2", published by the Department for Transport (DfT) in October 2013, set out the need for the scheme. At the heart of the Strategic Case were issues around route capacity (the number of train services) and train capacity (the number of passengers each service can carry) on the West Coast Main Line (WCML).

2 Following on from the publication of the Strategic Case, DfT has undertaken further work to keep up to date its analysis of route capacity and train capacity issues on the WCML. The purpose of this report is to bring together the evidence that has been captured by DfT's updated analysis of WCML capacity issues. The report covers the following topics:

- **The strategic importance of the WCML** – explaining how the WCML serves a number of the UK's most critical rail markets, highlighting how these markets have grown over the last 20 years and illustrating how the major upgrade of the WCML between 1998 and 2008 has supported this
- **The WCML today** - covering the existing capacity and performance pressures on the WCML and the growth in freight and passenger demand that is anticipated
- **Route capacity** - setting out the key constraints on each section of the WCML, the trade-offs that would be required in order to run additional trains and the potential alternative options for relieving these constraints
- **Train capacity** - analysing future crowding issues on the two key WCML operations, the West Midlands franchise and Inter City West Coast, under different demand growth and investment scenarios
- **Freight -** exploring the potential of the different phases of HS2 to accommodate the anticipated increase in demand for freight services along the WCML

The strategic importance of the West Coast Main Line

3 The WCML is one of Britain's most important rail corridors. It links four of Britain's biggest conurbations and serves all rail markets: inter-city; commuter; regional; and freight. Three of Britain's top six rail business flows (London to each of Manchester, Birmingham and Liverpool) are served by the WCML.

4 Inter City West Coast (ICWC – currently operated by Virgin West Coast) carries around 35 million passengers annually. In peak periods it operates 10-11 trains per hour (tph) to/from London Euston.

5 The West Midlands franchise (WM - currently operated by London Midland) operates commuter trains from Crewe, Birmingham, Milton Keynes and Northampton to London. In the morning peak hour it runs 13tph: 5tph operate on the WCML Fast

[1] Virgin West Coast operates 12tph between 18:00-18:59 on Fridays.

Lines alongside ICWC services, with 8tph running on the Slow Lines.

6 Since the 2013 Strategic Case was published, overall demand for rail travel has continued to grow at a higher rate than the long term forecast that underpins DfT's Economic Case for HS2. From 2013 to 2015 (years ended 31 March) the number of rail journeys in Great Britain grew by 10.2 per cent from 1,501 million to 1,654 million. This is an annual growth rate of 5 per cent – more than double the growth of around 2 per cent assumed in the Economic Case for HS2.

7 Over this period, on the WCML:

- Virgin West Coast has seen its annual passenger journeys grow by 13.5 per cent from 30.4 million in 2013 to 34.5 million in 2015 – equivalent to 6.5 per cent annual growth
- London Midland, the key commuter operator into London Euston, has seen its passenger journeys grow by 7.9 per cent from 60.5 million to 65.3 million – equivalent to 3.9 per cent annual growth. This is against a backdrop of a doubling of commuter journeys into London on the WCML since 1996/97

8 As a result of these trends, Euston is now the fastest growing terminus in London.

9 Regional and other suburban services operate alongside inter-city trains throughout the North and Midlands. Indeed, in recent years WCML commuter flows into Birmingham and Manchester have grown as quickly as those into London. Peak passenger numbers at city centre stations in Birmingham and Manchester have increased by 15 per cent and 27 per cent respectively over the last four years.

10 In addition, around 40 per cent of all Britain's rail freight trains use the WCML at some point in their journey.

11 This growth has been made possible by the £9 billion WCML upgrade. This took a decade to carry out and when it was completed in 2008, it had involved one hundred million person-hours of work, and significant disruption to the travelling public. By increasing the route capacity of WCML from around 9tph to 13-14tph, this allowed a 45 per cent increase in daily services from London to Birmingham and Manchester. Notably, the scale of growth between 2008 and 2015 means that two thirds of the additional inter-city seat capacity provided by the decade-long upgrade is already being utilised.

The West Coast Main Line today

12 Today, the WCML Fast Lines (the "Fast Lines") carry 15-16[2] trains per hour (tph) at the busiest peak periods. This is more than the 13-14tph envisaged at the time of the upgrade due to the pressure to run more outer-suburban commuter services along with today's inter-city timetable. This is a higher intensity of operation than comparable major fast lines in other European countries, including purpose-built high speed lines.

13 Despite its recent modernisation, the WCML rail corridor remains highly constrained, meaning that the route is operating close to capacity in the peak and it is challenging to increase service levels still further. This is due to:

- Physical constraints with the infrastructure such as the flat junctions[3], two-track sections and bottlenecks at station approaches

[2] 15tph operate in the high peak hours of 08:00 to 08:59 and 17:00 to 17:59. On weekdays between 08:02-09:01 this rises to 16tph which is enabled by reduced calls by fast line services south of Rugby. There are also 16tph between 18:00-18:59 on Fridays.
[3] This is where a crossing move is made such that a train travelling in one direction needs to cross the track used by trains in the opposite direction at the same level. By use of flyovers and dive-unders ('grade separation'), it is possible to reduce the adverse performance and capacity effects of flat, at-grade, crossings.

- The complex mix of inter-city, commuter, local and freight traffic that operates on the rail corridor with trains having varying speeds and stopping patterns

14 It is notable that these constraints impact the traffic that can be operated all along the route. They limit how many commuter services run into Birmingham and Manchester and the ability to run additional freight trains in the North and Midlands – not just the number of passenger services that can be run into Euston in the peak.

15 Operating the WCML at this intensity makes it challenging to maintain acceptable performance levels. Both Virgin West Coast and London Midland have consistently operated below their Public Performance Measure (PPM) targets since the route upgrade, and these targets have been revised down for Control Period 5 (CP5) in the face of the difficulties experienced in delivering higher performance levels.

16 The difficulties of operating additional trains on the WCML, particularly in the peak, have previously been acknowledged by the Office of Road and Rail (ORR). Between 2011 and 2013 the ORR turned down applications from Alliance Rail, Grand Central Railway, London Midland and Virgin West Coast to run additional services. This was because the performance risk of, effectively, filling the Fast Lines from the start of the morning peak until after the end of the evening peak was considered to be too great, as the service would never have the opportunity to recover from any perturbation.

17 Two further applications have since been at least partially successful. However, the circumstances in which the additional services have been permitted lend weight to the evidence that it is difficult to operate additional trains on WCML in the peak.

18 The first of these applications was for the two further peak hour London Midland trains, introduced in December 2014, increasing the frequency on the Fast Lines during peak hours to 15-16tph[4]. ORR could only grant access because the additional services were timetabled by operating faster 110mph rolling stock and 'flighting' two 110mph trains in a path previously occupied by one 100mph service. Making this timetabling solution work also required reducing commuter stops south of Rugby.

19 The second, and most recent award (August 2015), is the 10 year track access rights granted to Alliance Rail to operate six daily (five on a Sunday) off-peak return services between Blackpool and Queens Park station in London from December 2017. This means that some of the limited capacity available in off-peak periods (when frequency falls to 12tph) will be taken up. However, no additional peak services will be run.

20 Long term forecasts point to continued growth in the passenger and freight rail markets. Accommodating this demand on the WCML will be increasingly challenging.

Route capacity issues

21 The route capacity on the WCML is constrained at several points along the corridor, and each section of the route has different individual capacity constraints. However, because most trains need operating paths across several of these route sections, any solution to introduce more trains needs to be developed in a joined-up way along the route. With the route used so intensively, a constraint in one section can affect the timetabling of trains a considerable distance away in another section of line. Because of this, investing in the WCML corridor to allow more services to operate, whether they be passenger or freight, is complex.

22 To illustrate the range of constraints along the corridor, the table below splits the WCML into nine route sections, and summarises the key constraints in each section,

[4] 15tph operate in the high peak hours of 08:00 to 08:59 and 17:00 to 17:59. On weekdays between 08:02-09:01 there are 16tph which is enabled by reduced calls by Fast Line services south of Rugby. There are also 16tph between 18:00-18:59 on Fridays.

along with the implications this has for the service levels that can operate. The combination of these network constraints, and operating the WCML at such a high level of intensity, is having clear implications for the performance of the network, as identified in the October 2013 Strategic Case.

Section	Constraint	Impact on services
London Euston to Rugby	• The mix of traffic. Fast Lines carry 125mph inter-city trains and 110mph outer suburban trains. More paths would be available if trains operated at uniform speed • Flat junctions at Ledburn and Hanslope where commuter trains have to slow down to 60 mph to cross over from the Fast Lines to the Slow Lines, requiring precise timing of trains • Capacity is lost due to the uneven stopping patterns of London Midland trains, and two intercity trains stopping at Milton Keynes/Watford Junction • On the Slow Lines, there are no places for trains to pass each other between Wembley and Northampton	• Peak service level limited to 15-16tph so very limited ability to address crowding once existing peak trains are extended to full length • No capacity to give more towns and cities, particularly from the North West, direct services into London in the peak other than by starting existing trains further out • Calls by inter-city trains at Watford Junction and Milton Keynes have had to be reduced to accommodate 3tph London to Birmingham/Manchester timetable. In addition, direct links between Watford Junction and Liverpool, North Wales and Scotland have been withdrawn
Rugby to Birmingham New Street	• Coventry station, which has flat junctions at each end and is on the main freight route from the port at Southampton the Midlands and North West. Passenger and freight services need to be carefully planned through these junctions • The approach to Birmingham New Street where five routes join together • Knitting together the local West Midlands services with the Cross Country and West Coast timetable	• To accommodate the inter-city timetable, stopping trains between Coventry and Birmingham have been split into two services and the stopping trains from Coventry–Wolverhampton are no longer cross- linked meaning a change of train is needed for many cross-city journeys • Inter-city services that used to run between Coventry/Birmingham International and the East Midlands/Yorkshire/the North East have been withdrawn
Rugby to Stafford	• Brinklow – Attleborough Junction – Northbound 60-75mph freight services have to be slotted in around 125mph inter-city trains on a three track section • Colwich Junction – where two northbound inter-city trains per hour leave the route and cross in front of Southbound trains on a flat junction • The two-track section between Colwich Junction and the approach to Stafford. Here inter-city and freight services (with significant speed differentials) share the track	• More fast services along the Trent Valley to London from Stafford, Rugeley, Lichfield, Tamworth and Nuneaton cannot readily be provided • Constraints make it highly challenging to operate any more peak inter city services from the North West to London without reducing the reliability of other trains on the route • The number of day-time freight paths is limited
Stafford to Crewe	• Although this section is mainly four-track, the service mix and flat junctions, both at Stafford and Crewe, restrict route capacity • Crewe is a major passenger and freight hub. Complex crossing movements limit the number of available paths for passenger and freight services and the number of useable platforms for services to stop	• Limited availability of paths means that freight traffic to/from London and Birmingham needs to be held up for extended periods • Capacity constraints here and on other sections mean that the inter-city trains between Birmingham and Manchester cannot readily be accelerated. At present, the journey time is 1 hour 26 minutes for 85 miles
Crewe to Weaver Junction	• The two-track section between Winsford and Weaver Junction, where a mix of service and train types share the same track • At the North end of Crewe station, the line splits into three and there is a flat crossing	• It is difficult to increase local services because of the number of inter-city and freight trains • Extended journey times for services between Birmingham and Liverpool
Weaver Junction to Preston	• The diverse mix of service types that operate on the two-track sections between Weaver Junction and Preston, which includes a number of flat crossings. A number of regional services cross the WCML or run on it for short distances and thereby limit through capacity	• Limited ability to run additional inter-city services • Growth of freight paths to and from Scotland is constrained.
Weaver Junction to Liverpool	• The two-track section from Weaver Junction through Runcorn and over the River Mersey • The flat junction at Allerton where Liverpool-Manchester and WCML services merge	• Limited ability to increase services

Section	Constraint	Impact on services
Crewe to Manchester Piccadilly	• The two-track section between Sandbach and Cheadle Hulme, where fast long distance services from London and South Wales mix with slower stopping local trains • Flat junctions at Cheadle Hulme (where trains from London via Stoke-on-Trent join) and at Stockport (see below) • Approach to Piccadilly where the mix of stopping patterns and train origins/destinations curtails operational flexibility	• One out of every two Chester – Northwich – Manchester peak commuting trains was removed in 2008, forcing passengers to change at Stockport • Although Northern Hub will provide some more capacity in the Manchester area, it may not be sufficient to address all aspirations for improvements in services to Sheffield, Birmingham, Staffordshire, Shropshire and London • There is limited connectivity from Shropshire and from Staffordshire to Manchester Airport
Colwich Junction/ Norton Bridge to Manchester Piccadilly	• At Cheadle Hulme, the lines from Crewe and Stoke-on-Trent converge into a busy two-track section • The Stockport station area, where the lines from Chester, Sheffield, Hazel Grove and Buxton merge together for the approach to Manchester Piccadilly	• The Buxton –Blackpool service was split into three new services in 2008 to accommodate today's inter-city service • Services connecting Rose Hill in Manchester with Bolton via Oxford Road were also curtailed

Options for addressing these constraints

The Strategic Alternative to HS2

23 The report "HS2 Strategic Alternatives, Final Report"(DfT, October 2013) set out the alternative options for meeting the capacity and connectivity objectives set by Government when developing its plans for HS2. The most relevant option to compare against the impact of HS2 in the WCML corridor was termed "P1". This contained a package of measures, some of which had been put forward by objectors to HS2.

24 P1 assumes that all ICWC peak trains into Euston are run at 11-car length (the longest trains in the existing ICWC fleet) and reconfigured to increase Standard Class seating capacity at the expense of First Class. Likewise, all WM commuter trains are run at their maximum 12-car length. In addition to this, P1 includes a package of infrastructure enhancements that would more reliably allow 16tph into/from London Euston on the WCML Fast Lines across the peak. These have been costed at £2.5 billion and include the grade separation of junctions at Colwich and between Cheddington and Leighton Buzzard, 4-tracking between Attleborough and Brinklow and further power supply upgrades and line speed improvements.

25 Since P1 would involve major works on a live railway it would inevitably be highly disruptive to the travelling public. As with the 1998 -2008 WCML upgrade, passengers would be required to endure a prolonged period of route diversions and rail replacement bus services during weekend closures of sections of the line.

26 It is notable that since the publication of the 2013 Strategic Case, key elements of P1 have already been committed and are therefore built into the assumptions in this report. Specifically:

- Some of the proposed train lengthening is already underway and has been allowed for in the train capacity analysis within this report
- London Midland now operates some of the additional trains on the Fast Lines envisaged in the Strategic Alternative but without the need for grade separation
- Some of the infrastructure interventions are in hand, particularly the grade separated junction being built at Norton Bridge

27 Given the limitations of the Strategic Alternative in allowing additional peak trains compared to today's timetables, it is restricted in the extent to which it can address

medium-long term crowding issues on passenger services, and would do very little in terms of providing improved connectivity to a wider range of destinations, or indeed addressing freight capacity issues.

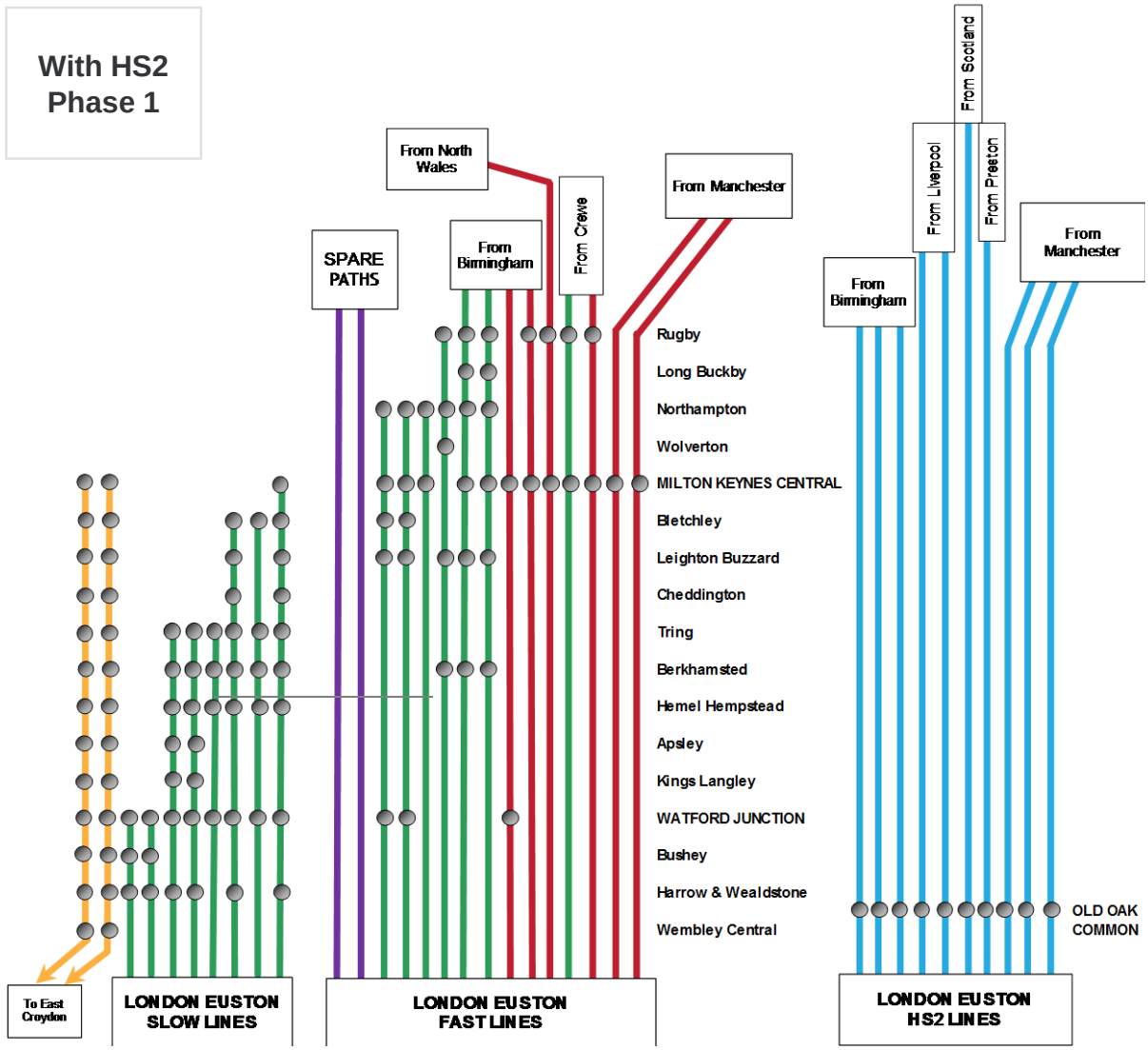
HS2

28 HS2 will impact the WCML in two phases – Phase One which is planned to open in 2026 and Phase Two which is planned to open in 2033. In March 2014, HS2 Limited published “HS2 Plus” which set out proposals for an acceleration of Phase Two, known as Phase 2a.

29 Phase One of HS2 will see a new high speed line constructed from London Euston to north of Birmingham, where it will reconnect with the existing WCML allowing fast services to serve Manchester, Liverpool, Crewe, Preston and Glasgow. New high speed trains will serve both Birmingham city centre as well as an interchange station which will serve both Birmingham Airport and the wider West Midlands. At Old Oak Common in west London, a new interchange will be built connecting HS2 with Crossrail and the Great Western Main Line.

30 The Phase Two “Y” shaped network will see the new high speed line extended to the north and east. On the western leg, the line will join up with the WCML south of Wigan and there will be a new station in Manchester city centre. The Eastern leg will join with the East Coast Main Line (ECML) approaching York.

31 The figure overleaf summarises the indicative HS2 Phase One service pattern that has been presented to the hybrid Bill Committee.



Indicative plan of services of the WCML and HS2 following Phase One[5]

32 HS2 Phase One would increase the capacity for fast trains on the HS2 and the West Coast Fast Lines combined into/from London Euston from 15-16tph to 23tph.

33 In Phase Two, the total number of fast trains into Euston will increase to 31tph. The additional 8tph will run on the WCML corridor as far as Birmingham and then operate on the Eastern leg of the HS2 "Y" network.

34 The principal impacts of this from a capacity perspective will be to:

- Increase the overall quantum of long distance inter-city services to circa 17tph, across HS2 and the WCML Fast Lines
- Provide a step change in commuter capacity on the WCML Fast Lines by using the capacity released from moving the majority of inter-city services to the dedicated HS2 route
- Potentially allow a wider range of direct connections to/from London for locations that currently have limited or no direct services
- Potentially allow a better range of services into Birmingham and Manchester, where in 2008 priority on the main routes was given to inter-city trains at the

[5] Source: HS2 Ltd. Version presented by HS2 to Hybrid Bill Committee

expense of local, regional and inter-regional services in order to get the enhanced inter-city timetable in place

How HS2 will help address train capacity issues

35 Assuming that rail passenger demand continues to grow, at some point in the future, both the existing commuter and long distance WCML services will become unacceptably overcrowded, even if all peak trains are operated at their maximum length.

36 To illustrate this issue of overcrowding, two growth scenarios have been modelled, covering the period up to 2033/34 when the full HS2 "Y" network is scheduled to open. The base data for this analysis are the latest count figures which are provided to DfT by all train operators, including London Midland and Virgin West Coast.

37 The 'Reference Case' applies the passenger growth rates from DfT's Planet Framework Model (PFM) – the model that underpins the HS2 Economic Case. Averaged out over the period from 2014/15 to 2033/34, these are growth of 1.8 per cent per annum for WM services (currently operated by London Midland) and 2.0 per cent for ICWC services (currently operated by Virgin West Coast). These growth rates take into account the impact of exogenous demand drivers such as GDP and population growth but do not take into account the initiatives of train operators to grow demand e.g. marketing, new products and service quality enhancements.

38 The 'Higher Growth Case' uses 'high sensitivity' growth rates from the DfT's Network Modelling Framework (NMF). In this scenario, the growth rates averaged out at 3.0 per cent per annum for WM services and 3.7 per cent per annum for ICWC services.

39 These 'high sensitivity' growth rates are closer to the actual growth in demand seen on Britain's railways in the period since privatisation. However, even these figures are significantly lower than the actual growth that has been witnessed. Since 1997, the number of passenger journeys on the London and the South East commuter network has grown at a rate of 4.3 per cent per annum whilst the number of inter-city journeys has grown at a rate of 4.7 per cent per annum.

West Midlands franchise crowding under today's service levels

40 In recent years, London Midland has been one of the most crowded London commuter train operating companies (TOCs). In each of the last seven years, Passengers in Excess of Capacity (PiXC), on London Midland has exceeded the London and South East average. In Autumn 2014, PiXC was 6.5 per cent across the AM and PM peaks, the second highest PiXC figures amongst London commuter train operators. This compared to PiXC of 4.1 per cent across the wider London commuter network.

41 Since the Autumn 2014 counts took place, London Midland has introduced a new timetable in December 2014 which added two additional services into London Euston in the AM peak hour in order to relieve some of these crowding issues.

42 The analysis in this report shows that even with this intervention, continuing to operate the current train service up to 2033/34 would lead to estimated PiXC levels of 18 per cent in the Reference Case and 30 per cent in the 'Higher Growth Case' - three to five times greater than levels seen today.

43 It is notable that these crowding levels would also be significantly higher than the most crowded TOC in Autumn 2014, which was Greater Western - with PiXC of 10.1 per cent. A series of major investments are in progress to mitigate this crowding including the re-modelling of Reading station and the introduction of new higher capacity Inter-city Express trains.

Impact of different interventions on West Midlands franchise crowding

44 To determine how this passenger crowding might be mitigated, three options have been considered:

- Extending all WM trains to 12-cars from the current mix of predominantly 8-car and 12-car trains
- The “Strategic Alternative”. The Strategic Alternative builds on the all 12-car option by adding sufficient route capacity to allow two further fast services between 07:00–08:00 (increasing the current 28 AM peak trains to 30)
- “With HS2”: With HS2 Phase One, route capacity released from running fewer inter-city services on the WCML allows the number of WM AM peak arrivals to increase from 28 to 41

45 The table below illustrates that the infrastructure investment contained within the Strategic Alternative only allows a 4.7 per cent increase in WM AM peak capacity into Euston over and above running all of today’s services with 12-cars.

Scenario	Number of services	Standard Class seats	Standard Class capacity
December 2014	28	15,132	20,234
All 12-carriage	28	19,344	25,884
Strategic Alternative	30	20,580	27,120
With HS2	41	30,330	41,103

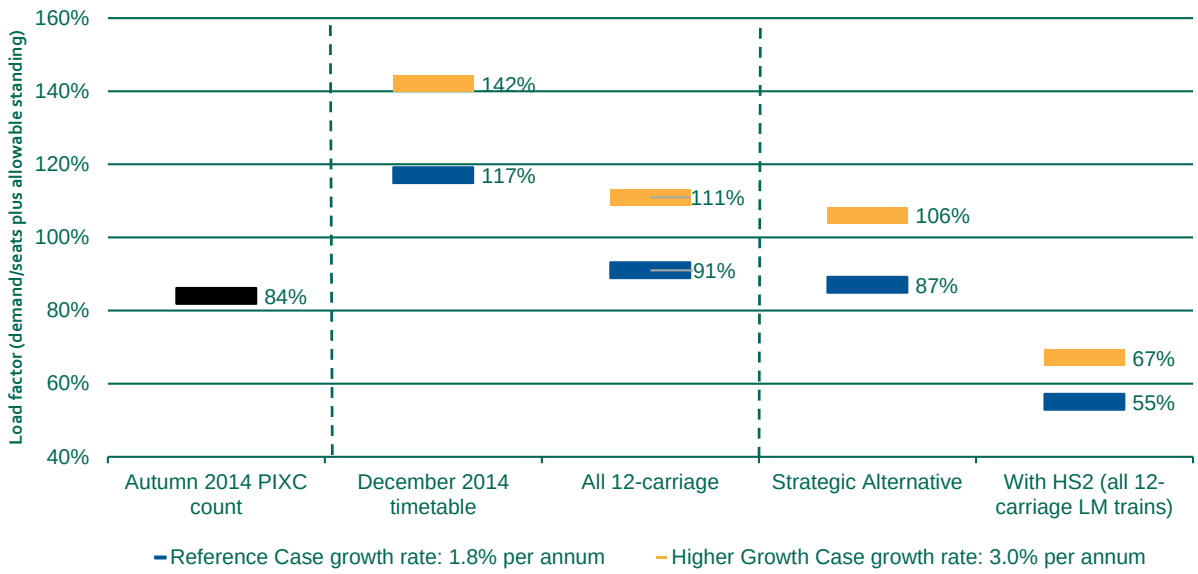
West Midlands franchise AM Peak capacity into Euston (07:00–09:59)[6]

46 HS2 conversely provides a step change in commuter capacity on the WCML corridor. This is because capacity released by operating much of today’s inter-city services on dedicated high speed lines could allow the number of WM services in the AM Peak to increase from 28 to 41, resulting in a 59 per cent increase in AM peak capacity into Euston.

47 The figure overleaf sets out the crowding impact of each of these scenarios by forecasting average load factors on WM across the AM peak in 2033/34. This covers all Euston arrivals between 07:00 and 09:59 with the load factor defined as demand divided by capacity under DfT’s PiXC measure (seating plus a standing allowance).

48 For each option, the yellow bars represent forecast load factors under the ‘Higher Growth Case’ and the blue bars under the Reference Case growth rates.

[6] Data source: Analysis of the December 2014 timetable; “The Strategic Case for HS2” (DfT 2013)



Forecast West Midlands franchise 2033/34 AM Peak load factors arriving at Euston (demand/seats and allowable standing)

49 The analysis demonstrates that:

- Operating the existing train service in 2033/34 would result in average load factors in the AM peak of 117 per cent in the Reference Case and 142 per cent in the Higher Growth Case'. This would translate into estimated PiXC across the AM and PM peaks of 18 per cent and 30 per cent respectively compared to 6.5 per cent in Autumn 2014
- Operating every service with 12 cars would reduce load factors to 91 per cent and 111 per cent respectively. This would translate into estimated PiXC of 11 per cent and 19 per cent
- The infrastructure investment contained within the Strategic Alternative only provides a marginal increase in WM capacity over and above running today's services with 12-cars. Average load factors in 2033/34 would be 106 per cent across the AM peak in the 'Higher Growth Case.' In the Reference Case, loadings would exceed today's levels
- Due to the release of WCML route capacity for commuter services, the "with HS2" option allows future growth on WM to be accommodated in both the 'Reference Case' and the 'Higher Growth Case.' With this additional capacity, average loadings across the AM Peak would not return to today's loads until 2063 in the 'Reference Case' and 2041 in the 'Higher Growth Case'

Crowding on ICWC today

50 In Autumn 2014, average weekday Standard Class load factors (number of passengers divided by number of seats) on Virgin West Coast were 68 per cent in the AM Peak (arrivals at London Euston between 07:00-09:59) and 67 per cent in the PM Peak (departures from London Euston between 16:00-19:59). On Fridays, PM Peak load factors are 79 per cent.

51 Because loads are not evenly distributed across train services, even with average load factors of less than 100 per cent there are some individual services with more passengers than seats. Autumn 2014 count data indicates that at present, 0.7 per cent of Virgin West Coast passengers across the AM and PM peaks are standing as trains arrive at/depart Euston. This rises to 2.4 per cent on a Friday PM peak.

Future crowding levels if all ICWC trains are lengthened and reconfigured

52 Standing will become a major issue on ICWC services by 2033/34. This is the case even if all peak trains are operated with11-cars and trains are reconfigured such that they provide eight cars of Standard capacity and three cars of First Class capacity instead of the seven cars of Standard capacity and four cars of First Class capacity provided today.

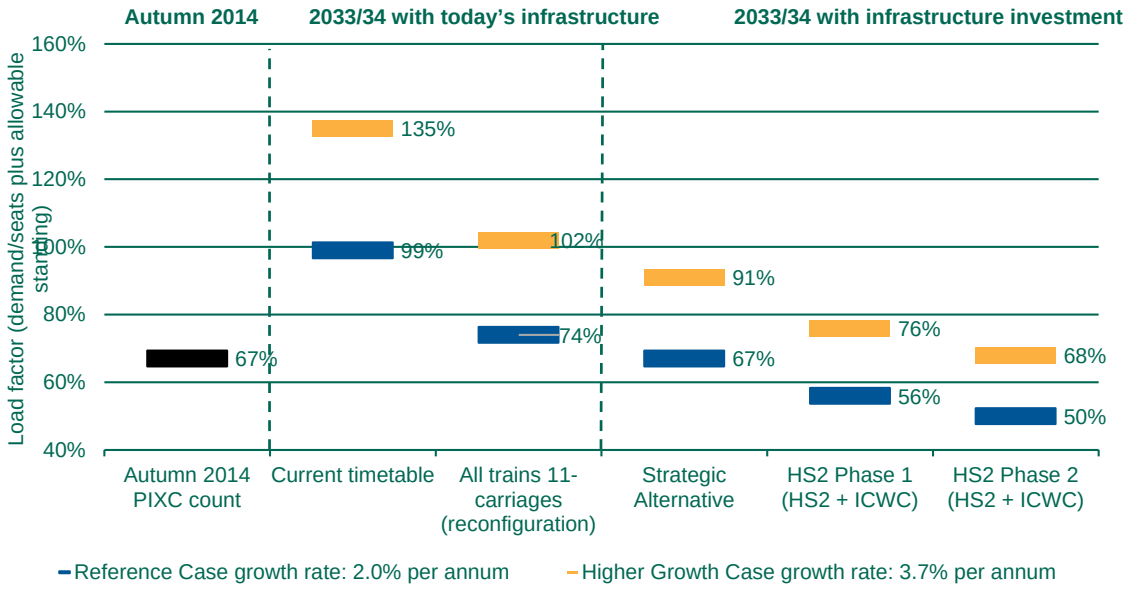
53 This report, shows that even with longer, reconfigured trains, by 2033/34:

- **Under the 'Reference Case'**, an average of 2 per cent of peak passengers will be standing on arrival at/on departure from Euston during AM and PM Peaks, with 9 per cent of passengers standing on departure from Euston in the Friday PM Peak
- **Under the 'Higher Growth Case'**, an average of 15 per cent of peak passengers will be standing on arrival at/on departure from Euston. This rises to 23 per cent of passengers standing in the Friday PM Peak on trains leaving Euston
- The long distance nature of the ICWC services means that many of the standing passengers identified in this analysis will be standing for an hour or more. In the 'Higher Growth Case' it is estimated that by 2033/34 on an average weekday, 3,200 passengers will stand on ICWC trains departing London in the PM peak. Of these, 1,350 (40 per cent) will be on trains with a first stop that is 59 minutes or more outside of London

54 On a typical Friday, when passenger volumes rise further, it is estimated that 5,900 passengers will be standing on departure from Euston. Of these, 3,500 (60 per cent) will be on trains with a first stop 59 minutes or more outside London, of which 1,300 (22 per cent) will be standing for 90 minutes or more to stations such as Crewe and Warrington.

Impact of different infrastructure interventions on ICWC crowding

55 The figure below illustrates estimated ICWC PM peak weekday load factors in 2033/34 under different investment scenarios.



Forecast ICWC and HS2 2033/34 weekday PM Peak (16:00–19:59) load factors)

56 This shows that:

- Operating every service with reconfigured 11-car trains leaves average load factors over 100 per cent in the 'Higher Growth Case.' In the 'Reference Case' weekday average load factors are 74 per cent, approaching the loadings conditions currently experienced on a Friday
- The Strategic Alternative provides some increase in ICWC capacity by providing a limited number of additional trains in the AM and PM peaks. However, average load factors are forecast to be 91 per cent by 2033/34 in the 'Higher Growth Case', rising to 102% by 2036/37
- The step change in route capacity provided by HS2 allows crowding issues on inter-city services on the WCML corridor to be solved for the long term, whilst accommodating the increase in demand that is predicted to be generated by the introduction of HS2
- Phase Two – which delivers the same quantum of services as Phase One to WCML destinations but would allow longer trains to run north of Birmingham – gives the potential to accommodate further long-term growth in demand

Freight

57 Network Rail anticipates that rail freight volumes will grow by over 40 per cent by 2023 compared with 2011 and by around 90 per cent by 2033. Notably for the WCML, the intermodal segment (much of which is traffic to/from ports to distribution centres in the North and Midlands) is expected to continue to grow the fastest.

58 Network Rail's overall forecasts, suggest that the requirement for WCML paths could increase from 42 today to 80 by 2033. Given the capacity constraints on the existing network, this additional pressure for freight paths would be challenging to accommodate without infrastructure investment.

59 As it adds limited additional route capacity, the Strategic Alternative offers very little in helping meet the increase in demand for WCML freight paths that is forecast by Network Rail.

60 In contrast, by releasing capacity on the WCML, HS2 could facilitate North-South freight movements, particularly intermodal traffic from the ports of the South East and Liverpool. Any decisions around increases in paths available for freight would be subject to established statutory, regulatory, and administrative processes that take place ahead of the introduction of any timetable change.

61 The Train Service Specification (TSS) presented to the hybrid Bill committee in January 2015 suggests that at least one extra freight train could operate each hour, in each direction, post Phase One between London and Handsacre and that a second might be possible as well.

62 The key additional benefit of Phase 2a for freight is that it would allow fast passenger trains to bypass three bottlenecks (the junction at Colwich, the two-track section south of Stafford and the junctions at Stafford itself) thus opening up more capacity that could be used for freight trains (and slower passenger trains) in these areas.

63 The 2013 consultation for Phase Two proposes a further extension of the high speed line from Crewe to Golborne Junction, just south of Wigan - as well as to Manchester. This could release capacity for freight traffic between Crewe and Weaver Junction, where the route to Liverpool leaves the WCML. This could be utilised for freight services to the West Midlands, Daventry and London from any potential future expansion in port facilities at Liverpool, once complete.

1. Introduction

Background - the 2013 Strategic Case for HS2

1.1 The Strategic Case for HS2, published by the Department for Transport (DfT) in October 2013, set out the need for the scheme and explained how it would strengthen the UK's transport network. At the heart of the Strategic Case were issues around route capacity (the number of train services) and train capacity (the number of passengers each service can carry) on the West Coast Main Line (WCML). It is the combination of these two measures of capacity that determines travel conditions.

1.2 The two phases of HS2 provide the means to address capacity issues on the WCML. Phase 2 also addresses capacity issues on the Midland Mainline (MML) and East Coast Mainline (ECML). However, this report is focused on the WCML corridor.

1.3 The WCML is Britain's single most important rail route serving a number of markets – all of which are of strategic national importance:

- Inter-city services on the WCML (Inter City West Coast operated by Virgin West Coast) link the major cities of London, Birmingham, Manchester, Liverpool and Glasgow
- At the southern end of the route, the West Midlands franchise (WM – currently operated by London Midland) operates commuter trains along a corridor through Milton Keynes to London
- Throughout the North West and the Midlands, commuter trains and other regional and inter-regional services operate to serve the major cities of Birmingham, Liverpool and Manchester (as well as many other regional centres such as Coventry, Crewe, Warrington, Preston, Chester, Stoke-on-Trent and Wolverhampton)
- The WCML is the most important freight route on Britain's rail network carrying around 40 per cent of all rail freight services at some point in their journey. Many of the freight services are time-critical and carry containers to and from major ports and provide essential links in retail distribution chains

1.4 The WCML has already been the subject of a major renewal and modernisation programme. This cost £9 billion and was completed in 2008 after a decade of major works. The upgrade allowed around 1,000 additional trains to run each week and reduced key long distance journey times, such as those between London and Manchester, by around 20 per cent.

1.5 The October 2013 Strategic Case for HS2 noted the following important points in respect of route capacity on the WCML:

- The WCML modernisation programme envisaged that following the upgrade, there would be a maximum of 13-14 trains per hour (tph) using the Fast Lines into and out of London Euston. By October 2013, plans were being developed to squeeze in extra fast commuter services which would take the peak service level

on the Fast Lines up to 15tph[7]. At this level of utilisation, the WCML would be operating more fast passenger trains than comparable main lines in other European countries – this despite its complex mix of commuter, freight and inter-city traffic

- Operating the WCML at this level of intensity was making it challenging to achieve target levels of punctuality. In 2013, long distance services on the WCML were achieving 85 per cent punctuality – around 4 per cent points worse than average for other long distance services. The performance of the relevant parts of the London Midland franchise was also around 85 per cent. This was 6 per cent below the national average for equivalent commuter services. Since October 2013, the punctuality of Virgin West Coast has remained at around 85 per cent and London Midland performance has deteriorated to 83 per cent as the extra commuter services have been added

1.6 The Strategic Case went on to set out the medium to long term consequences for train capacity, or overcrowding, on trains using the WCML.

1.7 Passenger crowding is already a major issue on Britain's railways. Over the past 20 years, passenger journeys have more than doubled. The Strategic Case described the problems already experienced by commuters at Euston. However, crowding problems are not unique to the London end of the route or limited to the traditional morning and evening peaks. For example:

- In 2014, more than 10 per cent[8] of passengers arriving on peak hour services into Birmingham and Manchester were standing
- Inter-city services experience significant surges of demand on Friday and Sunday afternoons and evenings when people make leisure trips for the weekend in addition to business/work travel

1.8 The 2013 "Economic Case for HS2" assumed demand would continue to grow at a rate equivalent to around 2 per cent per year for the period until 2036. However, noting that rail demand had actually grown by 4.4 per cent per year over the preceding decade (5.2 per cent on inter-city routes), the Strategic Case set out indicative projections of train load factors (demand divided by seats) in a range of growth scenarios (demand growth of 1.5 per cent, 2.5 per cent and 5 per cent per annum). This analysis highlighted that there was a risk of serious overcrowding by 2026 on both commuter and inter-city routes serving London, Birmingham and Manchester.

1.9 The Strategic Case then considered how both HS2, and the Strategic Alternative – an alternative investment programme that would rely on upgrading the existing route – would address the route and train capacity issues anticipated on the WCML.[9] It concluded that the Strategic Alternative, besides failing to provide the connectivity gains that HS2 would bring from improved journey times:

- Did not provide sufficient additional capacity to meet the long term needs for the railway

[7] This would be achieved by increasing commuter services top speed to 110 miles per hour (mph) and so reducing their speed differential against the inter-city trains running at 125 mph.
[8] "Rail passenger numbers and crowding on weekdays" (RAI02) (DfT) at https://www.gov.uk/government/statistical-data-sets/rai02-capacity-and-overcrowding
[9] The report "HS2 Strategic Alternatives, Final Report" (DfT, 28 October 2013) sets out the work that was undertaken on alternative options for meeting the capacity and connectivity objectives set by Government when developing its plans for HS2. The work was undertaken by DfT and Network Rail and supported by consultants Atkins. We summarise the Strategic Alternative at the end of Chapter 3 of this report.

- Did not release significant additional capacity for commuter and freight traffic on the WCML
- Would be very disruptive and costly to develop
- Failed to solve the problem of resilience and performance on the WCML

Work completed following the publication of the Strategic Case

1.10 Following on from the publication of the October 2013 Strategic Case, DfT has undertaken further work to keep up to date its analysis of route capacity and train capacity issues on the WCML. This takes into account subsequent trends in passenger demand and train loadings, revised estimates of future growth and the impact of measures being taken to ease crowding, including the introduction of longer trains.

1.11 This update has examined each route section of the WCML and identified:

- Where the route is running close to capacity and the constraints that prevent the operation of additional services (without potentially significant adverse impacts on other key service attributes such as spare punctuality and journey times)
- The apparent demand for additional services (long distance, commuter, regional and freight)
- The potential of both HS2 and the Strategic Alternative to provide the capacity required to allow additional services to be operated

1.12 The updated train capacity analysis has examined:

- The scale of the passenger crowding that is likely to arise by 2033/34 (the year in which Phase Two of HS2 will open) on the key WCML services – ICWC, WM and the commuter services into Birmingham and Manchester
- The ability of tactical measures such as the lengthening and reconfiguration of trains to address demand growth, taking into account measures introduced since 2013 and further potential measures of a similar nature, in the years ahead
- The impact of any further increase in capacity, beyond these tactical measures, provided by the Strategic Alternative
- The ability of HS2 to provide a long term, sustainable solution to passenger crowding issues across all key WCML markets

1.13 In addition, DfT has investigated further the potential freight benefits provided by each of Phase One, Phase 2a and Phase 2b of HS2.

1.14 In undertaking this work, DfT was supported by consultants KPMG and Steer Davies Gleave. Network Rail has reviewed and validated the analysis in respect of route capacity and freight.

Purpose of this report

1.15 The purpose of this report is to bring together the evidence captured by DfT's updated analysis of WCML capacity issues. The report follows the structure set out below:

- **The strategic importance of the WCML**: this chapter explains how the WCML serves a number of the UK's most critical rail markets. It highlights how these markets have grown, and increased in their importance over the last 20 years and how the major upgrade of the WCML has been critical in supporting this
- **The WCML today**: this chapter explains, at a high level, the existing capacity and performance pressures on the WCML, the growth in freight and passenger demand that is anticipated and the alternative options that exist for providing additional capacity
- **Route capacity**: taking the WCML section by section, this chapter sets out where the network is constrained, the trade-offs that would be required in order to run further trains and the impact of HS2 and the Strategic Alternative in providing additional route capacity to allow more trains to be operated
- **Train capacity**: for the major WCML operations, WM and ICWC, this chapter sets out future crowding issues under two scenarios of demand growth. It considers the potential of a number of investment options to accommodate future growth
- **Freight**: this chapter explores the potential of the different phases of HS2 – Phase One, Phase 2a and Phase 2b to accommodate the anticipated increase in demand for freight services along the WCML

2. The strategic importance of the West Coast Main Line

- The WCML is one of our most important rail corridors; it links four of Britain's biggest conurbations and serves all rail markets: inter-city; commuter; regional; and freight
- Since 1996/97, inter-city passenger journeys on the WCML have increased by 162 per cent
- Three of Britain's top six business rail flows (London to each of Manchester, Birmingham and Liverpool) are served by the WCML; a significant inter-city leisure market also exists
- The number of commuter journeys into London on the WCML has doubled since 1996/97. Taken together with inter-city traffic, Euston is the fastest growing of all London termini
- In recent years, commuter flows into Birmingham and Manchester have grown as quickly as those into London. Peak passenger numbers at city centre stations in Birmingham and Manchester have increased by 15 per cent and 27 per cent respectively over the last four years
- Rail freight is estimated to deliver £1.5billion per annum of economic benefits to UK plc; 40 per cent of all freight trains use the WCML at some point in their journey
- The £9 billion WCML upgrade, allowed a 45 per cent increase in daily services from London to Birmingham and Manchester. However, since completion in 2008, over 60 per cent of the additional inter-city seat capacity provided by the decade-long upgrade has already been filled

Overview

2.1 Figure 1 illustrates the main WCML corridor and the sub-routes that lie within it.

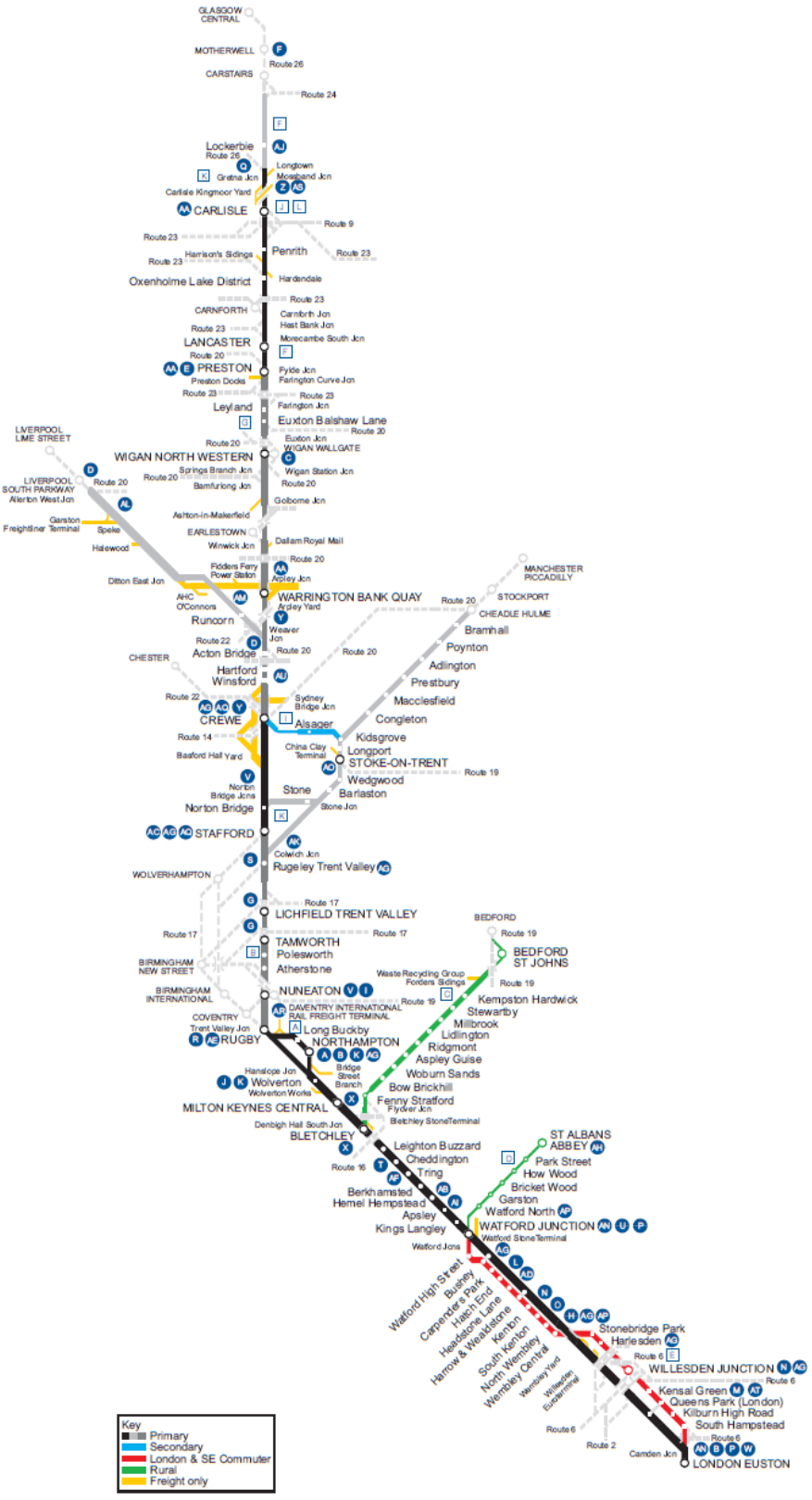


Figure 1: Illustration of the West Coast Mainline (WCML) corridor [10]

[10] Source: Network Rail

2.2 The WCML is predominantly a four-track railway between London and Crewe – albeit with a two-track section between Colwich Junction and Stafford. It comprises one pair of Fast Lines carrying a mix of long distance and outer suburban commuter services and one pair of Slow Lines carrying a mix of 'inner' commuter and freight services. This separation of train services helps maximise the utilisation of available capacity at the Southern end of the WCML. However, the service types cannot be fully separated. Some outer suburban services switch between the Fast and the Slow Lines; other services come together on two-track feeder sections of route or north of Crewe at key junctions.

2.3 The feeder branches are at Rugby (to Coventry, Birmingham and Wolverhampton) and branches at both Colwich Junction and Crewe which run to Manchester. There are further branches to North Wales, to Liverpool (from Weaver Junction) and to Blackpool. North of Crewe to Scotland, the WCML is mostly a two-track railway carrying a mix of fast inter-city services, local/regional services and freight traffic.

2.4 As Figure 2 illustrates, the WCML serves a complex mix of markets.

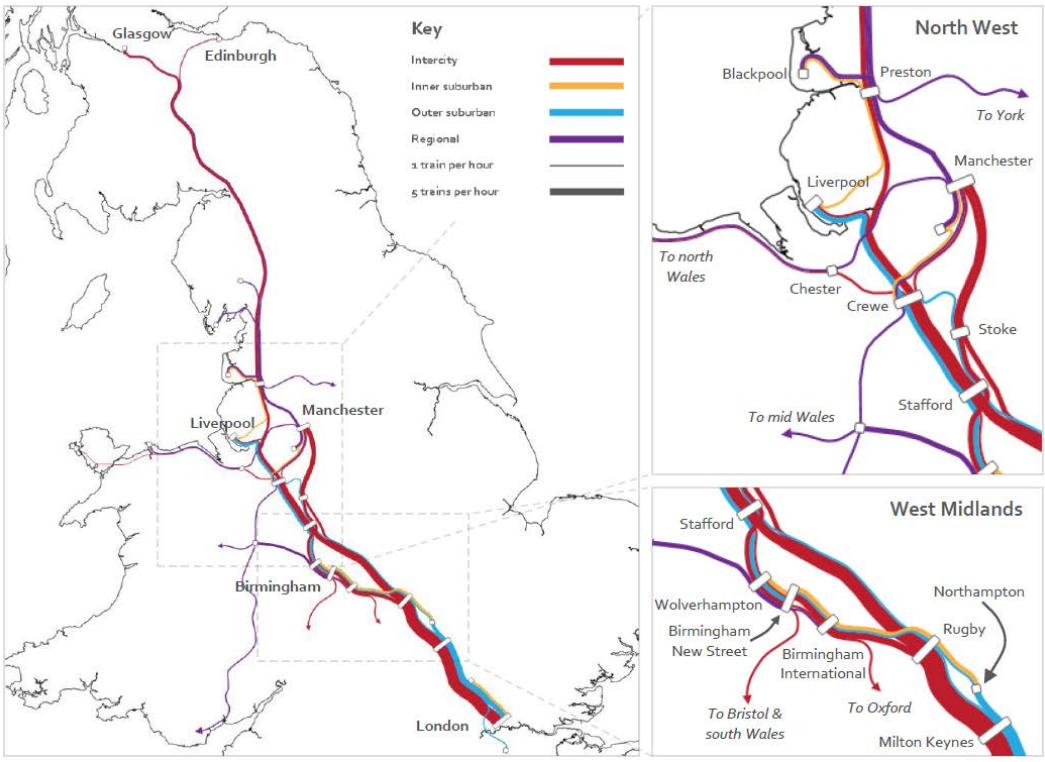


Figure 2: Overview of the passenger markets served by the WCML

2.5 The Inter City West Coast franchise – currently operated by Virgin West Coast - connects Britain's four largest conurbations and carries around 35 million passengers annually. In peak periods it operates 10-11tph[11] to/from London Euston.

2.6 The West Midlands franchise – currently operated by London Midland - operates commuter trains from Crewe, Birmingham, Milton Keynes and Northampton into London. In the morning peak hour it runs 13tph: 5tph operate on the WCML Fast Lines alongside ICWC services, with 8tph running on the Slow Lines.

[11] Virgin West Coast operates 12tph between 18:00-18:59 on Fridays.

2.7 Regional and other suburban services operate alongside inter-city trains throughout the North and Midlands. For example:

- London Midland runs a commuter service of 4tph into Birmingham New Street in the peak. There are also services operated by Arriva Trains Wales and Cross Country using the two-track Coventry corridor into Birmingham New Street
- The southern approaches to Manchester Piccadilly carry services operated by Virgin West Coast, Cross Country, Northern, TransPennine Express and East Midlands Trains

2.8 In addition to this, the WCML also accommodates up to four freight services per hour in each direction (42 services per day).

Inter-city services

2.9 ICWC services have been operated by Virgin West Coast since 1996/97. As illustrated in Figure 3, services are categorised into five service groups.

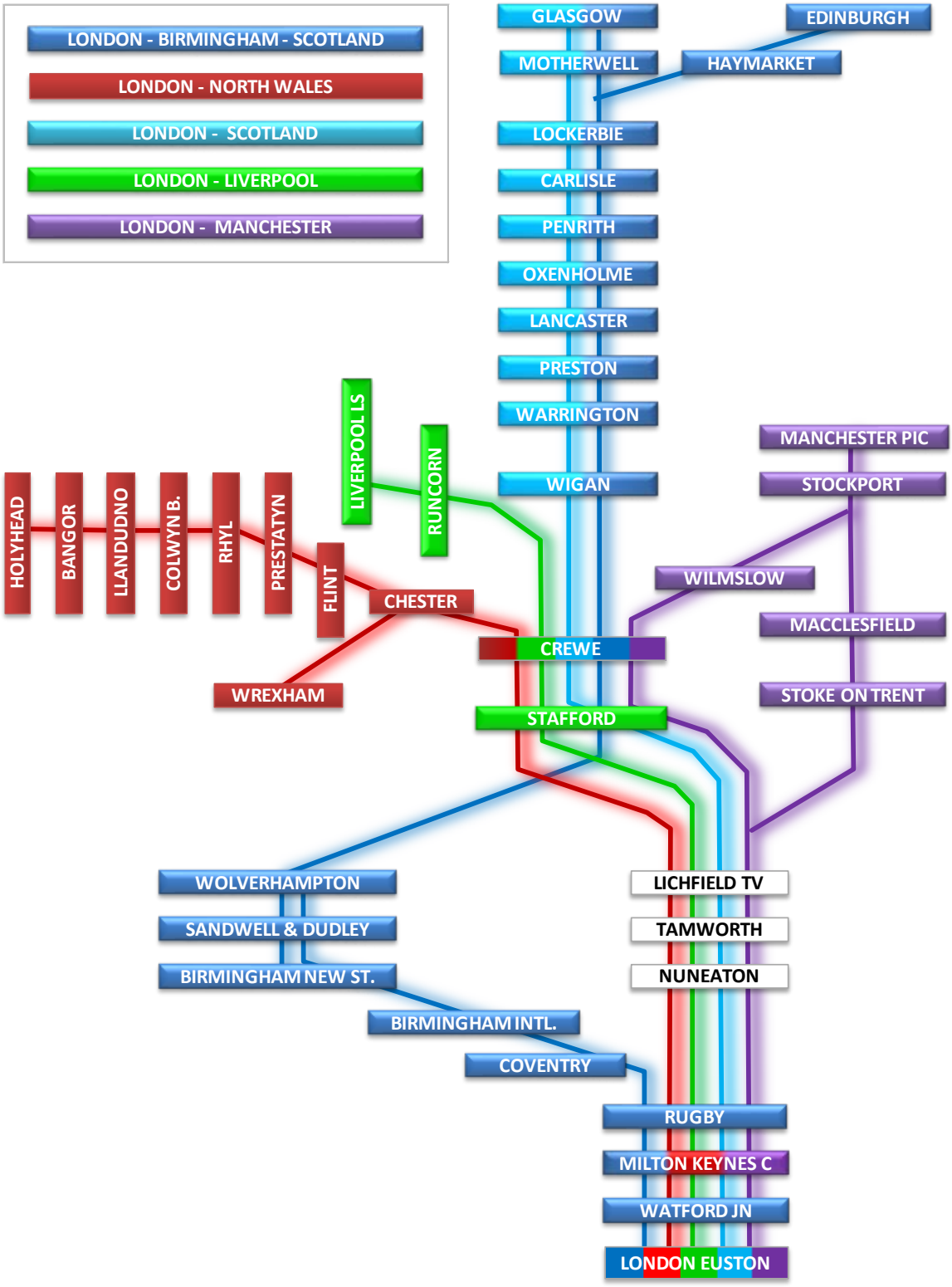


Figure 3 Summary of ICWC service groups

2.10 In the weekday AM peak, defined as between 07:00 to 09:59, ICWC runs 27 services to London Euston. In the evening (PM) peak period (between 16:00 and 18:59) 32 trains run from Euston. In the standard (normal) off-peak hour, nine services operate. Figure 4 sets out frequencies by service group - both Birmingham and Manchester have three services per hour throughout the day.

Service group	Off-peak standard hour	AM Peak hour (08:00-08:59)	PM Peak hour (17:00-17:59)
London - Birmingham/Wolverhampton	3	3	3
London - Manchester	3	3	3
London - Liverpool	1	2	2
London - Glasgow	1	1	2
London - Chester	1	1	1
Total	**9**	**10**	**11**

Figure 4 Summary of ICWC service frequency by service group[12]

2.11 Figure 5 illustrates the growth in passenger journeys that Virgin West Coast has experienced since 1996/97. Between 1999 and 2004, major works were carried out along the line of route to implement the West Coast Route Modernisation (WCRM) renewal and upgrade works, and demand levelled off. However, this has been followed by a period of extraordinary growth following the improvement in service and this has continued every year since – despite the economic downturn from 2008. In total, passenger journeys have grown from 13.2 million in 1996/97 to 34.5 million in 2014/15. Growth of 162 per cent since 1996/97 is over 50 per cent higher than the average growth rate observed on the wider Great Britain rail network, which is 106 per cent.

Figure 5 Historic growth in journeys on Virgin West Coast[13]

[12] Data source: DfT analysis of December 2014 timetable
[13] Data source: ORR data portal, ORR National Rail Trends

2.12 Figure 6 presents the demand growth that has been achieved on key WCML inter-city flows since 1995. London to/from Birmingham leads the way with growth of 255 per cent, followed by London to/from Manchester with growth of 210 per cent.

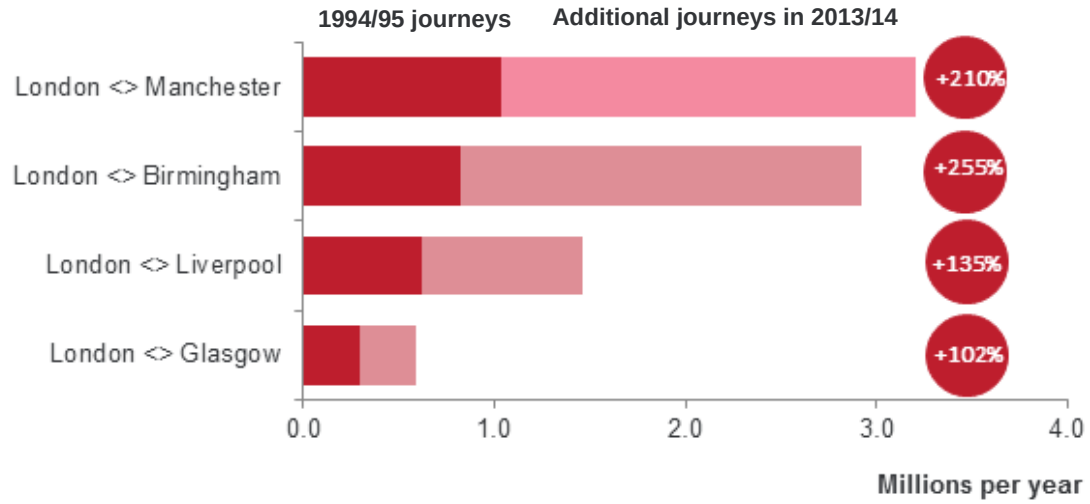


Figure 6 Historic growth on key ICWC flows[14]

2.13 The WCML inter-city market is particularly important for business travellers as it provides regular and fast services between Britain's major cities. Figure 7 compares the types of journey being made on the WCML inter-city flows with Britain's rail network as a whole. Journeys have been categorised into three journey-types: business, leisure and commuting.

2.14 As can be seen from Figure 7, inter-city journeys on the WCML have a much higher proportion of business trips than the average for the GB rail network. In 2013/14 it is estimated that 52 per cent of all rail journeys between London and Birmingham, Manchester, Liverpool and Glasgow were business trips.

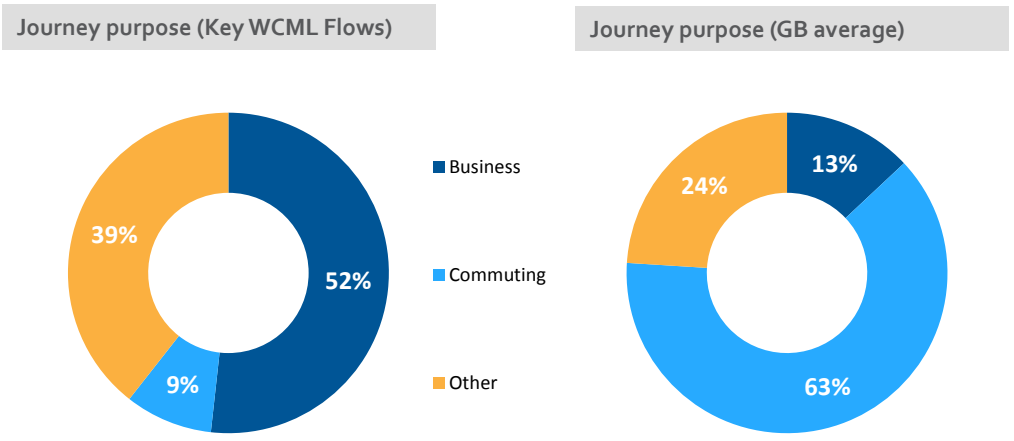


Figure 7 Journey purpose – Key WCML flows versus UK average in 2013/14 [15]

[14] Data source: RUDD (LENNON ticket sales data)
[15] Data sources: RUDD (LENNON), National Rail Travel Survey (2010, DfT), HS2 Ltd

2.15 Figure 8 provides further evidence of the importance of the WCML for business travel. The table shows the top five inter-city rail flows on the WCML for business trips together with their position in the overall list of inter-city rail flows in Britain. In 2013/14 the flows between London and Manchester and London and Birmingham were the two most significant rail business flows in Britain, with London-Liverpool and London-Coventry also featuring in the top 10.

Overall Rank	Flow (both directions)	Business trips in 2013/14
1	London <> Manchester	1,843,000
2	London <> Birmingham	1,528,000
6	London <> Liverpool	491,000
8	London <> Coventry	479,000
11	London <> Birmingham Intl	366,000

Figure 8 Top-5 WCML inter-city business corridors (London and non-London) in 2013/14[16]

2.16 In addition to the business market, the WCML also serves a number of other important inter-city markets. This includes passengers who are travelling to/from higher education; on holiday or for short breaks; visiting friends or family; making shopping trips or travelling to/from sport events. Indeed, the WCML links the top five cities in England, measured in terms of leisure visits by overseas visitors. Overall, tourism contributes £106 billion to the English economy[17].

2.17 Friday and Sunday afternoons and evenings are a particularly popular time, not only for leisure travel, but also for those who travel away for work/business reasons on a weekly rather than a daily basis – an approach that is not unusual for longer distance travellers. The combination of leisure, and passengers travelling for other purposes, means that services at these times, and in particular on Friday evenings, can be especially busy.

2.18 As explained in detail in Chapter 3, given network capacity constraints, there is limited scope for the ICWC operator to provide additional services to address these spikes in demand. Virgin West Coast has therefore sought to accommodate Friday demand by:

- Running an additional Euston-Preston service at 18:46 and Euston-Manchester service at 18:57 giving a total of 16tph on the Fast Lines (across both commuter and inter-city operations) between 18:00 and 18:59 on Fridays
- Providing more seats by re-classifying carriages. All 9-car Pendolinos are having one First Class carriage permanently converted to Standard. Voyager trains have one car that can be used as either First or Standard Class, depending on the time of day and demand levels

2.19 The pattern of travel across the evening peak period is affected by ticketing restrictions, with the highest volume of passengers departing Euston from 19:00 - 20:00. It is likely that some of the post-19:00 demand is displaced from the standard commuting peak period (taken as being 16:00-19:00) because of the non-availability of cheaper tickets.

[16] Data sources: RUDD (LENNON), National Rail Travel Survey (2010, DfT), HS2 Ltd
[17] VisitEngland.com, "The value of tourism in England" (Visit England 2014) https://www.visitbritain.org/town-data

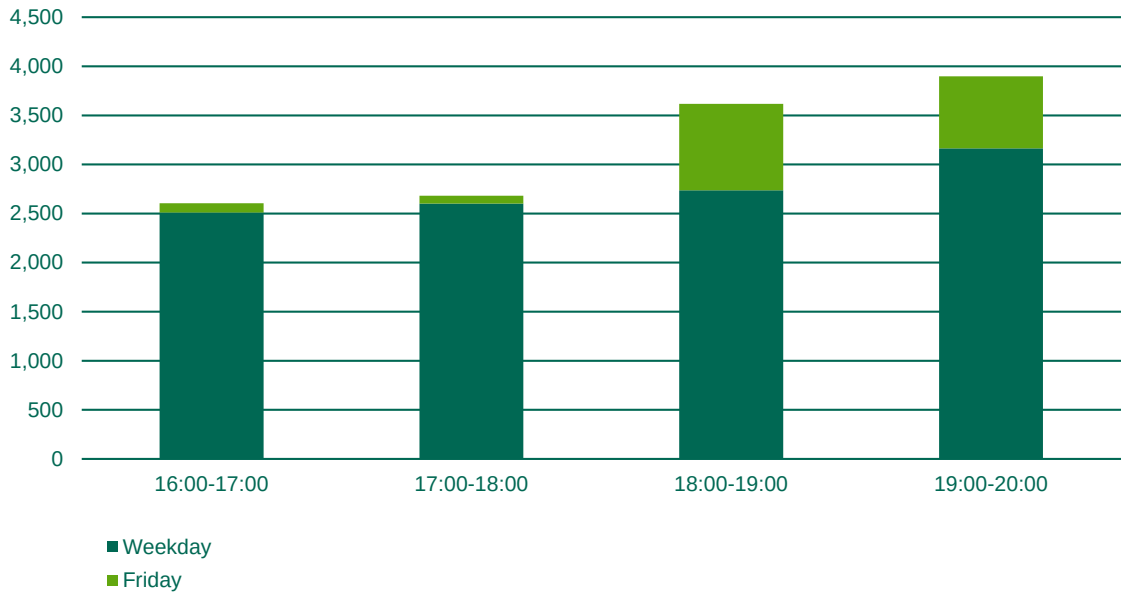


Figure 9 Comparison of passenger numbers departing London Euston on ICWC services[18]

2.20 As 19:00 to 19:59 is the busiest hour on Virgin West Coast services, analysis of the PM Peak on ICWC services has been extended to run from 16:00 to 19:59 throughout this report.

[18] Data source: DfT Autumn 2014 train counts

Commuter services

West Midlands commuter services

2.21 WM commuter services to/from London on the WCML have been operated by London Midland since 2007/08. Figure 10 illustrates the stations served by London Midland.

Figure 10 Summary of London Midland commuter routes at southern end of WCML

2.22 Inner suburban services use the WCML Slow Lines. Journeys are typically less than 40 miles from London with key stations served including Watford, Tring, Berkhamsted and Hemel Hempstead. Outer suburban services use a mix of the WCML Fast and Slow Lines. Journeys are typically more than 40 miles from London and key stations served are Leighton Buzzard, Milton Keynes, Northampton and Rugby.

2.23 Figure 11 sets out the average growth rates observed across the London and the South East (LSE) rail market during the 19 year period to 2014/15. It also shows the growth that has been experienced by the London Midland TOC since its first full year of operation in 2008/9 and compares this to wider LSE growth over the same seven year period. This chart shows that passenger journeys on London Midland have grown significantly over time, exceeding the pace of wider rail growth across the LSE area (leaving Transport for London's Overground operation aside).

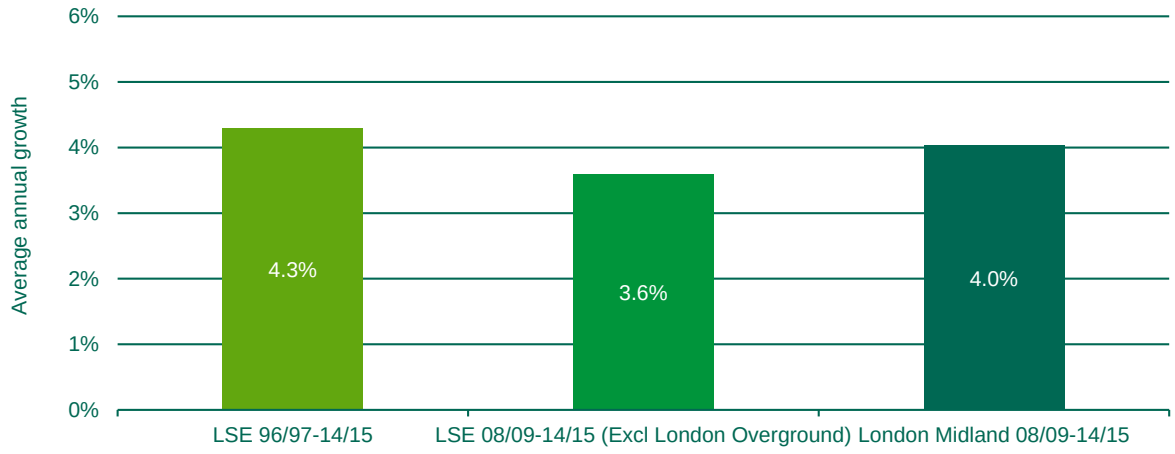


Figure 11 LSE and London Midland historic growth (average annual growth)[19]

2.24 Figure 12 analyses historic growth on six key London Midland flows in more detail. The dark green bars represent the number of passenger journeys on each flow in 1996/97, the lighter green represents the growth in journeys to 2013/14. On average, passenger demand on flows across the LSE sector has grown 102 per cent from 1996/97 to 2013/14. Growth on longer distance WM commuter flows such as Milton Keynes - London, Northampton - London, and Rugby - London has outperformed the LSE average over this period. Rugby, Milton Keynes and Northampton are some of the major stations served by those London Midland trains that operate on the Fast Lines.

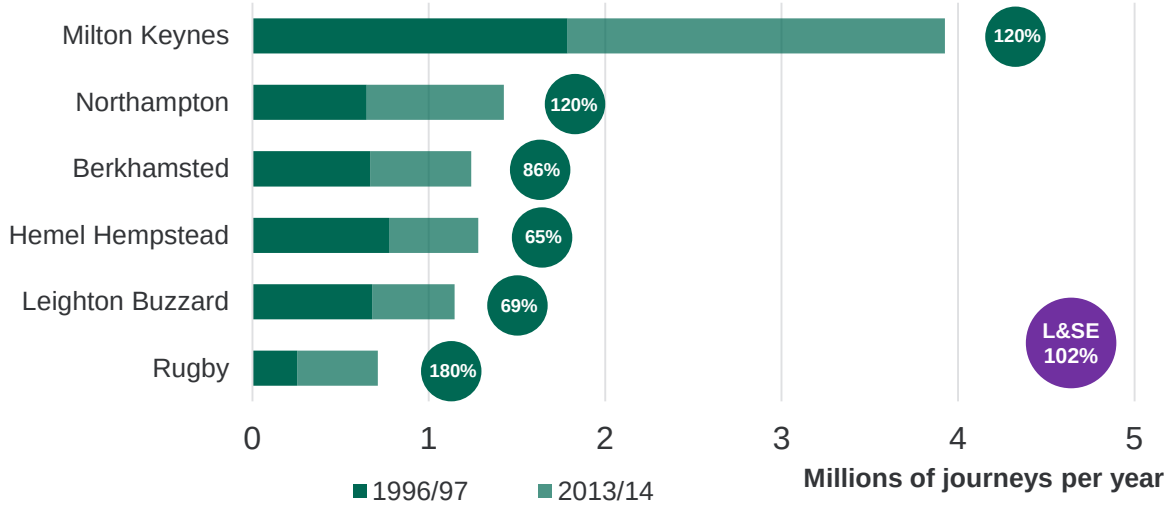


Figure 12 Growth on key London Midland flows to/from London (1996/97 to 2013/14)[20]

[19] Data source: ORR data portal. Note: London Overground has been excluded from the 2008/09-2014/15 figures as it has substantially increased its network coverage and incorporated former LUL services which would not be included in the base demand figures. Total LSE journey growth including London Overground is 5.2%

[20] Data source: DfT's RUDD (based on LENNON)

2.25 This growth is part of a wider trend of an increase in the average length of commuter journeys in the UK, and has increased the pressure for additional outer-suburban services on the WCML as shown in Figure 13. This trend reflects continued housing growth in the Milton Keynes/South Midlands area.

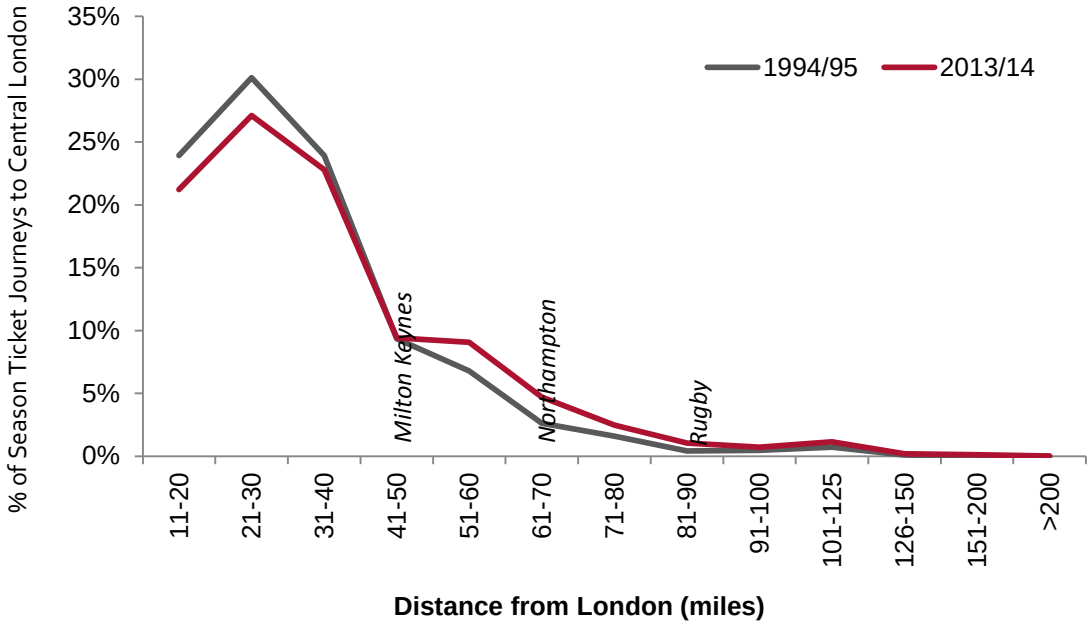


Figure 13 Distribution of season ticket journeys to Central London (outside of London Travelcard area)[21]

2.26 It should be noted that this trend is likely to continue in the WCML corridor. Milton Keynes/South Midlands is the largest planned area for additional housing provision in the South East. The Strategic Economic Plan for the South East Midlands LEP, which includes Milton Keynes and Northampton, sets out plans to deliver 86,700 new homes by 2020/21 in order to accommodate an increase in population of 151,400.

[21] Data source: DfT analysis of LENNON data

Birmingham services on the WCML

2.27 Four train companies operate a mix of fast and slow passenger services along the two-track section of the WCML into Birmingham New Street: Virgin West Coast; London Midland; Arriva Cross Country; and Arriva Train Wales. Freight services also operate on the same track. Figure 14 illustrates the service pattern that operates into Birmingham New Street station in the morning peak hour (08:00 – 09:00).

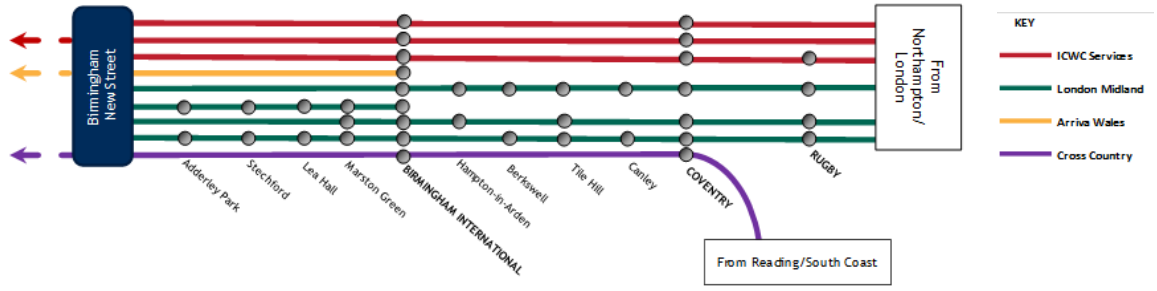


Figure 14: December 2014 AM Peak hour (08:00 – 09:00) WCML timetable into Birmingham New Street[22]

2.28 Overall peak usage of Birmingham city centre stations is growing. Figure 15 below shows that between 2010 and 2014 peak arrivals and departures increased by 15-16 per cent, or 3.6 per cent per year on average. This is comparable to the growth rate in London commuter traffic (excluding London Overground) over the same period (see Figure 11).

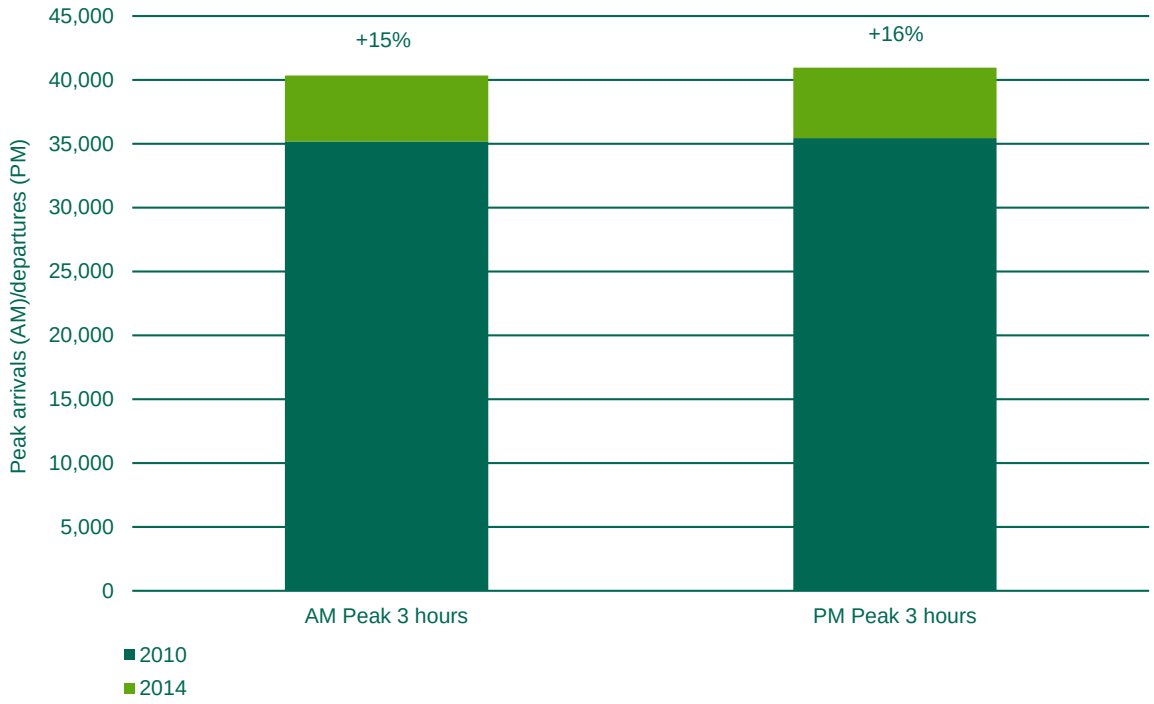


Figure 15: AM Peak arrivals and PM Peak departures from Birmingham stations (New St, Moor St, Snow Hill) 2010-14[23]

[22] Data source: DfT analysis
[23] Data source: " Rail passenger numbers and crowding on weekdays" (RAI02) (DfT) Table - RAI0212

Manchester services on the WCML

2.29 As with Birmingham, a mixture of fast and slow passenger services, plus freight, share the same WCML track into Manchester Piccadilly.

2.30 Four Northern Rail trains per hour provide the peak commuter services into Manchester Piccadilly: two operate from Crewe (one via Manchester Airport); one operates from Alderley Edge; and the other from Stoke-on-Trent. In addition to these, the following regional and inter-city services operate, and during peak hours also carry commuters into Manchester:

- Virgin West Coast - 3tph from London to Manchester
- Arriva Trains Wales - 1tph from South Wales to Manchester
- Arriva Cross Country - 2tph from Birmingham to Manchester

2.31 In addition, a number of other services join and make use of the route at Stockport – from Buxton, Sheffield, Hazel Grove and Chester.

2.32 Recently peak usage of Manchester city centre stations has grown at a faster rate than has been experienced in either London or Birmingham. Figure 16 below shows that over the period 2010-2014, arrivals and departures have increased by 27 per cent on average across the two peak periods, equivalent to 6.2 per cent per year.

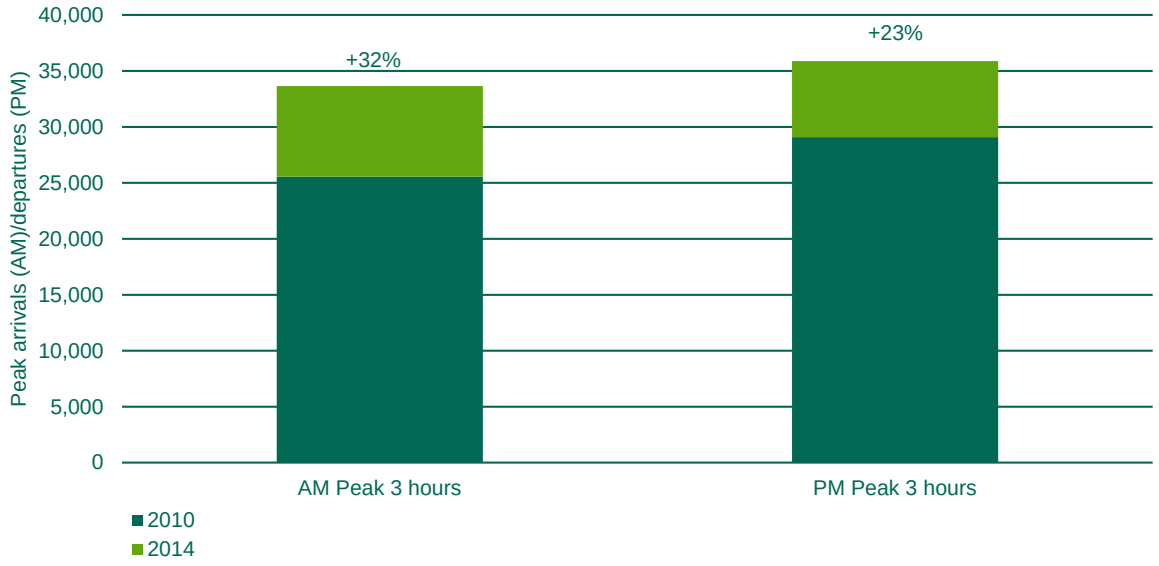


Figure 16: AM Peak arrivals and PM Peak departures from Manchester stations (Piccadilly, Oxford Rd, Victoria) 2010-14[24]

[24] Data source: "Rail passenger numbers and crowding on weekdays" (RAI02) (DfT) Table - RAI0212

Freight services

2.33 The WCML is more than a passenger railway – it is the vital artery of Britain's rail freight industry. As with the passenger railway, there has been significant growth in the demand for rail freight with volumes rising by 70 per cent since privatisation in the mid-1990s.

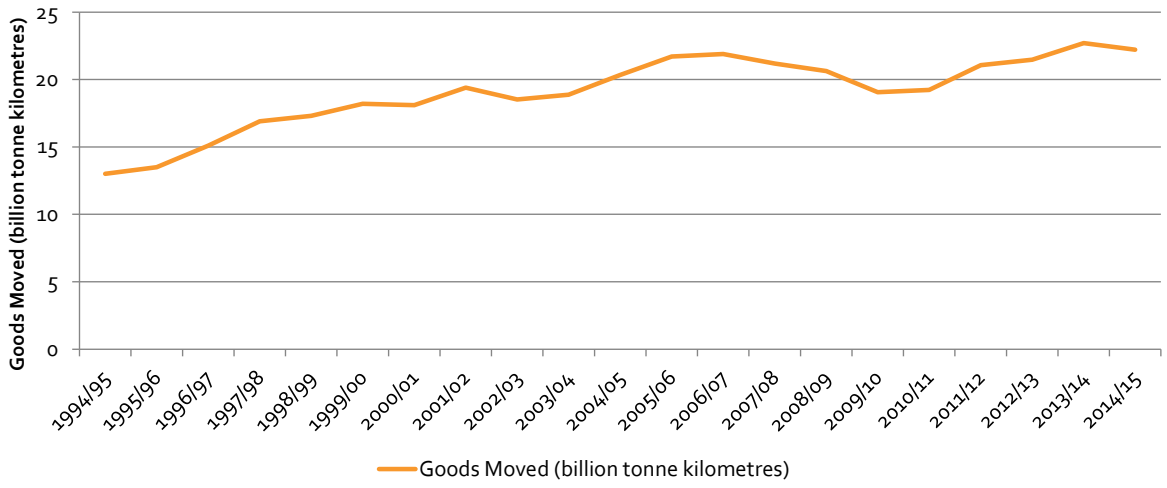


Figure 17: Freight market growth (Source: Freight Market Study, Network Rail, 2013)

2.34 The WCML has played an important role in supporting this growth in rail freight. Indeed over 40 per cent of freight trains use the WCML at some point in their journey[25]. Chapter 6 describes the different freight markets that currently operate on the WCML.

The WCML upgrade

2.35 The growth in passenger numbers and freight traffic outlined above has only been made possible by a decade long programme of upgrade works. The £9 billion WCML renewal and modernisation programme comprised £2.5 billion of investment in infrastructure upgrades and £6.5 billion of investment in infrastructure renewals.

Infrastructure upgrades

2.36 Infrastructure upgrades carried out under the modernisation programme can be summarised as follows.

2.37 Speed enhancements:

- Route wide speed improvements: Fast Line speeds were increased to 125 mph (for trains with Tilt Authorisation Speed Supervision (TASS) equipment only) and Slow Line speeds increased to 100 mph
- The line speed between Preston – Carlisle – Glasgow was increased to 125 mph for trains with TASS equipment where possible

2.38 Junction and track improvements:

- A new track arrangement was put in place at the Euston station throat, increasing route capacity

[25] Network Rail 2003 Business Plan (www.networkrail.co.uk/3176_BusinessPlan2003MixedTrafficRoutes.pdf)

- The dive-under at Willesden was upgraded for passenger use (and used by Southern services to/from Milton Keynes)
- At Bourne End, Ledburn and Bletchley, new junction crossovers were installed to provide for an increased speed of transfer between Fast and Slow Lines (up to 60 mph)
- Rugby station and its approaches from the north was totally rebuilt
- The track layout at Birmingham International was re-modelled to provide for a better turnback facility
- At Tring a new central turnback loop was laid
- The Nuneaton-Rugeley route section was four-tracked
- A new track layout and segregation of key flows with a new flyover was delivered on the Nuneaton and Leicester line
- Between Colwich – Stoke-on Trent – Cheadle Hulme, speed enhancements were delivered and the track gauge increased for freight traffic
- There was greater segregation of tracks at Wigan
- A double-track junction was built at Euxton Junction, to the south of Preston, where the Manchester line diverges
- Between Crewe – Weaver Junction – Liverpool, higher line speeds were enabled with some new bi-directional signalling from Crewe to Ditton
- Between Colwich – Stafford – Crewe, the diversionary route from Crewe to Kidsgrove was electrified and speed and capacity improvements delivered at Colwich, Stafford and Norton Bridge

Station works

- All suburban stations between London Euston and Northampton had platform extensions allowing 12 car trains to call at these stations
- Birmingham New Street has a new bay platform
- Wolverhampton benefited from a new through platform
- Rugby station was comprehensively rebuilt

2.39 Other infrastructure improvements:

- Installation across the whole route of a Tilt Authorisation Speed Supervision (TASS) system which protects against overspeeding
- Extensive re-signalling of the southern section of the line, with use of axle-counter detection systems
- New lineside fencing was put in place and a number of level crossings removed
- Power supplies were strengthened across the whole route

Disruption caused

2.40 The WCML renewal and modernisation programme lasted a decade and when it was completed in 2008, it had involved one hundred million person-hours of work. Major works of this nature on live railways are inevitably disruptive to the travelling public. The WCML programme meant that for over five years, passengers endured route diversions and rail replacement bus services during weekend closures of sections of

line. Furthermore, a section of route via Stoke-on-Trent had to be closed entirely for over two months in 2003.

Transformation of the service pattern

2.41 The upgrade was the critical factor in allowing service levels to be increased with the number of peak hour trains increasing from nine in 1994 to 11 in 2008 and 15-16tph today. The culmination of the route upgrade on the WCML was the introduction by Virgin West Coast of the 'Very High Frequency' (VHF) timetable in December 2008. This introduced an hourly service from Chester and increased the train frequency from two tph to three tph between London and Manchester and London and Birmingham.

2.42 Across the day, this increase in capacity has translated into the increase in volume of services detailed in Figure 18.

Flow	2000	2014	Change
London <> Birmingham	37	48	+11
London <> Manchester	20	48	+28
London <> Liverpool	15	18	+3
London <> Scotland	17	18	+1
London <> Chester/North Wales	3	14	+11
London <> Milton Keynes	142	141	-1
London <> Northampton	52	54	+2

Figure 18 Summary of all day (weekday) changes to service frequency on WCML services from London[26]

2.43 The increase in inter-city capacity brought about by the upgrade has allowed Virgin West Coast to broadly keep pace with the growth in demand. Overall, passenger journeys carried by Virgin West Coast grew by 51 per cent from 22.9m in 2008/09 to 34.5m in 2014/15 – equivalent to 7.1 per cent growth per annum. Figure 19 shows that:

- The upgrade, together with lengthening of a number of the original 9-car Pendolino sets to 11-car, has allowed for an additional 3,900 seats on ICWC services into London Euston in the AM Peak
- The number of passengers arriving into London Euston has increased by around 2,600 per day
- Taken together, this has resulted in the average load factor (the number of passengers on the train divided by the number of seats) staying broadly constant- 72 per cent and 70 per cent
- However, 67 per cent of the seats delivered by the December 2008 timetable are already been filled. Today's demand is higher than the total number of seats than were being provided in both the AM and PM peaks prior to the upgrade

[26] Data sources: September 1999 timetable and December 2013 timetable

	AM Peak (07:00 – 09:59)	
	Autumn 2008	Autumn 2014
Standard Class seats into Euston	7,136	11,040
Standard Class passengers into Euston	5,154	7,762
Average load factor	72%	70%
New capacity already utilised	n/a	67%
2014 load factor with 2008 seats		109%[27]

Figure 19 Utilisation of WCML upgrade capacity[28]

2.44 At the same time that the additional inter-city capacity has been rapidly filled, growth in commuter demand has meant that in recent years, London Midland has consistently been one of the most crowded London commuter operations.

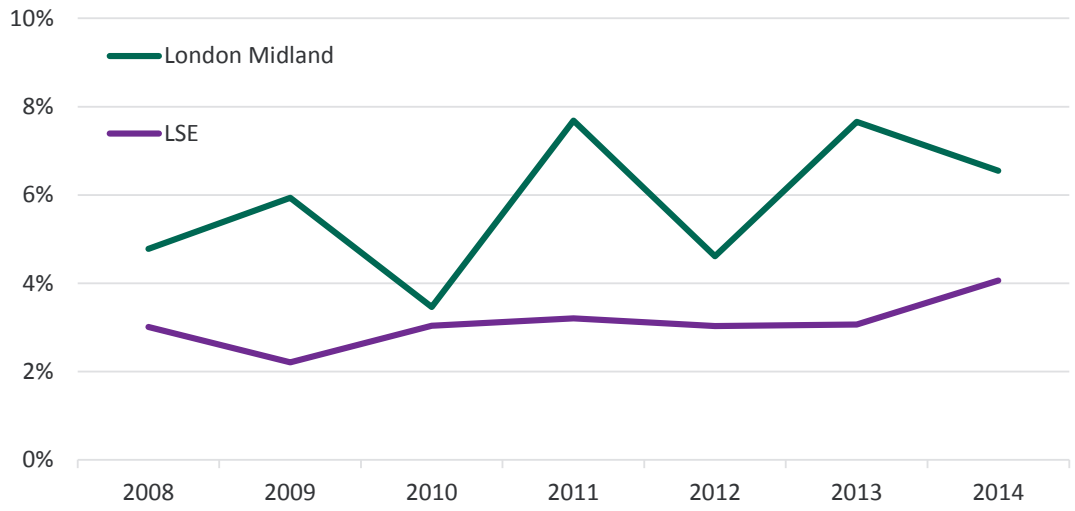


Figure 20 London Midland historic PIXC - AM and PM peak combined[29]

2.45 In Autumn 2014, London Midland had the second highest level of overcrowding of all London Commuter (LSE) TOCs at 6.5 per cent across the AM and PM peaks.

2.46 The WCML modernisation programme envisaged that following the upgrade, there would be a maximum of 13-14tph using the Fast Lines into and out of London Euston. However, in order to keep pace with passenger demand in December 2014, London Midland introduced another two peak hour services, resulting in up to 15-16tph operating during the peak.

2.47 The consequences of this are that the WCML is now operating at a higher level of intensity than many comparable fast main lines in other European countries. This is beginning to have notable consequences for performance and reliability.

[27] The PM Peak equivalent is 109%.
[28] Data source: Analysis of DfT train count data provided by Virgin West Coast.
[29] Data source: DfT Passengers in Excess of Capacity

3. The West Coast Today

The intensity of WCML operations

3.1 Following the introduction of the London Midland December 2014 timetable, 15 trains now operate on the WCML Fast Lines into Euston in most peak hours. Indeed, in one 60-minute period on weekdays between 08:02 and 09:01, 16 trains operate. This has been achieved by increasing the top speed of the London Midland commuter trains to 110 miles per hour (mph) and limiting the number of stops of these trains south of Rugby. There are also 16tph between 18:00-18:59 on Fridays.

3.2 This is more than the 13-14tph envisaged at the time of the WCML upgrade due to the pressure to run more outer-suburban commuter services along with today's inter-city timetable. This is a higher intensity of operation than major fast lines in other European countries, including purpose-built high speed lines as shown in Figure 21. This is despite the fact that the WCML has a more complex mix of long distance and commuter traffic.

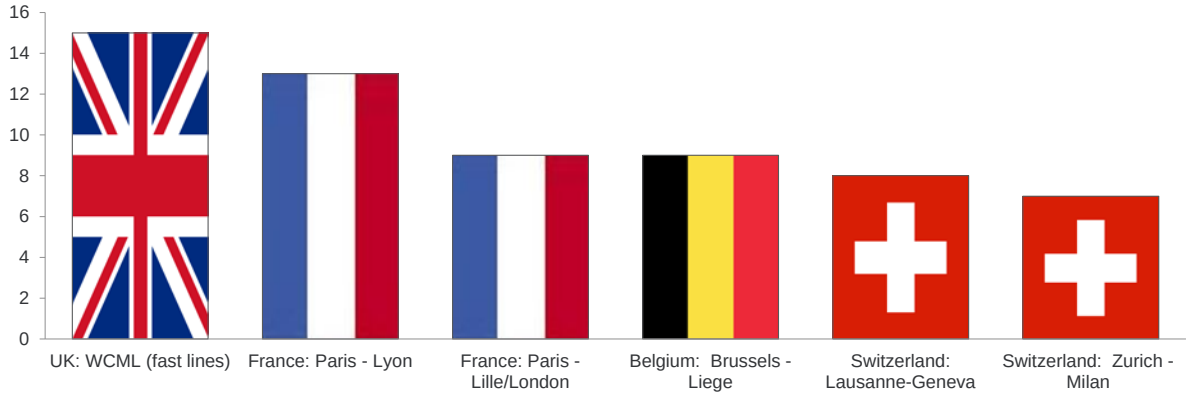


Figure 21 Comparison of intensity of operation between the WCML Fast Lines and selected major Fast Lines in other European countries [30]

3.3 It is challenging to run further services on the WCML due to a combination of:

- Physical constraints with the infrastructure. While the £9 billion modernisation and renewal programme addressed many of the constraints on the route, several still remain as set out in Chapter 4
- The complex mix of traffic that operates on this rail corridor

3.4 Figure 22 shows the key constraints that limit the services that can be operated on the WCML. It is notable that these constraints impact the traffic that can be operated all along the route. They impact upon commuter services into Birmingham and Manchester and the ability to run additional freight trains in the North and Midlands – not just upon the number of passenger services that can travel to Euston in the peak.

[30] Data source: Network Rail working timetable, www.bahn.de and the European Rail Timetable, summer 2014. Other lines on Britain's rail network operate at a higher level of intensity but they do not have services with the same top operating speed or mix of traffic.

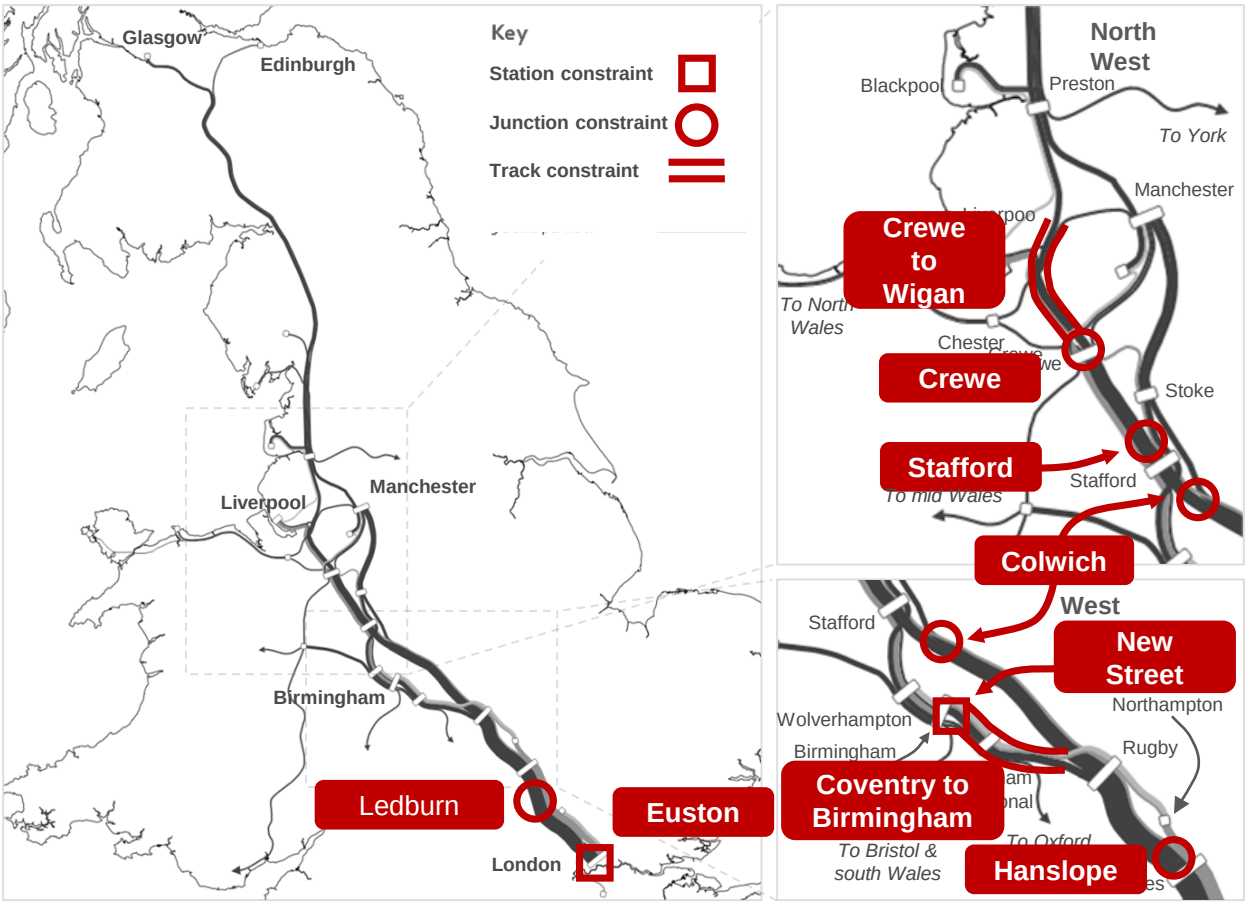


Figure 22 Location of key infrastructure constraints on the southern part of the WCML[31]

3.5 At a high level, from south to north, the main constraints that limit route capacity on the WCML are:

- **Euston** The track layout which connects the platforms at Euston to the approach tracks has been modernised. However, Network Rail has stated that the service limit of the station is 16tph given turn-round times and the pattern of services
- **Ledburn and Hanslope Junctions** These are flat junctions where outer suburban London Midland commuter trains cross over from the Fast Lines to the Slow Lines south of Leighton Buzzard and north of Milton Keynes respectively. Trains at these junctions need to be timed to match gaps in the flow of trains in the opposing direction. These junctions are also examples of where in-service timings of freight trains and fast inter-city services interact with each other on the southern part of the WCML - even though they are essentially using separate pairs of parallel tracks
- **Coventry-Birmingham** This two-track section of the route is shared by fast and slow passenger services and freight services. The slower speeds of stopping services mean that inter-city trains are delayed if they 'miss their slot'. In addition, at Coventry, north-south flows of freight trains to/from Southampton need to make conflicting moves across the WCML which runs from east to west through the station

[31] Data source: DfT analysis.

- **Birmingham New Street Station** The approaches to New Street station comprise four-tracks which are shared by a number of routes that come together for the final tunnelled approach to the city centre. Operating speeds are low and the need for certain services to access specific platforms further constrains operational capacity
- **Rugby – Nuneaton** This section of the route contains a three-track section where northbound freight and fast passenger trains share the same track. This constrains options to add further train paths in some instances
- **Colwich/Stafford Junctions** Here a mix of flat crossings and interactions between the Trent Valley section of the WCML and diverging routes to Wolverhampton and Stoke-on-Trent constrain capacity. A major scheme is under construction to resolve the constraints at Norton Bridge, one of the three junctions in the Stafford area. This will provide a flyover and reduce the number of pathing conflicts. However, the two-track section on the WCML through Shugborough tunnel and the flat crossing at the speed-limited Colwich Junction (see Figure 23) will continue to constrain capacity
- **Crewe – Wigan** This section of the route carries a heavy mix of inter-city, freight and stopping trains. At a number of locations such as Crewe and Warrington, regional services cross the route. In addition, local services join and leave the route at Winwick Junction and Spring Branch, Wigan, and freight traffic joins and leaves the route at locations including at Winsford, Hartford, Weaver, Acton Grange, and Winwick Junctions. Of these junctions, only Weaver is grade separated. As a result the capacity to add further services is constrained
- **Manchester Piccadilly** Fast and stopping trains both operate on the complex approach to Manchester Piccadilly station, limiting capacity and operational flexibility. The Northern Hub scheme, when fully implemented, will reduce some of the conflicts. In particular, re-routing Trans Pennine Express services between Yorkshire/the North East and Manchester Airport via Ordsall will ease some capacity constraints

3.6 These issues are outlined in more detail in Chapter 4, where the limitations they impose on expanding today's service levels to meet demand growth are also described.

3.7 Taken together, the constraints mean that on its busiest sections, the WCML is already operating at, or close to, capacity in the peak. This is best illustrated by the example of the Fast Lines between Rugby and London Euston.

3.8 Under Network Rail's Timetable Planning Rules, with existing signalling, the WCML Fast Lines currently could theoretically accommodate 20tph in the peak hours, although the approach to/from Euston and the station design itself effectively limit the practical capacity to 16tph with current turnaround times and service requirements. Figure 24 explains why in reality, the route capacity is effectively constrained at today's level of 15-16tph.

Figure 23 Colwich Junction[32]

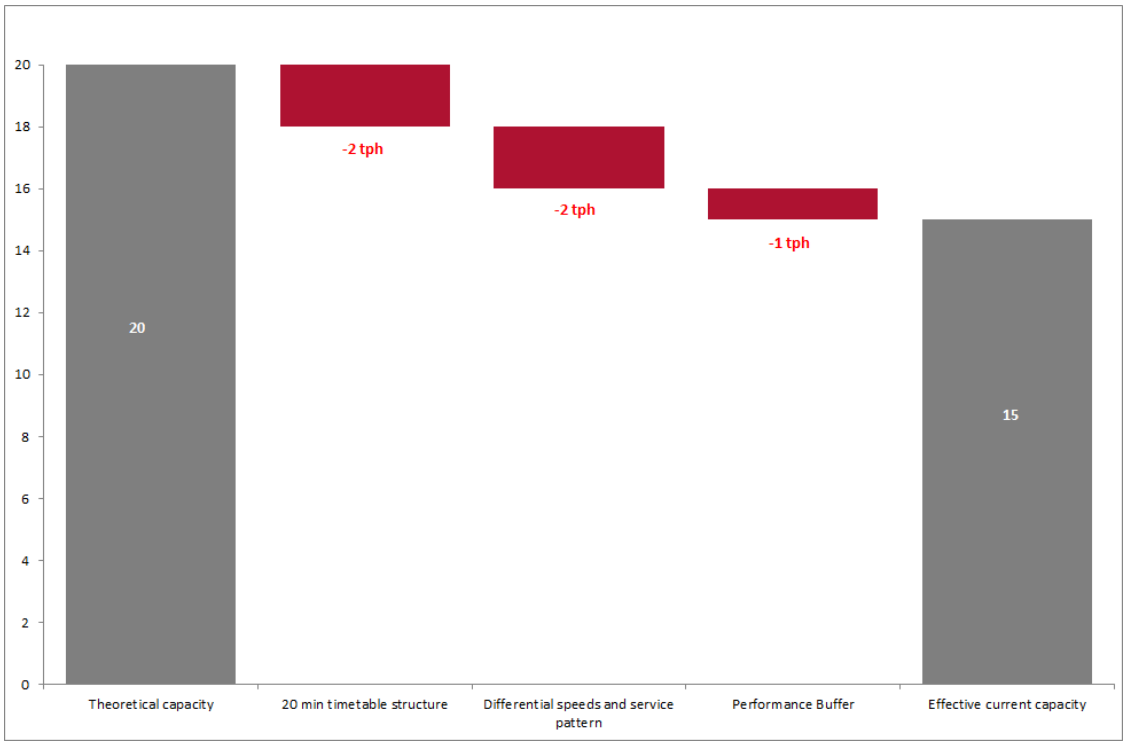


Figure 24 Reduction in theoretical capacity of the WCML[33]

[32] Source: Steer Davies Gleave
[33] Source: DfT analysis. Note: 16 arrivals are achieved between 08:02 and 09:01 which is enabled by reduced calls by fast line services south of Rugby. 16 departures from Euston are also achieved between 18:00 and 18:59 on Friday evenings.

20tph

3.9 The theoretical 20tph assumes operation of Class 390 Pendolino trains at the maximum line speed (125 mph), a minimum headway of three minutes between trains and no station calls south of Rugby.

18tph

3.10 The 20 minute timetable structure of Virgin West Coast's services between London and Birmingham and Manchester cost two paths, reducing the capacity to 18 tph. This structure, which brings significant passenger and revenue benefits, disaggregates the timetable into three 20 minute segments. Taken together with the need for a minimum headway of three minutes, this limits London Euston arrivals/departures to six per 20 minute period.

16tph

3.11 Timetable interactions with differential operating speeds and service patterns cost two further paths, reducing the capacity to 16tph. The impact of the complex service mix will vary for each hour of the timetable but in summary:

- Any 100/110mph London Midland service that crosses from the Fast to the Slow Lines south of Milton Keynes costs a path. An additional 'Up' path can be lost if the timetable is not constructed and operated in such a way as to leave a corresponding gap on the 'Up' Fast Line to facilitate a crossing movement
- Each stop at Milton Keynes or Rugby generally costs one Fast Line path. This can be mitigated if slower commuter paths are flighted together with a 100/110mph service weaving to the Slow Lines south of Milton Keynes as the inter-city train to Birmingham or Manchester is stopped at the station. The consequence being that if these slow trains miss this slot, fast trains behind can get held up and one still needs a gap southbound.
- Stopping a train at Watford Junction also costs one path, as there are no passing places.

15tph

3.12 Performance buffers in the timetable allow for recovery from perturbations – these typically cost one path per hour. At the height of the peak (for example Friday evenings) performance buffers have been relaxed.

Impact of running the WCML at today's intensity on performance

3.13 There are four factors to take into account when optimising train planning: journey time, service level (trains per hour), performance and access for maintenance (see Figure 25). Seeking to stretch one of these factors can compromise another.

3.14 The December 2008 VHF timetable, which followed the WCML upgrade, stretched two of these dimensions. Journey times were reduced at the same time as service levels (trains per hour) were materially increased. Access for a revised infrastructure maintenance programme was protected.

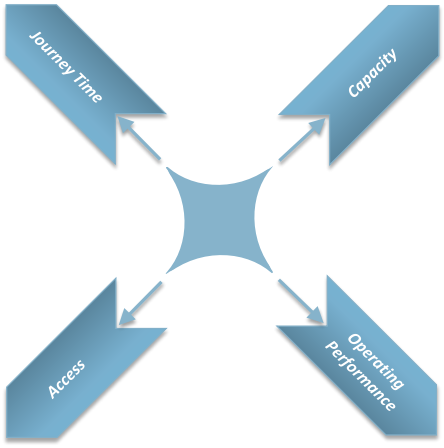


Figure 25 Journey time, capacity, performance, access diamond

3.15 The implications that this has had for the fourth factor, performance, are shown in Figure 26, which sets out on-time performance for the key WCML operators, Virgin West Coast and London Midland over the past five years. Passenger Performance Measure (PPM) is the measure used for on-time punctuality – the number of trains that arrive at the final destination 'on time' – defined as within 10 minutes of scheduled arrival time for inter-city services and within 5 minutes for commuter services.

3.16 Since the upgrade, Virgin West Coast's performance (measured as PPM) has plateaued – averaging 85.0 per cent over the four year period up Quarter 1 2015/16. Over the same period, average PPM for the long distance sector as a whole has been 87.6 per cent. On its London services, London Midland has substantially under-performed against LSE commuter sector comparators, with average PPM over the four year period up to Quarter 1 2015/16 of 84.4 per cent, compared to 90.1 per cent for the London and South East sector.

3.17 Performance targets for both operators have been revised down considerably for Control Period 5 (CP5) relative to CP4 in the face of the difficulties experienced in delivering higher performance levels.

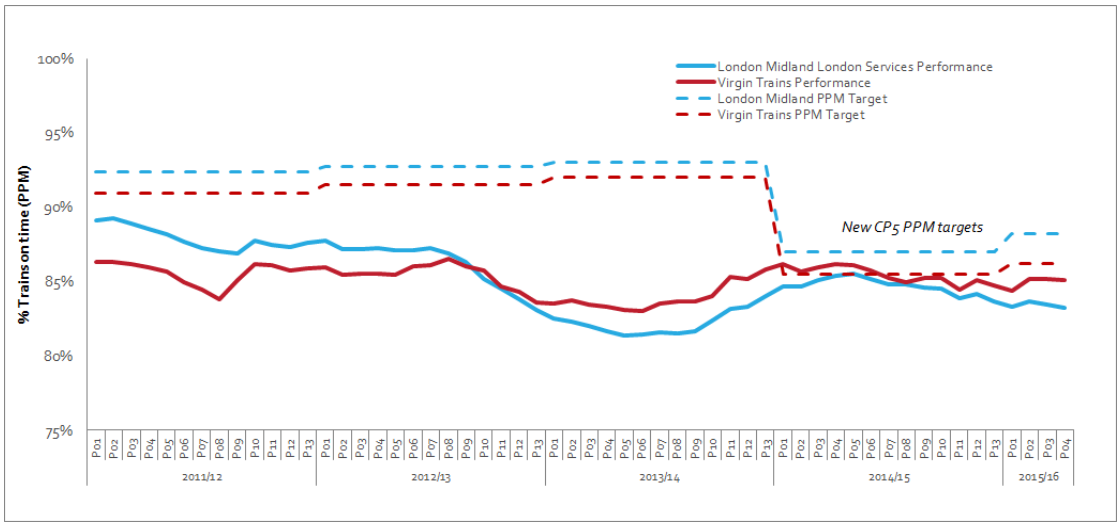


Figure 26 Performance (PPM Moving Annual Average) of Virgin and London Midland (London only services) TOCs[34]

[34] Data source: ORR

3.18 Whilst route congestion is only a partial cause of below-par PPM figures, Figure 27 suggests that it is a key contributing factor. This graph illustrates how primary and reactionary delays of long distance operators have changed over time. Primary delay is that delay directly caused to a train due to an incident on the route. Secondary delay or 'reactionary delay' is delay to a train as a result of an incident elsewhere on the route or to another train. The chart shows that the amount of reactionary delay that follows an incident on long distance operators has been increasing over the past seven years, even though the initial primary delay per train is falling. This suggests that, even though the industry has got better at responding to individual delay incidents, the knock-on impact of any given incident is likely to be greater than it was in the past, due to the higher volumes of traffic operating.

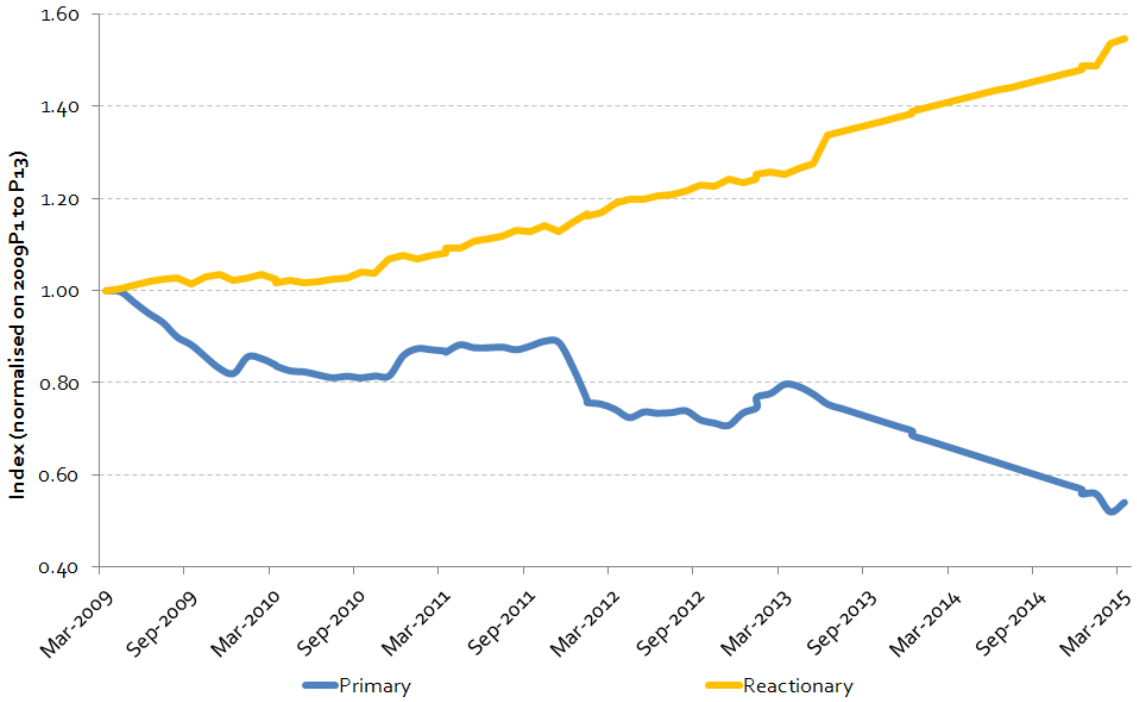


Figure 27 Changes in primary and secondary delay across long distance operators 2008/09 to 2014/15[35]

3.19 Poor performance affects a significant number of passengers on the WCML. As stated earlier, Virgin West Coast services are used by around 35 million passengers each year. Based on the last four years performance figures (PPM of 85.0 per cent), every year, approximately 5.0 million passengers are materially delayed on these services. This is some 2 million more than would be delayed under the CP4 PPM targets agreed with ORR.

Performance issues have deterred the ORR from allowing new services on the route

3.20 A number of TOCs have made applications to the ORR in recent years requesting access rights to run additional services on the WCML. Some of these applications were rejected on the basis that there was no industry business case for them – that is

[35] Data source: Network Rail TRUST data summary (up to April 2013) and Network Rail Delay Incident File (March 2014 to March 2015) – linear interpolation between the intermediate periods)

the forecast revenue on the services was deemed to be primarily abstractive (meaning it would simply be revenue transferred from other existing services).

3.21 Four applications met ORR's requirements in terms of an industry business case, but were turned down due to the potential impact that they would have on performance by adding to the level of congestion on WCML.

Applications from Alliance Rail, Grand Central Railway and London Midland turned down in March 2011

3.22 "*The performance risk of, effectively, filling the Fast Lines from the start of the morning peak until after the end of the evening peak is considered to be too great, as the service would never recover from any perturbation*" ORR, March 2011 (Note, these are three separate applications, but the ORR gave one joint response).

Application from Virgin West Coast for direct services from London to Blackpool and Shrewsbury turned down in July 2013

3.23 "*Performance on the WCML has been poor for several years and shows no signs of significant or sustained improvement. Our assessment is that even the … proposed additional services … are likely to cause a further material deterioration… We have therefore concluded that we should not approve the rights for the services requested*" ORR, July 2013.

3.24 Two further applications have been successful. However, the circumstances in which the additional services have been permitted, lend weight to the argument that it is difficult to operate additional trains on the WCML in the peak.

3.25 The first of these applications was for two further peak hour London Midland trains on the Fast Lines, increasing the peak hour frequency to five per hour. These additional services were introduced by London Midland in December 2014. ORR granted access because the additional services were timetabled by operating rolling stock at 110mph and 'flighting' two 110mph trains in a path previously occupied by one 100mph service. This timetabling solution only works because the number of London Midland stops on trains south of Rugby was reduced.

3.26 The second, and most recent (August 2015) award has been ORR granting to Alliance Rail the right to operate six daily (five on a Sunday) off-peak return services between Blackpool and Queens Park station in London from December 2017 for a period of 10 years. Whilst this award identifies that there is some limited capacity on the WCML in off-peak periods when the service pattern falls to 12tph, no additional services will operate in the peak period. Indeed, Alliance Rail did not apply for peak services in recognition of existing constraints.

Implications for future growth

3.27 Clearly the capacity constraints and performance issues highlighted above will have major implications should the growth in passenger and freight demand seen over the past 20 years, and outlined in Chapter 2 of this report, continue.

3.28 In this regard, it should be noted that DfT anticipates that there will continue to be growth over the long term in road and rail traffic. Indeed, 30 per cent and 40 per cent growth respectively is reflected in the DfT's National Policy Statement for National Networks.[36] The main drivers of the growth are rising population levels, economic growth and incomes. It is also worth noting that passenger rail volumes are expected to continue to grow at a rate faster than road traffic.

[36] https://www.gov.uk/government/publications/national-policy-statement-for-national-networks

3.29 Further, the forecasts underpinning the Phase 2a Economic Case are for around 60 per cent journey growth between 2013/14 and 2036/37 for long distance rail operators.

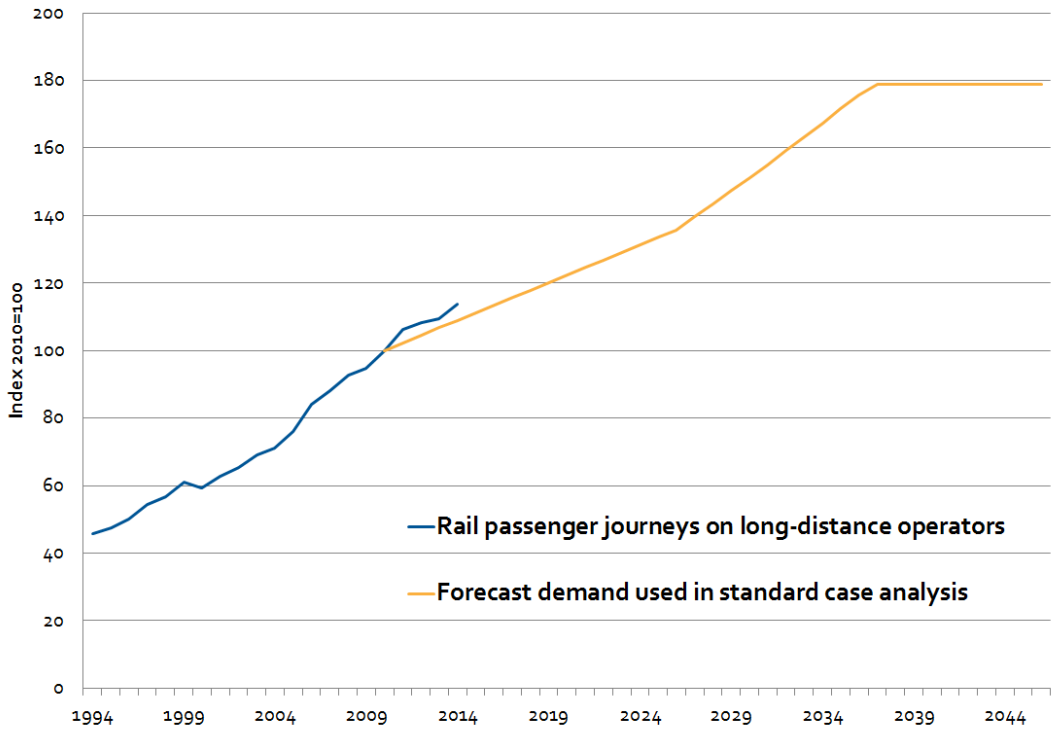


Figure 28 Rail passenger journey on long distance rail operators: forecasts vs actuals[37]

3.30 Equally, Figure 29 presents Network Rail's view of the forecast change in rail freight demand over the next 30 years. Network Rail anticipates that rail freight volumes will grow by over 40 per cent compared with 2011 levels by 2023 and by around 90 per cent by 2033. Notably for the WCML, the intermodal segment is expected to continue to grow the fastest. Much of this is traffic to/from ports, which will continue to grow as trade expands. The forecast also reflects rail's competitive advantage relative to road (fuel and drivers' wages are a lower proportion of costs for rail, than for road), and the growth of rail connected warehousing sites.

3.31 In total, Network Rail estimates that this growth in volumes will translate into an increase in demand for rail freight paths on the WCML from 42 per day today to 80 by 2033.

[37] Data source: HS2 Phase 2a Economic Case, November 2015 https://www.gov.uk/government/collections/hs2-phase-two-from-the-west-midlands-to-leeds-and-manchester

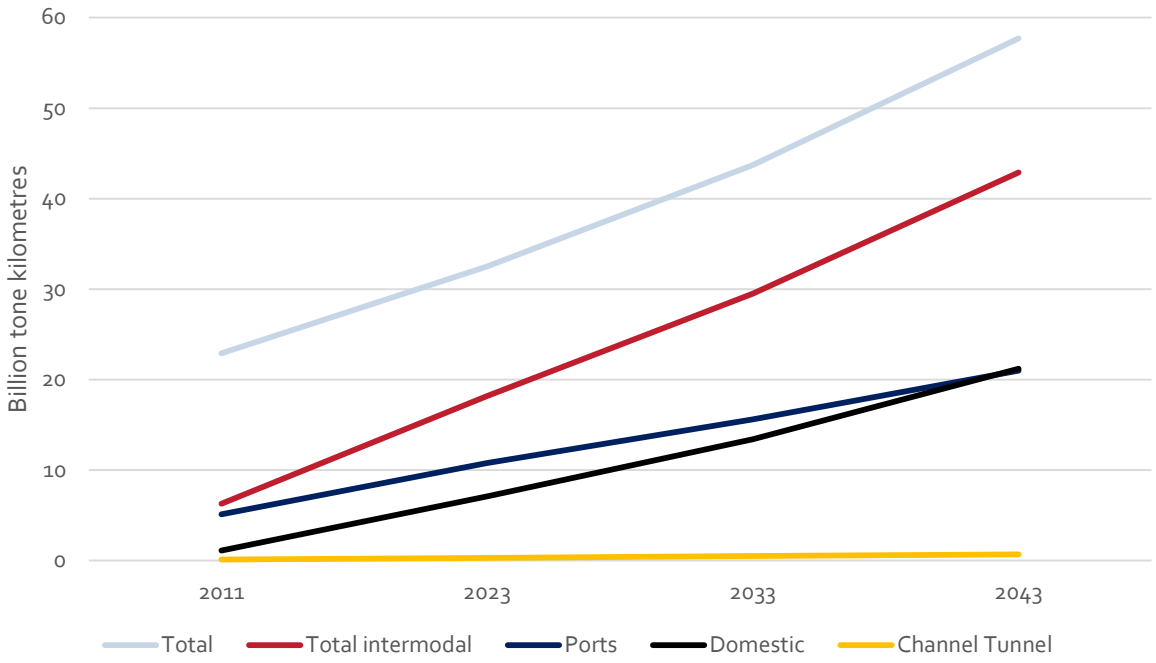


Figure 29 Forecast growth in rail freight demand[38]

3.32 Clearly, given the extent of the capacity constraints along the WCML rail corridor discussed above, it will be challenging to accommodate the expected increase in passenger and freight demand. In the short term, DfT is working with the industry, particularly via the upcoming franchise competitions for West Midlands and ICWC to seek innovative ideas to increase peak capacity. Whilst these competitions may allow some marginal capacity gains to be made through changing timetables, these gains would probably involve further compromises on the number of intermediate towns and cities served by long-distance and outer suburban services in order to ensure that punctuality and reliability are not adversely affected.

3.33 A long term solution will require further investment in the WCML infrastructure. The options for this are considered below. The potential of each of these options to accommodate future demand for route and train capacity on the WCML is then discussed in detail in chapters 4, 5 and 6.

HS2 and the Strategic Alternative

3.34 The October 2013 Strategic Case discussed the potential of both HS2 and the Strategic Alternative to provide additional capacity on the WCML corridor. These options are outlined at a high level below.

The Strategic Alternative

3.35 The report "HS2 Strategic Alternatives, Final Report" (DfT, October 2013)[39] sets out the work that was undertaken on alternative options for meeting the capacity and connectivity objectives set by Government when developing its plans for HS2. The work was undertaken by DfT and Network Rail and supported by consultants Atkins. It should be noted that whilst five packages of alternatives are described in the HS2 Strategic Alternatives report, this document focuses only on those that directly impact the WCML. This document also only considers the capacity benefits provided by the

[38] Data source: Long Term Planning Process: Freight Market Study, Network Rail, October 2013
[39] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/253456/hs2-strategic-alternatives.pdf

Strategic Alternative (and HS2) – it does not consider wider Government objectives such as improving connectivity.

Package P1

3.36 Package P1 is the Strategic Alternative to HS2 Phase One – the London to Birmingham route.

3.37 In terms of **route capacity**, P1 includes a package of infrastructure enhancements that would bring a number of benefits including increasing WCML Fast Line capacity so that 16tph into/from London Euston can be delivered consistently throughout the peak rather than in exceptional single hours. These have been costed at £2.5 billion and include the grade separation of junctions at Colwich and between Cheddington and Leighton Buzzard, four-tracking between Attleborough and Brinklow and further power supply upgrades and line speed improvements. This is comparable in scale to the enhancements element of the £9 billion WCML modernisation and route upgrade completed in the decade to 2008.

3.38 To allow a frequency of 2tph to both Liverpool and Glasgow, one of the 16tph would be operated as a double 6-car Class 390 Pendolino. It would run as a 12-car train as far as Warrington and then split with one 6-car set continuing to Liverpool and the other continuing to Glasgow.

3.39 In terms of **train capacity**, P1 Package assumes that:

- On the inter-city services, all Class 390 Pendolinos are extended to 11-car operation. Within the trains, one First Class car is converted to Standard Class giving an increase in capacity of 30 seats. Under this configuration, all 11-car Pendolinos would operate with eight Standard Class cars and three First Class cars
- On the commuter services, it is assumed that all Fast Line and Slow Line services to/from London Euston are extended to 12-car operation all-day

3.40 Packages YA and YB are the Strategic Alternative to HS2 Phase Two. With respect to the WCML, the deliverables for these Packages are as those for Package P1, with the added provision that the 2tph service between Wolverhampton and London Euston is extended to/from Manchester to improve capacity, connectivity and journey times between Birmingham and Manchester. This would require further WCML infrastructure upgrades such as passing loops between Congleton and Macclesfield, and an extra platform at Manchester Piccadilly.

3.41 Since the Strategic Alternative was developed, many of the measures to increase capacity which don't require major infrastructure investment have already been introduced on the WCML in order to accommodate recent growth in demand. These include:

- Extending Pendolinos to 11-cars and converting some First Class to Standard capacity. Of the 27 morning peak period (07:00-09:59) ICWC services in the December 2014 timetable, seventeen are 11-car Pendolinos and three are 10-car Voyagers, with seven 9-car Pendolinos operating services with lower levels of demand, mainly in the shoulders of the peak. This compares to an all 9-car Pendolino fleet in December 2011
- Between 08:00 and 09:00 arriving at London Euston, London Midland is operating an increased level of service on the WCML Fast Lines (five trains per hour, up from three). This has been achieved by enabling two 110mph services to run close together ('flighting'), occupying one 100mph path that was previously used.

A programme of modifications to the rolling stock was made to allow this to happen. One of the new services is achieved through re-timetabling a service from Crewe that arrived at Euston at 08:11 having stopped at Milton Keynes and Leighton Buzzard so that it arrives at 08:05 and runs non-stop from Northampton. A new service has then been introduced from Northampton that arrives at Euston 08:11 and includes stops at Milton Keynes and Leighton Buzzard that were previously on the train from Crewe

- Increasing the number of 12-car commuter trains on London Midland. Six of the busiest of 13 London Midland services between 08:00 and 09:00 and six of the busiest 12 London Midland services between 17:30 and 18:30 are now operated as 12-car trains

HS2

3.42 The two phases of HS2 each bring benefits to the WCML corridor: Phase One planned to open in 2026, and Phase Two is planned to open in 2033.

3.43 Phase One of HS2 will see a new high speed line constructed from London Euston to north of Birmingham, where it will reconnect with the existing WCML allowing fast services to serve Manchester, Liverpool, Crewe, Preston and Glasgow. New high speed trains will serve both Birmingham city centre as well as an interchange station which will serve both Birmingham Airport and the wider West Midlands. At Old Oak Common in west London, a new interchange will be built connecting HS2 with Crossrail and the Great Western Main Line.

3.44 Phase Two will see the line extended north and east, to join up with the WCML north of Warrington. An Eastern leg is also proposed which joins with the East Coast Main Line approaching York. On the WCML corridor there will be a new station in the city centre of Manchester.

3.45 HS2 will deliver a step change in capacity on the WCML corridor. The high speed line itself will be capable of carrying 18tph in each direction, although under the current scheme assumptions, this full capability will only be used once Phase Two is operational. In addition, operating inter-city services on dedicated high speed lines will release train paths on the existing network for commuter and freight services.

3.46 It is anticipated that the combined number of trains per hour in Phase One will be 33 with 10 on HS2 and 23 on the conventional network (split as 13 on the Fast Lines and 10 on the Slow Lines). The potential reduction from 15-16tph to 13tph on the Fast Lines could bring performance benefits by providing greater resilience.

3.47 Clearly increasing Fast Line route capacity in terms of paths/hour by over 50 per cent from 15-16tph to 23tph whilst providing an additional 2tph on the Slow Lines is a much more comprehensive and long term solution to the issues of WCML route capacity than that provided by the Strategic Alternative.

3.48 The next three chapters in this report set out the latest analysis and evidence as to why it is right to make this transformational investment in rail capacity on the WCML corridor. In summary:

- **Chapter 4** considers the issue of route capacity in greater depth. It explains the services that run on each route section of the WCML today, the pressures to run additional trains, and the comparative ability of HS2 and the Strategic Alternative to allow extra services to be run and new markets to be served
- **Chapter 5** considers passenger train capacity. Given the demand growth that is anticipated, it sets out the limitations of tactical measures such as train

lengthening to contain overcrowding, should additional services not be able to operate. It then looks at the potential of the extra route capacity provided by both the Strategic Alternative and HS2 to accommodate future passenger levels over the long term

- **Chapter 6** specifically looks at the freight market and the benefits that each of the Phases of HS2 will provide in accommodating demand for further WCML freight paths

4. Route Capacity – Passenger Operations

- The route (or line) capacity on the WCML is constrained at several points along the corridor. These constraints impact all of the markets that operate on the route – inter-city, regional, commuter/local passenger services as well as freight
- Closer to London, the constraint is essentially the number of trains in each route section, together with the terminus at Euston. Further away, the constraints are more often to do with conflicts at junctions arising from the number of services approaching from different routes that feed into the WCML
- Between Crewe and Scotland, the constraints are largely as a result of mixing slow and fast trains on a two-track railway with the result that fast trains catch up with slow trains
- In some areas, the existing service pattern had to be modified, with some services cut back in order to accommodate the 2008 VHF (Very High Frequency) inter-city timetable
- Going forward, developing new rail markets such as adding direct London services from a wider range of cities in the North West when people most want to travel - in peak periods - is similarly challenging
- Future timetable changes that provide additional capacity for some markets are likely to involve trade-offs that mean cutting capacity or connectivity in others. They may also have adverse punctuality impacts and/or require the extension of existing journey times
- The Strategic Alternative (to HS2) would not provide sufficient capacity to accommodate a material expansion of today's service pattern beyond the level of 16tph across the peak
- Building HS2 provides a step-change in route capacity on the WCML corridor increasing the number of fast paths across HS2 and the current route combined from 15-16tph to 23-25tph

4.1 This chapter looks at the main problems of route capacity on the WCML today, section by section. It illustrates the practical limits of further adapting the existing timetable and infrastructure in order to run more services. For each route section, this chapter sets out:

- The WCML services that run today
- The capacity issues that limit the number of services that can operate
- The pressures that are likely to give rise to a demand to run additional services on that part of the WCML in the future

4.2 The route sections considered are:

- London Euston to Rugby
- Rugby to Birmingham New Street
- Rugby to Stafford
- Stafford to Crewe
- Crewe to Weaver Junction
- Weaver Junction to Preston
- Weaver Junction to Liverpool
- Crewe to Manchester Piccadilly
- Colwich Junction/Norton Bridge to Manchester Piccadilly

4.3 It is also important not to overlook the approach to Euston itself where trains to and from London are fed into one of 18 different platforms through a complex series of junctions.

4.4 These route sections are highlighted in Figure 30 below.

4.5 Each section of the route has different individual capacity constraints. However, because any additional trains that are provided would need to have operating paths across several of these route sections in order to provide a timetable that works, a process that is joined-up between these routes sections is ultimately needed.

4.6 Having outlined the issues, this chapter considers three options to relieve route capacity pressures on the WCML corridor:

- The Strategic Alternative
- ETCS (the European Train Control System)
- HS2

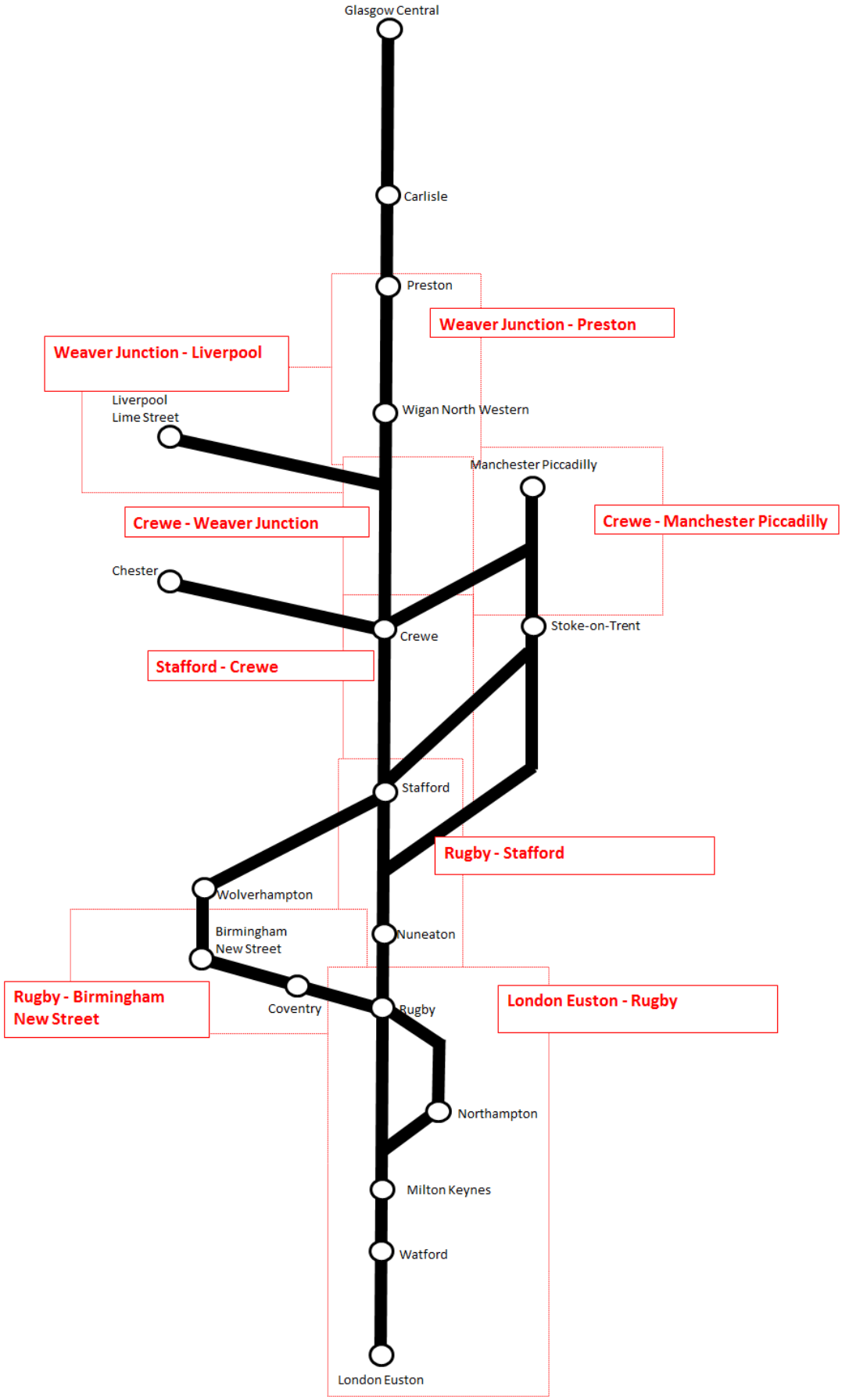


Figure 30 Overview of the West Coast Mainline (WCML)

Principles of route capacity

4.7 Before looking at the route section by section, it is helpful to consider what limits the capacity of a railway network (the number of trains operating on the network each hour) in practical terms. The capacity of a route is determined by the following factors:

- The number of tracks, and the minimum headway (the time permitted between trains) that trains can be operated at
- The mix of traffic operating on a line – there is a greater throughput of traffic when trains operate at a uniform speed (and with similar acceleration/deceleration characteristics) and less capacity available when these characteristics vary
- The stopping patterns of passenger services – there is a greater throughput of trains when services have a uniform stopping pattern (as is the case on commuter services and urban light rail/metro systems such as London Underground). Services with different stopping patterns reduce available capacity
- The configuration of junctions – 'flat', or nongrade-separated, junctions reduce capacity because trains joining or leaving the route have to cross another track on which trains operate in the opposite direction. To an extent this is unavoidable at large terminal stations
- The configuration of stations (such as the number of platforms and platform length) and the approaches to stations
- How the trains are operated (for example, the turn-around times required at terminus stations before the train is ready to make another journey)
- Rules applied by NR in order to operate the railway safely
- Choices about access rights, as ultimately determined by ORR

4.8 The range of factors involved means that assessment of capacity is a complex activity which can only be partially automated through the industry's timetable planning systems.

London to Rugby

Today's service pattern

4.9 The WCML is a four-track railway between London and Rugby; two of the tracks are capable of carrying services at up to 125mph (the Fast Lines) and the other two-tracks have line speeds between 75 and 100mph (the Slow Lines).

4.10 Figure 31 sets out today's service pattern on the WCML south of Rugby based on the December 2014 timetable. In peak periods up to 15tph operate on the Fast Lines, split typically between Virgin West Coast inter-city services at 10-11tph (12tph between 18:00 and 18:59 on Friday evenings) and outer suburban commuter services run by London Midland at 4-5tph. On the Slow Lines, London Midland operates up to 8tph with Southern operating a further 1tph (3tph in one hour between 06:45 and 07:45) from Milton Keynes or Watford Junction to East Croydon.

Time period	Fast Lines (Virgin West Coast)	Fast Lines (London Midland)	Slow Lines (London Midland)	Slow Lines (Southern)
AM peak (Arrivals at London Euston)				
07:00 – 07:59	8	2	5	1
08:00 – 08:59	10	5	8	1
09:00 – 09:59	9	4	4	1
Off peak (standard hour)	9	3	4	1
PM peak (Departures from London Euston)				
16:00 – 16:59	11	3	4	1
17:00 – 17:59	11	4	7	1
18:00 – 18:59	10	4	7	1

Figure 31 Summary of standard weekday passenger services on the WCML December 2014 Timetable[40]

4.11 In the off-peak, 12tph operate on the Fast Lines – 9 inter-city services and 3 outer suburban services. On the Slow Lines, London Midland operates 4tph and Southern operates 1tph. Freight services also run in the off peak on the Slow Lines (up to 4 paths per hour) – with priority given to passenger services in the peak. The time taken to travel between multiple major conurbations makes it difficult to avoid some freight services encroaching into peak periods that end at 10:00 and re-start at 16:00.

Route capacity issues

The mix of traffic on the line

4.12 The Fast Lines carry a mix of 125mph inter-city trains and 110mph outer suburban trains. The minimum headway is three minutes if all the services were operating at 125mph. However, additional headway is required in the timetable to prevent the inter-city services catching up with the commuter services, which typically take 2 to 3 minutes longer between London and Milton Keynes.

4.13 On the Slow Lines, the significant commuter market means that freight services can generally only be operated in the off-peak. A notable constraint here is that there is nowhere for trains to pass each other between Wembley and Northampton.

The stopping patterns of passenger services

4.14 In order to provide northwards connectivity and faster capacity to/from London, three inter-city services per hour stop at Milton Keynes. During the peaks some of these stops are designed only for passengers travelling north of Milton Keynes, and these specific services are not available to London commuters. This is also the case with the one inter-city train per hour that calls at Watford Junction throughout the day; this service consumes one additional fast line path by making this call.

4.15 Outer area London commuter trains serving the section between Leighton Buzzard/Milton Keynes and Northampton use the Slow Lines for the northern part of their route and Fast Lines for the southern. These trains ‘weave’ between the two pairs of parallel tracks at various designated points. The places where ‘weaves’ currently are timetabled are shown in Figure 32.

[40] Data source: December 2014 National Rail timetable, Network Rail

Crossing location	Rugby	Hanslope Junction	Milton Keynes Station	Ledburn Junction	Bourne End Junction
Distance from London	*82 miles*	*56 miles*	*50 miles*	*37 miles*	*25 miles*
AM peak (Arrivals at London Euston)					
07:00 – 07:59				2	
08:00 – 08:59		2		2	1
09:00 – 09:59	1			2	1
Off peak (standard hour)	1			2	
PM peak (Departures from London Euston)					
16:00 – 16:59	1			2	
17:00 – 17:59	1		1	2	
18:00 – 18:59		1	1	2	

Figure 32 Summary of London Midland Outer Suburban Service Crossing Locations[41]

4.16 On the Slow Lines, some capacity is lost in the peak due to the uneven stopping pattern of the London Midland commuter services. For example, between 08:00 and 09:00 only two of the eight London Midland trains in that period make the same stops. The ideal, from purely a capacity perspective, would be for all of the trains to have the same stopping patterns, but some services would have lengthier journey times as a result.

Pressure to run additional services

4.17 There is clear pressure to get more from the London to Rugby section of the WCML. Going forwards, this pressure to run additional services comes from six sources:

- To provide additional West Midlands (WM) franchise peak services/commuter capacity to reduce standing from outer-suburban stations. A number of trains are already at 12-car length and more are planned
- More peak inter-city services, particularly from the West Midlands where loadings are highest (noting that extending the remaining third of the Pendolino fleet that has not yet been extended out to 11-cars would potentially address some of this challenge)
- The new East-West rail link that will reopen an existing route from Bicester to Bletchley in order to support housing development in Buckinghamshire. This would allow direct trains from Oxford to Milton Keynes and also possibly permit an additional cross country train from the south coast to Manchester. At present, finding paths for these trains on the WCML between Bletchley and Milton Keynes is not straightforward
- Serving new markets by giving more towns and cities direct services to London. Network Rail's "Long Distance Market Study" (October 2013) considered options

[41] Data source: "December 2014 to May 2015 National Rail working timetable" (Network Rail)

for services between a number of regional centres across the West Midlands/North of England and London

- To re-instate station calls by inter-city trains at the key intermediate stations of Watford Junction and Milton Keynes which have had to be reduced since 2008
- Accommodating additional freight traffic on the Slow Lines, in particular to address the growth in intermodal traffic from ports in the south east and also potentially Liverpool

4.18 However, given that the WCML is operating at, or very close to, capacity in this route section, satisfying these pressures in one market is only likely to come at the expense of compromising another market. This is illustrated by two examples below.

Convert inter-city paths to commuter paths

4.19 Journey times from London Euston to the key outer suburban stations of Leighton Buzzard, Milton Keynes, Northampton and Rugby are currently typically 33, 45, 60 and 76 minutes respectively - journey times for which commuters expect to have a seat rather than be required to stand. However, as Chapter 5 illustrates, this is likely to prove challenging in the future as crowding pressures grow. To relieve West Midlands franchise overcrowding, a theoretical option is that the number of inter-city trains might be reduced by, say, 2tph and the paths released used for commuter trains instead. As an example, in the current timetable this might be done through:

- Withdrawal of the Birmingham International to London train arriving at 08:50 and the Manchester Piccadilly train to London Euston arriving 08:45, on the basis that these have the lowest Standard Class loadings in the AM peak
- Similarly, in the PM Peak and on the same basis, withdrawal of the 17:33 Liverpool service and 17:57 Lancaster trains

4.20 The effect of this, as demand increases, would clearly be to increase loadings and the numbers of passengers standing on the remaining peak inter-city trains. Given that passengers on these services are typically making journeys of an hour or more, standing for this duration would be considered unacceptable and is not something that could be readily contemplated. Figure 33 shows the impact if such services were removed, on the level of seats provided to and from a number of stations on the WCML corridor in the peak.

Station	Reduction in ICWC service	Reduction in Standard Class seats	% reduction in Standard Class seats
Coventry	3 tph to 2 tph	446	40
Manchester Piccadilly	4 tph to 3 tph	446	30
Stockport	4 tph to 3 tph	446	30
Macclesfield	2 tph to 1 tph	446	60
Stoke-on-Trent	2 tph to 1 tph	446	60
Rugby	2 tph to 1 tph	446	60

Figure 33 Reduction in ICWC service levels/Standard Class seats in the morning peak between 08:00 and 09:00[42]

[42] Data source: December 2014 timetable

Station	Reduction in ICWC service	Reduction in Standard Class seats	% reduction in Standard Class seats
Rugby	2 tph to 1 tph	446	60
Tamworth	1 tph to 0 tph	446	100
Lichfield	1 tph to 0 tph	446	100
Stafford	2 tph to 1 tph	446	60
Crewe	4 tph to 3 tph	446	27
Liverpool	2 tph to 1 tph	446	60
Warrington	2 tph to 1 tph	446	60
Wigan	2 tph to 1 tph	446	60
Preston	2 tph to 1 tph	446	60
Lancaster	2 tph to 1 tph	446	60

Figure 34 Reduction in ICWC service levels/Standard Class seats in the evening peak between 17:30 and 18:30

4.21 As a result of this reduction in ICWC services, Tamworth and Lichfield passengers would lose their one regular peak weekday inter-city service from London that departs after 17:00, with the next fast service departing at 19:40, forcing them to travel on the slower WM service. This would increase journey times by up to 26 minutes - a 42 per cent and 38 per cent increase for Tamworth and Lichfield passengers respectively.

Slowing the WCML Fast Lines to 110mph

4.22 Reducing the maximum speed to match the speed of the slowest rolling stock (110mph) and giving a uniform speed on the WCML Fast Lines would in theory allow all trains to operate at 3 minute headways. Assuming no other changes, the capacity of the Fast Lines might theoretically be raised by 2tph to 17tph. This additional capacity in theory might allow one additional WM train to be run between 08:00 and 09:00, increasing the frequency from 5tph to 6tph. In the evening peak, an extra 2 trains might be accommodated increasing the number of evening peak services from 4 to 6tph between 17:30 and 18:30. The increase in the number of trains would require the procurement of additional Class 350 110mph rolling stock (or equivalent).

4.23 Slowing down the inter-city timetable to 110mph would add approximately six minutes to all inter-city trains over the 82 miles between London Euston and Rugby based on the speed differential between 110mph and 125mph. It is also possible that further journey time increases would be required to accommodate the additional weaves required at Ledburn Junction. The additional journey time would affect around 70,000 passengers per day, which would conflict with wider Government objectives of improving connectivity to the North and the Midlands.

4.24 In any event, Network Rail has advised that no more than 16tph can readily be operated on the Fast Lines into Euston because of the constraints of the approach tracks and platforms with the current mix of services and terminal turn-round times. Encroaching into turn-round times is likely to adversely impact punctuality.

Destination	Journey time – December 2014	Potential journey time
Birmingham	1 hour 24 minutes	1 hour 30 minutes
Manchester	2 hours 8 minutes	2 hours 14 minutes
Liverpool	2 hours 14 minutes	2 hours 20 minutes

Figure 35 Impact of slowing down the inter-city timetable

Serving new long distance markets into London

4.25 Constraints on the WCML mean that it is very challenging to provide additional direct trains to more places. Although some towns and cities (such as Shrewsbury, Blackpool and Wrexham) have a limited direct service to London Euston, other places have not.

4.26 In 2013, Network Rail's "Long Distance Market Study" highlighted the following places from which there may be sufficient demand to provide new/enhanced services. It should be noted that in each case, the business case for new services would need to be established:

With a limited service currently

- Shrewsbury
- Telford
- Blackpool.

Not directly connected at all

- Walsall
- Sutton Coldfield
- Blackburn
- Bolton
- Burnley
- Rochdale
- Barrow-in-Furness

4.27 Recent experience on the East Coast Main Line is that opening up markets by providing new direct services to London has resulted in strong growth in passenger journeys – indeed faster than that from stations that are already served. Examples of this are the new services introduced between London and Hull and London and Sunderland.

Rugby to Birmingham New Street

Today's service pattern

4.28 The WCML route between Rugby and Birmingham New Street is a two-track railway with operating speeds of up to 125mph. It carries nine passenger trains (shared across four TOCs) and 1 freight train per off peak hour:

- Virgin West Coast - 3tph from London to Birmingham New Street (with about a third continuing on to Wolverhampton, Shrewsbury and Scotland)
- London Midland - 2tph stopping services from London to Birmingham New Street, 1tph from Northampton to Birmingham New St and 1tph from Birmingham International to Birmingham New Street stopping at all stations
- Arriva Trains Wales - 1tph from Birmingham International to North Wales, non-stop between Birmingham International and Birmingham New Street
- Arriva Cross Country - 1tph from Bournemouth to Manchester via Birmingham New Street, stopping at Coventry, Birmingham International and Birmingham New Street
- Freight: 1tph between Coventry and Stechford (which is the junction for the cross-Birmingham freight line)

4.29 In the PM peak period between 17:00 and 18:00, an additional London Midland service is operated between Birmingham and Coventry, but this is only made possible by not operating a freight train from Stechford to Coventry in that hour. Although signalling on the route would permit 15tph, the number of junctions and the congested approach to Birmingham New Street significantly constrain the timetable.

Route capacity issues

4.30 The capacity challenges on this section arise from the need to combine fast and slow trains together on just two tracks. The biggest constraints on route capacity are:

- The diverse mix of traffic of different speeds that operates on the route. For example, a stopping train between Coventry and Birmingham International takes six minutes longer than an inter-city train
- The fact that trains are joining from a range of other routes on mostly flat junctions
- Coventry station, which has flat junctions at each end of the station and is also on the main freight route from the port at Southampton to Nuneaton, Crewe and the North West, a key artery for intermodal traffic. Inter-city, local and freight services must be planned with great care through these junctions
- The final approach to Birmingham New Street. Trains approach Birmingham from five different routes (London, Nuneaton, Derby, Lichfield and Leamington) and so need to be 'melded' together to accommodate any out of course running. In addition, it is worth noting that the approach to New Street runs under the Bullring Shopping Centre, the foundations of which prevent widening of the approaches. In part for this reason, the current redevelopment of New Street only provides capacity on the concourse level and for passengers to/from platforms - platform capacity has not been increased by this project
- The problem of knitting together the West Midlands area and Cross Country timetables, both of which are based around 15/30 minute cycles, with that on the WCML, which is based on 20 minute cycles. This means that some gaps need to be left in the service to allow effective "meshing" of the two to take place.

Pressures to run additional services

4.31 The current timetable was put in place at the time of West Coast Route Modernisation with some difficulty. Local services were significantly altered in order to fit in the frequent fast services of the VHF timetable. The result was that stopping trains between Coventry and Birmingham had to be split into two services, one from Coventry to Birmingham New Street (but missing out the smaller stations from Birmingham International) and the other from Birmingham International to Birmingham New Street, forcing passengers making some local journeys to change trains. In addition, none of these trains can continue through to the other side of Birmingham, meaning that passengers must change trains at New Street to reach destinations towards Wolverhampton.

4.32 In addition, the Cross Country service on the route had to be (marginally) slowed down to fit it in. There is pressure to increase Cross Country frequencies from Birmingham International/Coventry and to add a second cross country train via Coventry, providing a 30 minute frequency to Oxford and Reading as well as providing a direct service to the East Midlands/North East.

Rugby to Stafford

Today's service pattern

4.33 The 51 miles between Rugby and Stafford is predominately a four-track railway, but there are significant two and three-track sections, notably the seven mile three-track section between Rugby and Nuneaton and the two-track section just south of Stafford at Shugborough Tunnel. The fast tracks operate at 125mph and the slow tracks at between 60mph and 125mph, with planning headways of three minutes on all lines.

4.34 A mixture of service types and train types operate, again covering long distance and regional passenger markets and freight markets, although capacity pressures have meant that stopping passenger trains to London, mostly provided by London Midland, are rarely more than hourly (even to major locations such as Lichfield and Tamworth). These stations currently only have two fast trains to/from London in the peak, and none in the off peak period.

4.35 Four radial lines from the West Midlands area connect with the WCML Trent Valley stations at Nuneaton, Tamworth, Lichfield Trent Valley and Rugeley Trent Valley, although the development of any integrated timetable pattern for connections has been severely limited by the low number of WCML services that can call at these stations. Thus, access to the WCML from most Midland communities to the north and east of Birmingham is much easier via New Street, even though it is longer than the direct, Trent Valley route.

4.36 The existing off peak passenger service pattern is 7tph, rising to 9tph in the peak:

- London to Liverpool – 1tph off-peak; 2tph in the PM peak
- London to Manchester – 3tph off-peak and peaks
- London to North Wales – 1tph off-peak and peaks
- London to Scotland – 1tph off-peak and peaks
- London to Crewe – 1tph (calling at all local stations)
- London to Preston/Lancaster/Glasgow – 1tph in the PM peak; and
- Freight: Up to 3tph

Route capacity issues

4.37 Constraints are:

- **Brinklow – Attleborough Junction**: this seven mile section has only three tracks southbound there is a Fast and a Slow Line, but northbound there is just one. This introduces a significant constraint because of the speed differential of trains on the route 60-75mph for freight services and 125mph for inter-city passenger services
- **Colwich Junction**: this critical non grade-separated junction, five miles south of Stafford is where the two northbound inter-city trains for Stoke-on-Trent and Manchester each hour leave the route and cross in front of all of the southbound passenger and freight trains from Scotland, Liverpool and Crewe
- **The two-track section between Colwich Junction and the approach to Stafford about four miles away (including the 700m Shugborough Tunnel)**: here inter-city and freight services share the same tracks in both directions, again with a significant speed differential
- **Whitehouse Junction, immediately North of Shugborough tunnel**: this is a flat junction where southbound freight services to London must cross northbound passenger services, meaning lengthy track/crossing occupation times
- **Stafford station**: there are flat crossings north and south of the station where the line from Manchester to Wolverhampton and Birmingham crosses the WCML. This means that trains from Manchester and Stoke-on-Trent going to Birmingham have to cross over in front of fast inter-city trains from London, although this is being substantially relieved by the Norton Bridge project (see 4.43 below)

Pressures to run additional services

4.38 There are three main pressures:

- Better services along the Trent Valley providing regular services to London from Stafford, Rugeley, Lichfield, Tamworth and Nuneaton, with ‘inter-city’ timings
- Increased inter-city services from the North West to London
- Good quality day-time freight paths that allow freight trains to enter the route section at Rugby or Nuneaton and run to their exit from the WCML without having to stop (since there are no places where freight trains can be held off-line in a loop to permit faster passenger services to ‘overtake’)

Stafford to Crewe

Today’s service pattern

4.39 Stafford to Crewe is a highly utilised section of the WCML which links together lines from London and Birmingham and carries services for the routes to North Wales, Manchester, Liverpool and Scotland. The junction at Stafford is one of Britain’s network wide focal points: Northbound passenger trains from origins as diverse as London, Southampton, Bristol, Plymouth and the West Midlands converge here and then go on to serve Manchester, Liverpool, Holyhead, Glasgow and Edinburgh. The freight service pattern is also complex.

4.40 In terms of passenger services, in the off peak 10tph operate from Stafford to the North of England and Scotland, increasing up to 12tph in peak periods. In addition, 47 freight paths are available each day in either direction:

- London to Liverpool – 1tph off-peak; 2tph in the PM peak
- London to Manchester – 1tph in the off-peak and peaks
- London to North Wales – 1tph in the off-peak and peaks
- London to Scotland – 1tph off-peak and peaks
- London to Crewe (calling at all local stations)
- London to Preston/Lancaster – 1tph in the PM peak
- 1tph Birmingham to Scotland operated by Virgin West Coast
- 2tph Birmingham to Manchester operated by Arriva Cross Country (operates between Stafford and Norton Bridge, the junction for Stoke-on-Trent)
- 2 semi fast trains per hour Birmingham to Liverpool operated by London Midland

Route capacity issues

4.41 This section is mainly a four-track railway with, as previously described, a pair of Fast Lines on the east and Slow Lines on the west of the alignment. The Fast Line has a maximum of 125mph with the Slow Lines operating up to 100mph following the soon to be completed line speed upgrade between Norton Bridge and Crewe. Even with four tracks and the rebuilt Norton Junction, the service mix and remaining flat junctions along the route will still restrict route capacity. The key issues are:

- The need for weaves and crossing moves means that the number of trains is restricted to 13tph on both the Fast Lines and the Slow Lines
- Crewe Station – Crewe is a major passenger and freight hub. Lines from Manchester, Scotland, Stoke-on-Trent, Chester, and Shrewsbury converge at Crewe and there are flat junctions north and south of the station. The crossing movements at these junctions and the limited number of platforms available for through trains at Crewe restrict capacity for passenger and freight services. The station itself and associated track layout was partially upgraded in the 1960s and 1980s but is now in need of modernisation

4.42 Network Rail is currently completing the Stafford area improvement project as part of Control Period 5 (CP5). The work is being delivered in phases and includes:

- Phase 1: Line speed improvements between Crewe and Norton Bridge (already completed) which have increased the maximum speed on the Slow Lines used by freight and local passenger trains from 75 to 100mph. Further line speed increases between Stafford and Great Bridgeford (just south of Norton Bridge) are also part of the project, and are scheduled to take place after the resignalling work around Stafford is completed
- Phase 2 (already completed) which has created a new 775 metre freight loop in the station area and replaced life expired signalling, telecoms and power supplies
- Phase 3 involves the construction of a grade-separated junction at Norton Bridge, removing much of the conflict between services on the WCML and those to/from Stoke-on-Trent via Stone. Completion is expected in the winter of 2016

4.43 By reducing the junction conflict, the Stafford area improvement project will deliver local capacity gains and improvements in network punctuality.

Pressures to run additional services

- Faster inter-city trains between Birmingham and Manchester the current services make many station calls and take 1 hour 26 minutes to cover this 85 mile journey
- A better local stopping service as a supplement to the Cross Country service between Birmingham, Stafford and Stoke-on-Trent, allowing more frequent stops at small stations (at present these are hourly at best)

Crewe to Weaver Junction

Today's service pattern

4.44 This section is largely a two-track railway that is highly utilised by a mixture of long distance services from Liverpool and Scotland to London, stopping passenger services to Liverpool and a significant volume of freight, some for Liverpool and the rest for Scotland. The speed differential of the different services presents the main operational challenge.

4.45 The service pattern on this section of the WCML in the off-peak is 5tph passenger and up to 3tph freight. In the PM peak the number of passenger services rises to 7tph.

- 1tph London to Liverpool operated by Virgin West Coast
- 1tph London to Scotland operated by Virgin West Coast
- 1tph Birmingham to Scotland by Virgin West Coast
- 2tph to Birmingham to Liverpool operated by London Midland. One service operates non-stop between Crewe and Runcorn, the other makes stops at some or all of the three local stations
- Additional PM peak services from London operated by Virgin West Coast: 1tph to Liverpool and 1tph to Preston/Lancaster/Glasgow
- Freight: 1-3tph (up to 37 freight movements per day in each direction between Crewe and Preston)

Route capacity issues

4.46 Route capacity is mainly constrained by the two-track section between Winsford and Weaver Junction, where a mix of service and train types share the same track. Trains that stop at the local stations are six minutes slower through this route section than the Virgin West Coast inter-city train, while freight services are up to five minutes slower than inter-city services. Therefore each stopping service or freight train consumes more train paths than inter-city services, reducing overall capacity.

4.47 The interaction between fast passenger and freight trains is particularly important here as all freight both to Liverpool and Scotland is routed through this section. Therefore, as freight flows grow, there will be challenges for timetabling and potentially the need to seek to radically alter today's freight routing strategy in the North West.

4.48 At the north end of Crewe station, the line splits into three and there are flat crossings for passenger services. Some freight is routed via dedicated tracks that pass under the junctions and connect the freight yards south of the station to the line to Manchester and towards Weaver Junction. These tracks have no platforms, so cannot be used for passenger services that stop at Crewe.

Pressures to run additional services

- Since local stations are served only by the Liverpool – Birmingham trains, direct connections from Winsford, Hartford and Acton Bridge to Warrington and places further north are precluded
- Other longer distance inter-regional or inter-city services
- Increased freight services

Weaver Junction to Preston

Today's service pattern

4.49 This section once again carries a complex mix of services, including inter-city, commuter services to Liverpool and Manchester, regional services to the Lake District and Blackpool and freight services. It has a mixture of two and four-track sections with a number of flat junctions.

4.50 Below is a summary of the services levels between Weaver Junction and Preston.

Inter-city services:

- 1tph London to Scotland; off peak and peak - operated by Virgin West Coast
- 1tph Birmingham to Scotland off peak and peak - operated by Virgin West Coast
- Additional PM peak services: 1tph to Preston/Lancaster/Glasgow - operated by Virgin West Coast

Regional services:

- Transpennine Express services from Manchester Airport via Manchester Piccadilly to:
  - Scotland - 1tph (these have recently been converted to electric operation)
  - Blackpool North - 1tph
  - Barrow-in-Furness - 9 trains per day
  - Windermere - 2 trains per day
  - Preston - 1 train per day
  - Lancaster - 1 train per day
- Northern Rail services:
  - Manchester Victoria to Blackpool North - 1tph
  - Liverpool to Blackpool North - 1tph (currently operating to/from Preston as an Electric Multiple Unit (EMU))
  - Hazel Grove to Preston - 1tph (currently operating to/from Blackpool North)
  - Wigan to Liverpool - 2tph, 4tph in peak hours
  - Warrington Bank Quay to Liverpool Lime Street - 1tph
  - Ormskirk to Preston - 1tph
  - Colne to Blackpool South - 1tph
  - York to Blackpool North - 1tph
  - Ellesmere Port to Warrington Bank Quay - 2 trains per day

- Arriva Trains Wales
  - Manchester Piccadilly to Llandudno/Holyhead/Chester - 1tph
- Freight: up to 37 paths per day

Route capacity issues

4.51 The biggest constraints on route capacity on this section are:

- The diverse mix of fast inter-city services, stopping passenger services and freight of variable speeds creates a significant challenge to fit the inter-city timetable with that of various local and regional services
- Conflicts with a number of regional services that cross the WCML or run along it for short distances. All of these services which come on and off the WCML at un-modernised, speed-constrained flat junctions (Acton Grange, Winwick, Golborne, Springs Branch, Balshaw Lane, Euxton and Farrington Curve)

Pressures to run additional services

4.52 There are pressures to add to services in this section, including:

- Additional inter-city services from the North West to London as well as between Manchester, Preston and Scotland (recently electrified via Newton-le-Willows)
- Additional freight paths to and from Scotland, particularly intermodal

Weaver Junction to Liverpool

Today's service pattern

4.53 This route branches off the core WCML to serve Runcorn and Liverpool Lime Street and, in the final three miles from Edge Hill into Lime Street, it is joined by the intensive service from Manchester to Liverpool. Currently, Runcorn has three trains per hour: two of them are London Midland services to/from Birmingham and one is a Virgin West Coast service to/from London. The branch is also a key freight corridor serving the terminals at Ditton, the Halewood Car plant, Garston Freightliner terminal and Liverpool Port and has up to 25 freight paths per day in each direction.

Route capacity issues

4.54 Key constraints are the:

- Two-track section from Weaver Junction through to Runcorn and over the River Mersey
- Flat junction at Allerton where Liverpool-Manchester and WCML services merge

Pressures to run additional services

4.55 There are pressures to add to services in this section, including:

- Liverpool inter-city services to be every 30 minutes
- The expansion of freight traffic to/from Liverpool Port

Crewe to Manchester Piccadilly

Today's service pattern

4.56 The line between Crewe and Manchester Piccadilly links Crewe with Manchester via Wilmslow and Stockport. As with Birmingham New Street, the final approach from

Stockport is a complex mix of train services from across the country that has to be melded together on the four-track approach to Piccadilly.

4.57 The passenger service pattern between Crewe and Cheadle Hulme is outlined below:

- 1tph from London to Manchester operated by Virgin West Coast
- 1tph from Cardiff to Manchester operated by Arriva Trains Wales
- Local stopping services operated by Northern Rail:
  - 1tph from Crewe to Manchester
  - 1tph from Alderley Edge to Manchester
  - 1tph from Crewe to Manchester via Manchester Airport
  - Two Cross Country trains per day from Birmingham/South Coast to Manchester via Crewe
  - A further set of services that join the route at Cheadle Hume and Stockport
- Freight:
  - Manchester Piccadilly to Slade Lane Junction – 29 paths per day
  - Slade Lane Junction to Cheadle Hulme – 9 paths per day in one direction

Route capacity issues

4.58 Route capacity constraints on this section include:

- The 18-mile two-track section between Sandbach and Cheadle Hulme – here fast long distance services from London and South Wales mix with slower stopping local trains and freight trains
- Cheadle Hulme Junction – this flat junction is the point where trains from London via Stoke-on-Trent join back with those from London via Crewe, as well as Cross Country and local services
- Short section of two-track railway between Cheadle Hulme and Adswood Road Junction which is shared by trains from both the Crewe and Stoke-on-Trent directions heading towards Stockport and Manchester
- The approach to Piccadilly station where the complex track layout and range of destinations curtails operational flexibility

4.59 A number of improvements are planned as part of the Northern Hub programme to increase platform capacity at Manchester Piccadilly and on its immediate approaches. This will bring valuable service enhancements and take some of the pressure off the approach to Manchester Piccadilly. It will also allow better connections to both Manchester Victoria and Manchester International Airport.

Pressures to run improved and additional services

4.60 There are pressures to add to services in this section, including:

- Faster services between Sheffield and Manchester, which join the route just south of Stockport
- One out of every two Chelford - Northwich - Manchester peak commuter trains was removed in 2008, forcing passengers to change at Stockport
- Additional services to Manchester Airport, particularly from the South

Colwich Junction/Norton Bridge to Manchester Piccadilly

Today's service pattern

4.61 This branch of the WCML to Manchester carries a wide mix of service types with inter-city, regional, and local services all using the same section of railway. However, very little freight traffic is routed this way; most goes via Crewe instead. In the busiest section of the route between Stoke-on-Trent and Kidsgrove Junction, 7tph operate:

- 2tph from London to Manchester operated by Virgin West Coast
- 2tph from South West England to Manchester operated by Arriva Cross Country
- 1tph from Stoke-on-Trent to Manchester operated by Northern Rail
- 1tph from London to Crewe operated by London Midland
- 1tph from Derby to Crewe operated by East Midlands Trains
- Freight: Norton Bridge to Stone Junction – 1 path per day in each direction, Colwich Junction to Cheadle Hulme – 3 paths per day in each direction

Route capacity issues

4.62 Key route capacity constraints are:

- The mix of service types and operating speeds between Stoke-on-Trent and Cheadle Hulme restrict route capacity. For example a stopping Northern service (from Stoke-on-Trent to Manchester) is typically 14 minutes slower than an inter-city service
- As previously mentioned, at Cheadle Hulme the lines from Crewe and Stoke-on-Trent converge into a busy two-track section until just south of Stockport
- The Stockport station area, where the lines from Sheffield, Hazel Grove and Buxton merge together for the final five mile approach to Manchester Piccadilly. Although there are separate fast and slow routes from Stockport to Piccadilly, elaborate crossing movements are needed to get the trains onto the right route for the approach

4.63 As previously noted, some improvements in the Manchester area are coming as part of the Northern Hub programme.

Pressures to run additional services

4.64 There are pressures to add to services in this section, including:

- A Buxton - Blackpool service which was split into three new service groups: Buxton - Manchester Piccadilly, Hazel Grove - Preston and Manchester Victoria - Blackpool to accommodate the VHF timetable
- Local services connecting Rose Hill, in Marple to the east of Manchester, to Piccadilly and Bolton via Oxford Road were also curtailed. The Rose Hill trains now terminate at Manchester Piccadilly because of the shortage of paths across all the tracks at Piccadilly

Options for addressing the constraints

The Strategic Alternative

4.65 Chapter 3 provided a brief overview of the Strategic Alternatives to HS2 In essence, the Alternative proposed the following:

- A new grade-separated junction near Milton Keynes to allow commuter trains to leave the Fast Lines without slowing down to access Northampton. This would increase the capacity of the Fast Line to 16tph throughout the peak
- Four-tracking the route from Rugby to Birmingham (the 'Coventry Corridor')
- Lengthening both West Midlands and ICWC trains: the former to 12-cars and the latter to 11-cars
- Power supply reinforcement, particularly on the northern part of the route
- Grade-separation just north of Stafford, to allow trains from Birmingham to Stoke-on-Trent and Manchester to operate more reliably
- Doubled inter-city frequencies to Liverpool and Glasgow, through the use of splitting and joining. This would mean some existing trains operating in two portions, and then splitting/joining at Warrington Bank Quay. As a result, alternate trains to Glasgow would have to be slowed down by perhaps 7-10 minutes to allow time for this and a new fleet of shorter trains would be required, since the existing Pendolino trains are too long to be operated in this way

4.66 Figure 36 summarises the service pattern assumed in the Strategic Case.

4.67 In fact, significant elements of the Strategic Alternatives work are already committed. Specifically, the train lengthening proposed is already underway and has been allowed for in the train capacity analysis in Chapter 5 of this document. In addition, London Midland now operates more trains on the Fast Lines as a result of the LM110 project of the kind envisaged in the Strategic Alternative but without the need for grade separation. Some of the infrastructure interventions are in hand, particularly the grade-separated junction being built at Norton Bridge discussed previously.

4.68 Provision of a grade-separated junction south of Milton Keynes would allow the route to go up to 16tph throughout the peak compared with the current situation where 15tph are generally operated throughout the peak (aside from between 08:02-09:01 on weekdays, and 18:00-18:59 on Fridays, when 16tph are operated).

4.69 When originally developed a few years ago, the Strategic Alternative envisaged that additional paths would be created to increase both Birmingham and Manchester services from three trains per hour to four. However, in the interim, one of the additional Fast Line train paths has been taken up by a 110mph London Midland commuter service, so in practice, only one additional inter-city path is likely to be available following the £2.5 billion programme of works.

4.70 The Strategic Alternative would in effect be a further "patch and mend" solution to the capacity problems on the WCML. The considerable expenditure and disruption involved would provide some crowding relief via a limited extension of today's services. However, there would be much less opportunity to reinstate services curtailed to accommodate the VHF timetable, or to improve connectivity to places that are currently poorly served. In addition, the potential opportunity to release capacity on the WCML to accommodate the growth in demand for freight paths that is forecast by Network Rail would be missed.

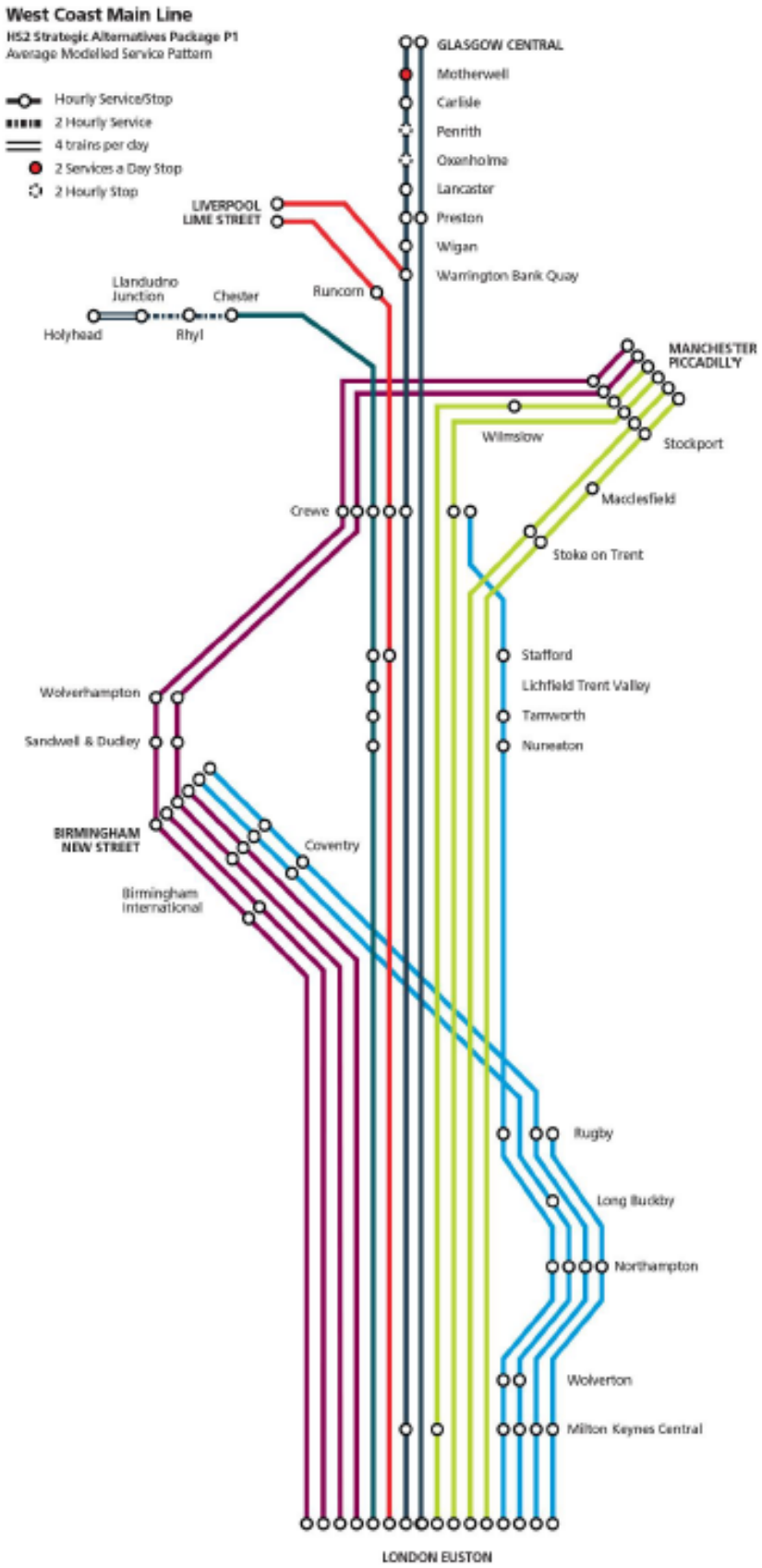


Figure 36 Strategic Alternative Package P2 service specification[43]

[43] Source: "HS2 Strategic Alternatives, Final Report" (DfT, 28 October 2013)

European Train Control System (ETCS)

4.71 While not an explicit part of the Strategic Alternative, the European Train Control System (ETCS) is a signalling, control and train protection system which is seen as offering the potential to increase capacity by optimising the operating distances between train services in real time. Its application on the WCML is not yet programmed or committed. ETCS could reasonably be expected to bring some benefits, especially in terms of punctuality, helping to address the question of secondary delays in particular. But the basic infrastructure issues on the WCML that constrain the number of services that can be run, notably complex, non grade-separated junctions, the mixing of trains running at different average speeds and the lack of capacity at stations, would remain.

HS2 capacity benefits

4.72 In reading the following section it is important to note that Network Rail is currently leading a strategic rail study ("Capacity Plus") with the objective of identifying strategic options for rail services to operate after the implementation of HS Phase One. This will include options for train services made possible through released capacity on the WCML. Options being assessed include new long distance services (to enhance inter-regional connectivity and potentially through services to London from new origins), additional capacity for freight growth and options to accommodate further commuting growth into London.

4.73 At this stage, no decisions have been taken on the introduction of these new services. Well established statutory, regulatory, and administrative processes will be used to build an open and shared evidence base, consult passengers, communities and freight users, establish options and take decisions ahead of the introduction of a new timetable.

4.74 As described in Chapter 3, HS2 would increase the capacity for fast trains on HS2 and the West Coast Fast Lines combined to/from London Euston from 15-16tph to 23tph. It could also increase capacity on the Slow Lines from 8 to 10tph. Figure 37 summarises the HS2 Phase One service pattern that has been presented to the hybrid Bill Committee. It should be noted that a range of service options exist and that final choices do not need to be taken until closer to route opening when they could be better shaped by the market pressures prevailing at that time.

4.75 The second phase of HS2 adds high-speed capacity with an increase in train lengths to Manchester – and potentially for Scottish services too. While Phase One allows a transformation in local and regional services operating over today's congested Coventry corridor, Phase Two opens up the prospect of a similar transformation through Greater Manchester's 'Stockport corridor' with new services, greater capacity and new connections, as well as better and more services through Staffordshire and Cheshire.

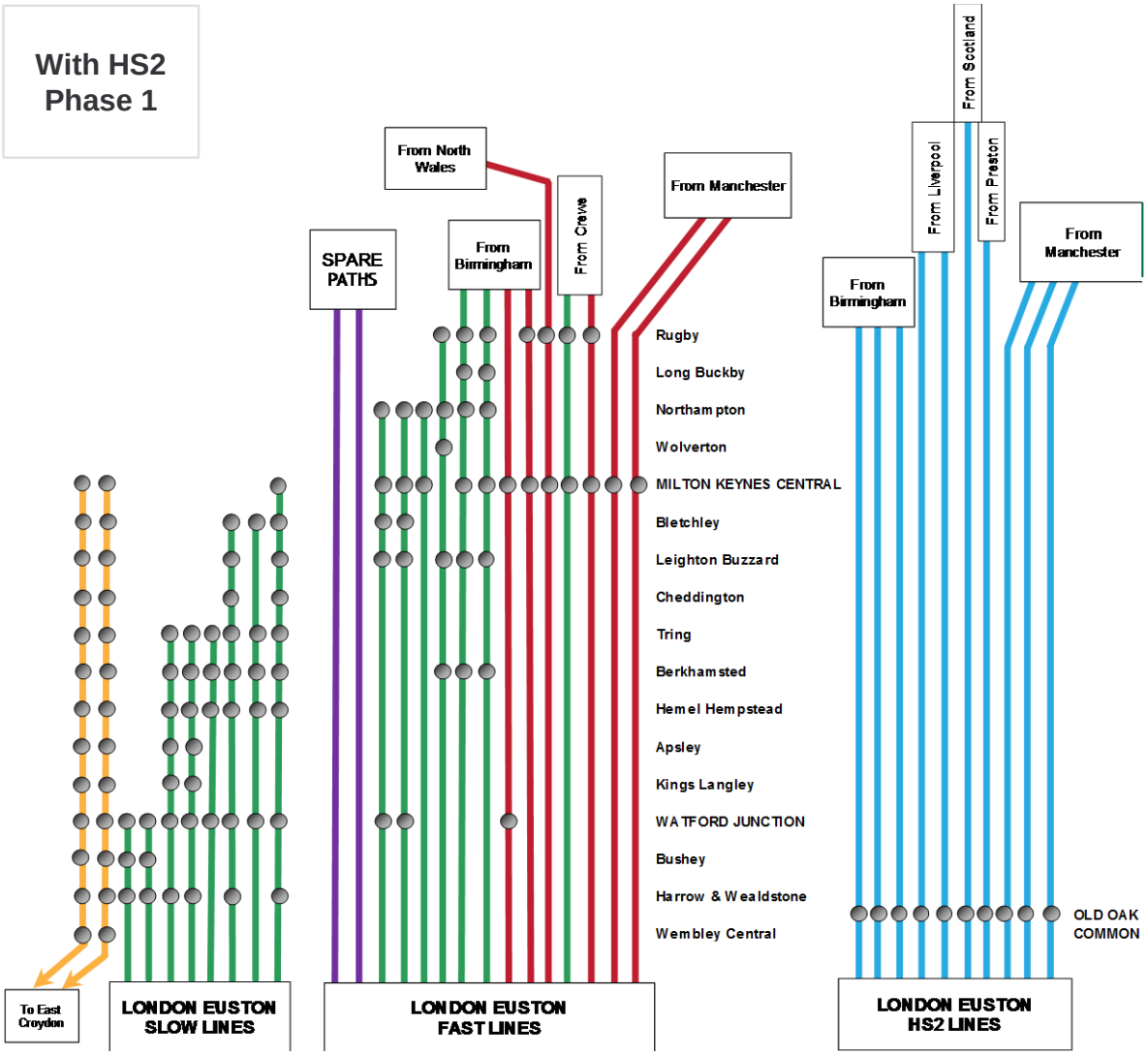


Figure 37 Indicative plan of services of the WCML and HS2 following Phase One[44]

4.76 The following sections look at what HS2 offers, by route section. This extra capacity means that a balanced approach can be taken to address inter-city, commuter and freight growth along the WCML.

London to Rugby

4.77 HS2 Phase One provides a long-term response to the route capacity issues highlighted above by providing two extra tracks between Rugby and London and the expansion of London Euston station. After the completion of HS2 Phase One, combining HS2 and WCML together, there will be capacity for 31 passenger trains directly into London Euston per peak hour from the western half of the country. Following the completion of HS2 Phase Two, including the addition of trains from the eastern leg of the network, the total number of trains could be up to 41 passenger trains directly into London Euston per peak hour.

[44] Source: HS2 Ltd. Version presented by HS2 to Hybrid Bill Committee, 2015

Commuter services

4.78 With HS2 Phase One, capacity released from running fewer ICWC services on the WCML allows WM services across the three AM peak hours to increase from 28 today to 41, under the Autumn 2013 Business Case assumptions used to support the Phase One hybrid Bill.

4.79 HS2 would potentially allow most trains from Leighton Buzzard and further north to use the Fast Lines. This, in turn, would allow a more even stopping pattern on the Slow Lines which at present is a hybrid between semi-fast and all-stations services. This could create two further paths per hour on the Slow Lines where the current service is a mix of semi-fast passenger, slow passenger and freight. This change would also permit more frequent local connections for Milton Keynes from its surrounding stations, including in future from the planned East-West rail link, helping establish it as a regional hub.

4.80 As noted above, no decisions have been taken on the introduction of new or amended services as a result of HS2.

Inter-city services

4.81 Peak inter-city services across both HS2 and the WCML added together under Phase One could increase by around 50 per cent, i.e. from today's 11/12tph to 17tph (plus 2 potential spare paths on WCML for future use). Of the 17, 12 are planned to serve the North and Scotland (7 via HS2 and 5 via the WCML), whilst five could connect London with the West Midlands (3 of these via HS2 and 2 via the existing route). These latter two services could make more calls off peak than at present, opening up the possibility of a distinct "inter-regional" express service fully linking the principal stations between London, Rugby and Birmingham in order to support growth in the Northamptonshire and Milton Keynes area.

4.82 As noted above, no decisions have been taken on the introduction of new or amended services as a result of HS2.

New markets

4.83 Without the need to accommodate longer distance demand to Britain's major cities on the WCML, HS2 potentially gives scope to provide connections to some of the next tier of smaller centres which cannot be provided with through services today because of the capacity limitations. This could potentially include:

- More inter-city services, to stations not currently served by direct trains or stations that currently have relatively poor direct services
- More stops (which require capacity) on some of the inter-city services at intermediate stations such as Watford Junction and Milton Keynes, particularly those to the North and Scotland, which lost most of their calls in 2008

4.84 As noted above, no decisions have been taken on the introduction of new or amended services as a result of HS2.

Rugby to Birmingham New Street

4.85 HS2 essentially provides a high speed bypass of this section, allowing inter-city trains to run straight into Birmingham without conflicts with either interurban, stopping or freight services.

4.86 This means that the timetable between Rugby and Birmingham can potentially be recast to give higher priority to cross country, stopping and freight trains than is

possible today. This could result in an increase in service levels along the Coventry corridor.

4.87 Centro[45],in its recent paper "HS2 Unlocking the Benefits", outlined the potential opportunities of improved service levels and local/regional connectivity that can be delivered post HS2 Phase Two in combination with other planned infrastructure works such as the doubling of the track between Leamington and Coventry.

4.88 Centro's network plan (detailed in Figure 38) sets out a standard pattern of 12tph between Birmingham International and Birmingham New Street, with 8tph operating between Coventry and Birmingham New Street. This is an increase of 3tph on the current standard pattern off peak between Birmingham International and Birmingham New Street and an increase of 1tph between Coventry and Birmingham New Street.

4.89 The uplift in capacity may provide the opportunity to provide better connectivity both across the West Midlands and to destinations beyond the West Midlands, for example via:

- Cross Birmingham links - from Leamington to Walsall and from Birmingham International to Wolverhampton/Shrewsbury
- A London to Liverpool via Birmingham New Street and Walsall service - providing direct services for Walsall to London and Liverpool
- More frequent inter-city services from Wolverhampton/Shrewsbury to London
- Re-routing of the South Coast to Newcastle service via Coventry and Birmingham International, providing direct services between Coventry and Birmingham International to the East Midlands, Yorkshire and north-east England

4.90 As noted above, no decisions have been taken on the introduction of new or amended services as a result of HS2.

Rugby to Crewe

4.91 Transferring the current Manchester, Liverpool and Scotland to London inter-city services to operate over HS2, releases five paths per hour on the existing WCML between Rugby and Crewe.

4.92 This could give the opportunity to:

- Provide better service levels to Trent Valley stations, with more regular fast services to London, particularly from Lichfield and Tamworth, and improved connectivity to Manchester and Liverpool
- Serve new inter-city markets

Provide new regional services such as Oxford (via East-West rail) to Manchester or Milton Keynes to Liverpool

- Potentially accommodate up to two more freight paths per hour

As noted above, no decisions have been taken on the introduction of new or amended services as a result of HS2.

It should be noted that while HS2 Phase One will bypass the constraints of the 3-track section between Brinklow and Attleborough, service levels between Rugby and Crewe will still be subject to the constraints of flat junctions at Colwich Junction and Whitehouse Junction and the two-track section through Shugborough tunnel, through which all services on HS2 and the existing WCML would have to pass. This section

[45] The body responsible for the delivery of public transport in the West Midlands, representing the seven metropolitan borough councils.

would, however, be relieved by the Phase 2a extension from Lichfield to Crewe, extending the capacity benefits of the Phase One scheme northwards.

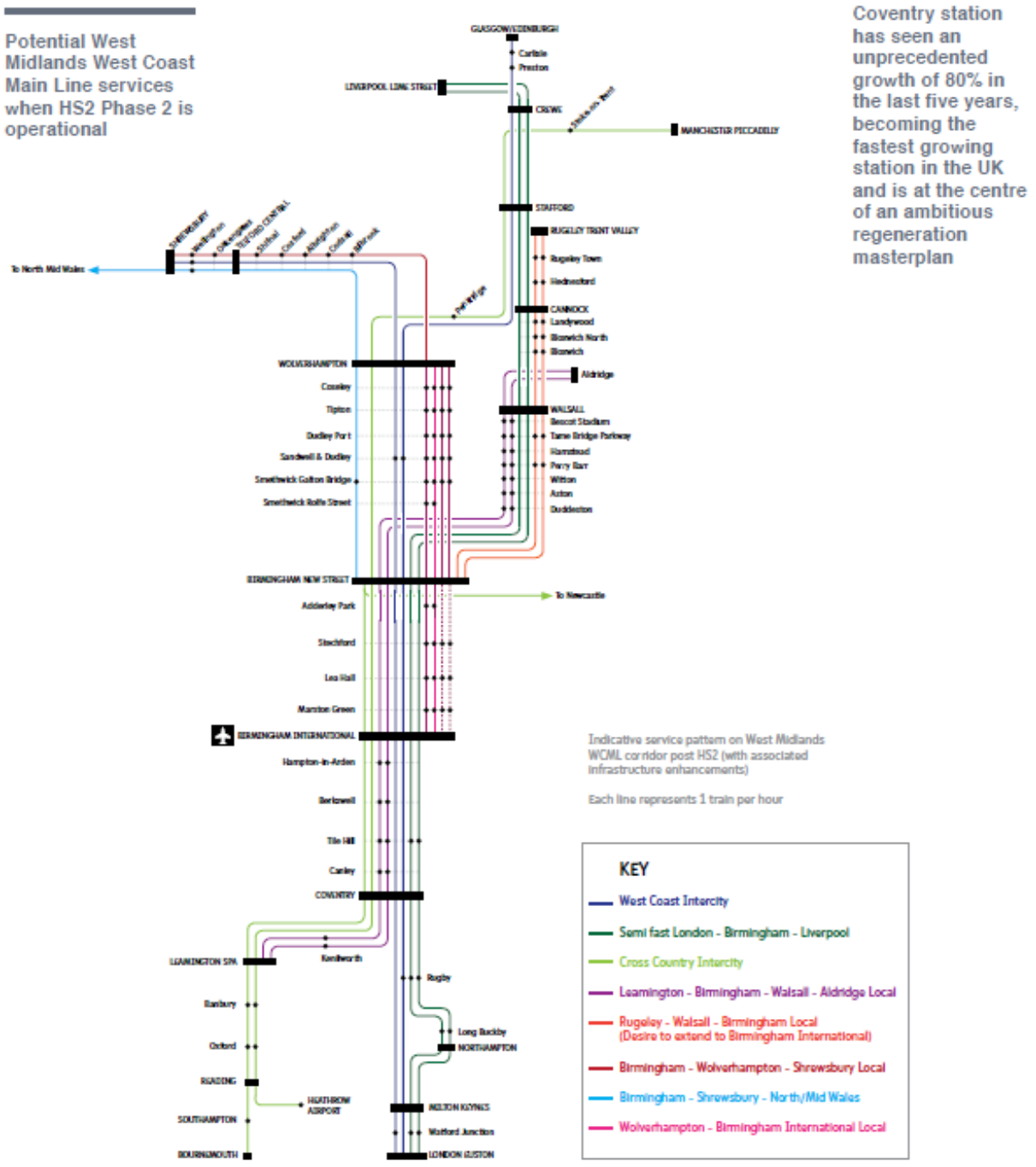


Figure 38: Service Plan from Centro for post HS2 Phase Two (Source "HS2 Unlocking the Benefits" by Centro)

Crewe to Weaver Junction

4.93 Under Phase Two, HS2 services to Liverpool and Lancaster/Blackpool would need to use the existing WCML between Crewe and Weaver Junction with the expectation that at least two HS2 trains each hour will operate between London and Liverpool and one train per hour between Lancaster/Blackpool and London. HS2 would allow the two trains per hour to Scotland (one from London, one from Birmingham) currently operating on the WCML to be replaced with HS2 services, releasing two inter-city peak paths per hour on the existing WCML. These paths could be used by

high speed conventional (non HS2) services such as the proposed second hourly service between Liverpool and London and a service between Carlisle and London, retaining and enhancing the availability of direct London services.

4.94 Further capacity could be released (depending on the stopping pattern mix and future operating speeds of freight and passenger services) since HS2 could provide more timetable flexibility as a result of HS2 services by passing existing WCML constraints and interacting with fewer services south of Crewe.

4.95 The greater flexibility provided by HS2 could give the potential for:

- A better defined network of local and interurban services, connecting Liverpool, Preston, Manchester and Crewe
- More freight services to be accommodated

4.96 As noted above, no decisions have been taken on the introduction of new or amended services as a result of HS2.

Weaver Junction to Preston

4.97 HS2 Phase Two will join the existing WCML at Golborne Junction between Warrington Bank Quay and Wigan North Western stations. Similar to the Crewe to Weaver Junction section, the two London/Birmingham to Scotland services that will run on HS2 will release paths between Weaver Junction and Golborne Junction. However, north of Golborne Junction, Scotland trains will operate on the existing WCML in a way similar to the current services.

Weaver Junction to Liverpool

4.98 This section is likely to benefit from any released capacity on the Crewe to Weaver Junction section of the WCML.

Crewe/Colwich Junction/Norton Bridge to Manchester Piccadilly

4.99 Following construction of Phase Two, there would in effect be another two tracks on the approach to Manchester from the south, a 50 per cent increase on today. It is planned that the current inter-city services on the WCML will be moved to HS2, releasing capacity on both the Crewe and Stoke corridor to Manchester.

4.100 The released capacity in the Crewe/Stoke corridor could allow reshaping of services, such as:

- More stopping trains, particularly from Stoke-on-Trent, Macclesfield and Bramhall
- Extension of the Derby to Crewe service to Manchester Airport
- Improved frequency between South Wales and Manchester
- Service frequency from the mid-Cheshire line could be increased, and more connections via the Northern Hub scheme would become possible

4.101 As noted above, no decisions have been taken on the introduction of new or amended services as a result of HS2.

5. Train Capacity Analysis

Introduction

5.1 Chapters 3 and 4 considered issues of route capacity on the West Coast Main Line (WCML). Taken together they highlighted that:

- Growth in demand, both in the passenger and in the freight markets, are, and will continue to lead to pressures to run additional services on the WCML corridor
- At its busiest points, in the peak, the WCML is operating at, or close to, its full route capacity, making it challenging to accommodate additional services on the route
- HS2 will provide a step change in route capacity and therefore gives a wider range of options to accommodate new services in the WCML corridor than the Strategic Alternative

5.2 This chapter considers the question of train capacity. In other words, how effectively the level of seats and standing capacity provided on trains can accommodate passenger demand on the WCML corridor. In particular, it considers:

- The level of train crowding that will arise on the West Midlands (WM) franchise (currently operated by London Midland) and the Inter City West Coast (ICWC) franchise (currently operated by Virgin West Coast) services should further investment in route capacity not occur
- The ability of tactical measures such as the lengthening and reconfiguration of trains to accommodate this crowding
- The extent to which the investment in route capacity provided by the Strategic Alternative and HS2 allows sufficient additional train capacity to provide a long term solution to any future overcrowding problems

Future growth scenarios

5.3 In order to assess future passenger crowding, two Growth Scenarios have been modelled: a ‘Reference Case’ and a ‘Higher Growth Case’.

5.4 The ‘Reference Case’ uses a peak period growth rate derived from the DfT’s Planet Framework Model (PFM) – the same source used for the Economic Case HS2, in November 2015. The growth rates used in the ‘Reference Case’, averaged out over the period from 2014/15 to 2033/34, are:

- 1.8 per cent for WM services
- 2.0 per cent for ICWC services

5.5 The ‘Higher Growth Case’ uses the ‘high sensitivity’ growth rates from the DfT’s Network Modelling Framework (NMF). The growth rates used in the ‘Higher Growth Case’, averaged out over the period to 2033/34, are as follows:

- 3.0 per cent for WM services
- 3.7 per cent for ICWC services

5.6 The base year for the analysis is 2014/15 and it uses train loading figures taken from the passenger counts undertaken by the Train Operating Companies (TOCs) and supplied to DfT. For ICWC, Virgin West Coast passenger counts from Autumn 2014 have been used. For WM, later London Midland counts, undertaken in Spring 2015, have been used to provide the base loadings. This is because these counts take into account the impact of London Midland's December 2014 timetable change in which two additional London Euston arrivals were added in the peak hour. Within the analysis, train capacities for both WM and ICWC are consistent with the timetables and train configurations operated by the train companies in December 2014.

West Midlands (WM) services

- Today, the current operator London Midland experiences notable levels of overcrowding into and out of London – 6.5 per cent in Autumn 2014
- Without intervention, crowding could lead to major issues on WM; PiXC is estimated to increase between 18 per cent and 30 per cent by 2033/34
- PiXC is estimated to be in the range of 11-19 per cent in 2033/34, even if all AM and PM peak services are lengthened to 12-cars
- HS2 can mitigate this by allowing step change in peak capacity on WM that cannot be achieved with the Strategic Alternative

5.7 Before examining how crowding levels are forecast to change on WM services, it is important to look at the growth rates used in this exercise in a historic context. The left-hand side of Figure 39 sets out the growth rate observed across the London and South East (LSE) sector as a whole during the 18 year period since privatisation to 2014/15 as well as that observed on London Midland since the first full year of operations in 2008/9. The growth rates are 4.3 per cent per annum and 4.0 per cent per annum respectively.

5.8 Figure 39 compares these rates with the growth in the 'Reference Case' and the 'Higher Growth Case.' The forecasts presented on the right-hand side of the graph represent the projected impact of a number of exogenous demand drivers such as growth in the economy, growth in the population and changes in modal competition (for example changes in rail usage given changes in the cost of car ownership). The forecasts also include the impact of endogenous demand drivers such as changes in rail fares and the impact of the timetable/capacity changes that occurred in December 2014. The forecasts do not include the impact of any train operator-led initiatives, for example new products, improvements in service quality or marketing.

5.9 Figure 39 illustrates that the rate of demand growth used for this exercise is around 45 per cent of historic London Midland growth rate in the 'Reference Case' and 75 per cent of this growth rate in the 'Higher Growth Case.'

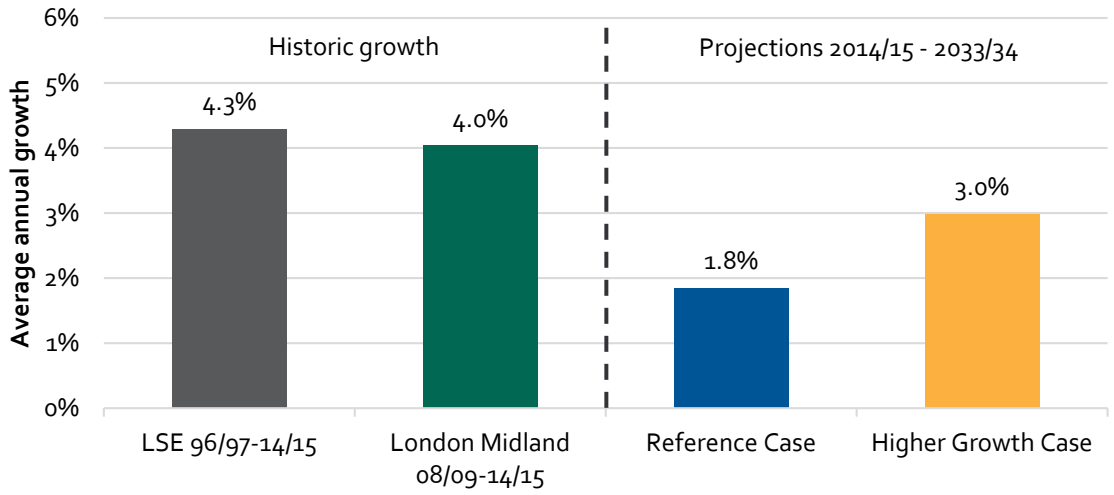


Figure 39 West Midlands franchise (currently operated by London Midland) historic and projected growth[46]

5.10 Passengers in Excess of Capacity (PiXC) is DfT's published measure of the level of overcrowding on trains. It is defined as the number of passengers standing above the agreed capacity limits of a train, divided by the total number of passengers on the train.

5.11 For current London Midland services, 'agreed capacity' per train is measured as the number of seats on the train plus 2.2 passengers per square metre of standing space. For a sub-set of London Midland outer suburban services that do not stop within 20 minutes of London, capacity is defined as seating capacity only (i.e. any passenger standing is included in the PiXC measure).

5.12 Figure 40 compares morning (AM) and evening (PM) peak PiXC on the TOCs that DfT groups within the LSE sector. The most crowded TOC is Greater Western. Crowding on these services is being addressed through investment in the following: remodelling of Reading station and the surrounding track layout to improve the performance and capacity of the network, electrification of the Greater Western Main Line route; new trains as part of the Inter-city Express Programme; and new electric commuter trains. Behind Greater Western, London Midland has the second highest PiXC figures.

[46] Data source: ORR data portal; Planet Modelling Framework version 4.3; Network Modelling Framework.

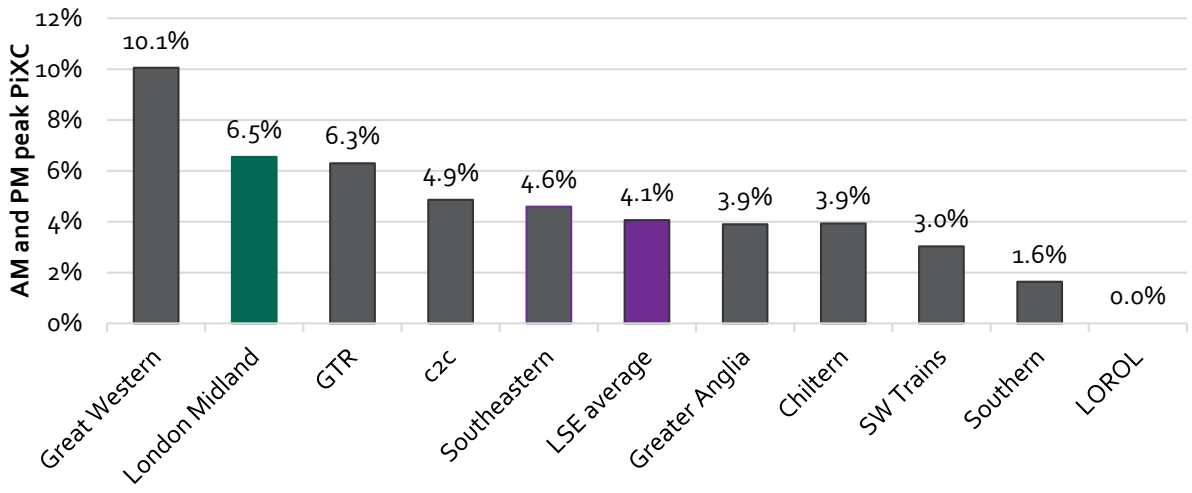


Figure 40 AM and PM peak Passengers in Excess of Capacity, Autumn 2014[47]

5.13 This problem is not a one-off. Figure 41 compares the PiXC levels on London Midland to the LSE average going back to 2008. In each of the last seven years, PiXC on London Midland has exceeded the LSE average. In five of the last seven years, London Midland has been measured as having the second highest PiXC levels behind First Great Western.

Figure 41 London Midland historic PiXC - AM and PM peak combined[48]

[47] Data source: DfT Passengers in Excess of Capacity statistics. Note that the South West Trains PiXC figure is calculated on a different basis to other operators, and would be higher if measured in the same way.
[48] Data source: DfT Passengers in Excess of Capacity statistics.

5.14 In response to its notably high levels of crowding, London Midland's December 2014 timetable added two additional services into London Euston in the AM peak hour. Using the Spring 2015 counts - which were undertaken after the new timetable was introduced - Figure 42 sets out how PiXC on London Midland services could be expected to increase in 2033/34 in two operational scenarios:

- **Today's capacity:** This assumes that the December 2014 timetable continues to be operated with the same size train fleet
- **All 12-car:** Assumes that all AM and PM peak services are operated at 12-car length (the current maximum length of operation)

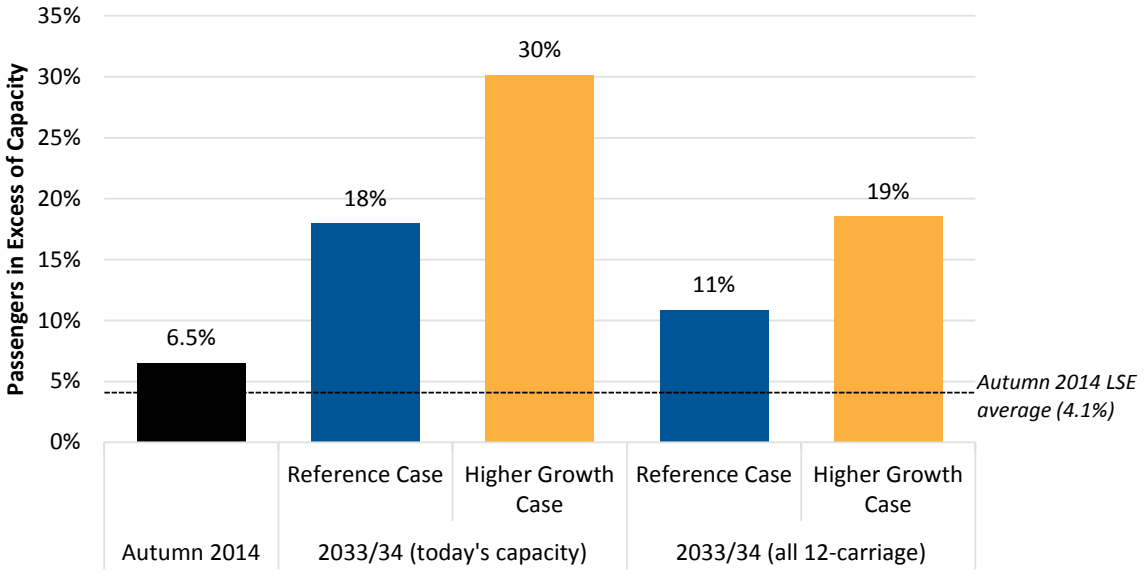


Figure 42 West Midlands franchise current and projected PIXC (AM and PM peak combined)[49]

5.15 Figure 42 demonstrates that continuing to operate the current train service in 2033/34 could result in overcrowding levels of 18 per cent in the 'Reference Case' and 30 per cent in the 'Higher Growth Case' - three to five times greater than overcrowding levels today. This is likely to present severe operational difficulties, such as extended dwell times as large numbers of passengers attempt to board and alight from trains. This could have a knock-on impact on punctuality.

5.16 This overcrowding could be mitigated in part by operating all trains at 12-car length[50]. However, even then, PiXC is forecast to range from 11-19 per cent - greater than it is on Great Western today, where major investment to mitigate crowding is in progress.

5.17 Overcrowding could become a serious issue on WM much sooner than 2033/34 if passenger demand continues to grow at the rate that has been seen on London commuter flows in the period since privatisation. If growth was to continue to average 4.3 per cent per annum, then by 2026/27, the year HS2 Phase One is scheduled to open, PiXC could be as high as 16.3 per cent, even if all trains had been lengthened to 12-cars. Higher capacity rolling stock and swapping station stops could potentially

[49] Data sources: DfT Passengers in Excess of Capacity Autumn 2014 and Spring 2015 train counts
[50] Lengthening all trains to 12 carriages on the West Midlands franchise is not a committed scheme.

help to ameliorate this situation. However, but it would result in more standing for passengers and potentially longer journey times from some stations.

Impact of different investment interventions

5.18 To determine how this passenger crowding might be mitigated, the impact of the Strategic Alternative and HS2 are considered. Figure 43 illustrates that the Strategic Alternative builds on the all 12-car option by allowing two further fast services between 07:00–08:00 (increasing the current 28 AM peak trains to 30.) With HS2 Phase One, route capacity released from running fewer inter-city services on the WCML allows the number of WM AM peak arrivals to increase from 28 to 41.

Scenario	Number of services	Standard Class seats	Standard Class capacity
December 2014	28	15,132	20,234
All 12-carriage	28	19,344	25,884
Strategic Alternative	30	20,580	27,120
With HS2	41	30,330	41,103

Figure 43 WM AM Peak (07:00–09:59 arrivals into Euston) capacity scenarios[51]

5.19 Figure 44 examines the capacity impact of each of these scenarios by forecasting average load factors on WM across the AM peak in 2033/34. This covers all Euston arrivals between 07:00 and 09:59 with the load factor defined as demand divided by agreed capacity (seating plus standing allowance). For each option, the yellow bars represent forecast load factors under the 'Higher Growth Case' and the blue bars under the 'Reference Case' growth rates. The analysis demonstrates that:

- Operating the existing train service in 2033/34 would result in average load factors in the AM peak of 117 per cent in the 'Reference Case' and 142 per cent in the 'Higher Growth Case'. This would translate into PiXC levels across the AM and PM peaks of 18 per cent and 30 per cent respectively compared to 6.5 per cent in Autumn 2014
- Operating every service with 12 carriages would reduce load factors to 91 per cent and 111 per cent respectively. This translates into PiXC levels of 11 per cent and 19 per cent
- The infrastructure investment contained within the Strategic Alternative only provides a marginal increase in WM capacity over and above running today's services with 12-cars. Average load factors in 2033/34 are estimated to be 106 per cent across the AM peak in the 'Higher Growth Case.' In the 'Reference Case', loadings would exceed today's levels (91 per cent to 84 per cent)
- Due to the release of WCML route capacity for commuter services, the "with HS2" option allows future growth on WM to be accommodated in both the 'Reference Case' and the 'Higher Growth Case' scenarios

5.20 With the additional capacity released by HS2, average loadings across the AM Peak would not return to today's levels until 2063 in the 'Reference Case' and 2041 in the 'Higher Growth Case'.

[51] Data source: Analysis of the December 2014 timetable; "The Strategic Case for HS2" (DfT 2013)

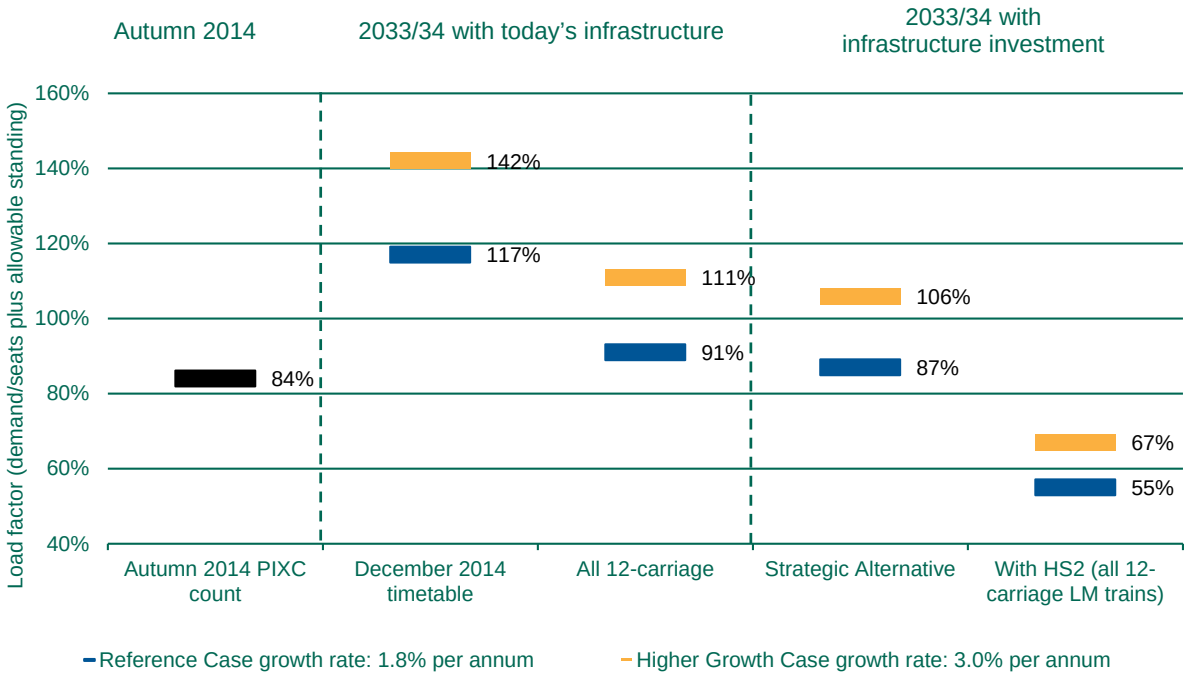


Figure 44 Forecast WM 2033/34 AM Peak load factors on arrival at Euston (demand/seats and allowable standing)[52]

Inter City West Coast services

- Certain ICWC services are overcrowded today and around two thirds of the additional peak inter-city seating capacity provided by the WCML upgrade is already being filled
- By 2033/34, standing on ICWC services to and from London will become a material issue even if all trains are extended to 11 cars and reconfigured to increase Standard Class capacity
- Changing fares restrictions is unlikely to solve crowding issues over the long term
- HS2 provides the flexibility to add over 100 per cent additional inter-city capacity to ICWC destinations and provides resilience for all future ICWC growth scenarios

Strong growth is forecast on ICWC, continuing historic trends

5.21 As for WM, Figure 45 compares historic growth both on Virgin West Coast and across the wider long distance rail sector with the growth rates used in the 'Reference Case' and 'Higher Growth Case.' Since 1996/97, the average growth achieved by Virgin West Coast has been 5.5 per cent per annum. This compares to 4.7 per cent per annum across the wider long distance rail sector. The 'Reference Case' and 'Higher Growth Case' assume annual growth rates of 2.0 per cent and 3.7 per cent respectively.

[52] Data sources: "Analysis of DfT Passengers in Excess of Capacity Statistics" (Autumn 2014) combined with PFM and NMF growth rates; "The Strategic Case for HS2" (DfT 2013)

5.22 Consistent with the WM growth rates, the forecasts include exogenous and endogenous demand drivers but exclude the impact of train company-led initiatives. Broadly speaking, the 'Reference Case' assumes that growth is at just over 40 per cent of the rate seen in the long distance rail market since privatisation. This rises to around 80 per cent in the 'Higher Growth Case'.

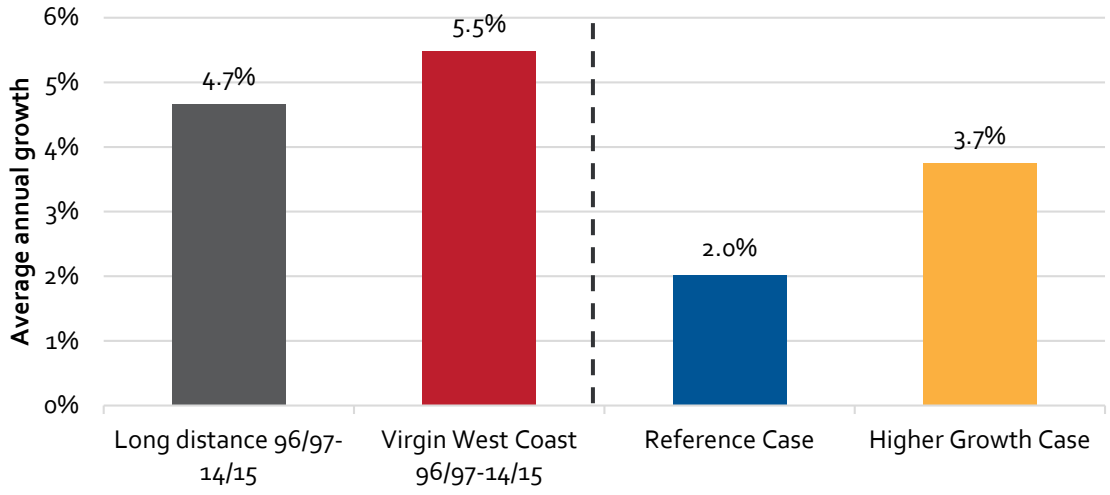


Figure 45 ICWC historic growth and projections (average annual growth)[53]

5.23 Within this analysis of crowding on ICWC services, the load factor is defined as the number of passengers on the train divided by the number of seats. On long distance services there is no allowable standing capacity – all passengers are expected to have a seat for their journey (this definition is relaxed on trains that call at stations that are less than 20 minutes from London Euston, although the allowable capacity is only available on that 20 minute leg of the train's journey). The analysis below focuses on Standard Class demand and capacity. First Class demand and capacity is excluded.

5.24 Figure 46 sets out load factors on ICWC services in the AM and PM peak periods based on the autumn 2014 counts. Within the analysis, the PM peak on ICWC has been extended to include the period from 19:00 to 19:59. Between 16:00 and 18:59 peak period restrictions apply to the types of tickets that can be used to travel on ICWC services. These restrictions finish at 19:00 when lower priced tickets become valid on ICWC services again. This makes the hour from 19:00 to 19:59 a particularly popular hour for travel and therefore highly relevant to any analysis of future crowding on ICWC.

5.25 Our analysis shows the following:

- Average loads on Virgin West Coast are currently 68 per cent in the AM peak and 67 per cent in the PM peak, rising to 79 per cent in the PM peak on Fridays
- Today, average loadings are as high as 100 per cent on Friday evenings between 19:00 and 19:59 – i.e. there are as many passengers as there are seats on Euston departures across this particular hour

[53] Data source: ORR data portal; Planet Modelling Framework (PFM) version 5.2b; National Modelling Framework (NMF)

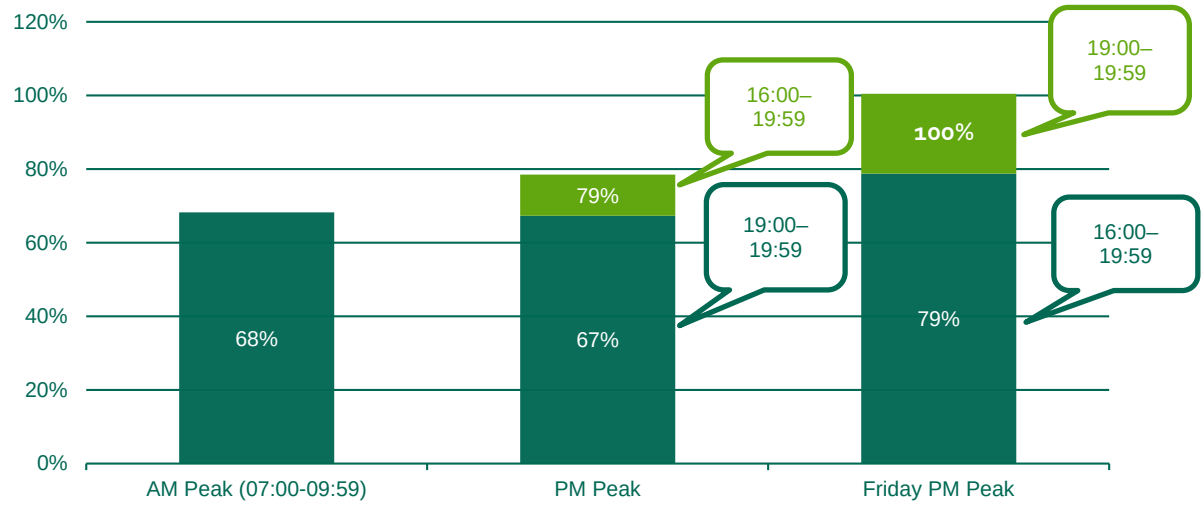


Figure 46 Virgin West Coast Standard Class load factors in autumn 2014[54]

Standing on ICWC will become a material issue by 2033/34

5.26 In looking at future crowding on ICWC, two options were considered for increasing train capacity within the constraints of the existing infrastructure[55]:

- **Extending all Pendolino (electric) trains to 11 cars and all Voyager (diesel) trains to 10 cars.** Of the 27 AM peak (07:00-09:59) ICWC services in the December 2014 timetable; seven are currently 9-carriage Pendolinos, 17 are 11-carriage Pendolinos and three are 10-car Voyagers. Of the 41 PM peak (16:00-19:59) ICWC services in the December 2014 timetable; 12 are currently 9-car Pendolinos, 21 are 11-car Pendolinos, three are 5-car Voyagers and five are 10-car Voyagers
- **All 11-car train reconfigured**: As per the previous option but with all 11-car Pendolinos re-configured from seven Standard Class and four First Class cars to eight Standard Class and three First Class cars

5.27 Both of these measures are part of the Strategic Alternative for ICWC services.

5.28 Figure 47 sets out the additional capacity that would be provided under these two options – up to a further 27 per cent in the AM peak and 33 per cent in the PM peak.

Scenario	AM Peak (07:00-09:59)	PM Peak (16:00-19:59)
Autumn 2014	11,040	15,869
All trains 11 car	12,074 (+9.4%)	18,350 (+16%)
All trains 11 car (reconfigured)	13,974 (+27%)	21,162 (+33%)

Figure 47 ICWC Standard Class seat capacity scenarios – existing infrastructure[56]

5.29 Taking the train-by-train loadings from the Autumn 2014 counts as a base, Figure 48 forecasts the proportion of peak ICWC passengers estimated to be on trains with a

[54] Data source: DfT Passengers in Excess of Capacity Statistics
[55] Extending all Pendolino trains to 11 cars and reconfiguring Standard Class carriages are not committed schemes
[56] Data source: DfT analysis

Standard Class load factor of >100% and therefore standing. This is assuming that all Pendolino trains are 11-car and have been reconfigured to have eight Standard Class cars as per the 'All trains 11-car reconfigured' scenario described above.

5.30 At present, count data suggests that 0.7 per cent of Virgin West Coast passengers across the AM and PM peaks are standing as trains arrive at/depart Euston. This rises to 2.4 per cent during the PM peak on a Friday.

5.31 In the 'Reference Case', by 2033/34, this is forecast to grow to an average of 2 per cent of peak passengers standing when arriving at/departing from Euston during weekday AM and PM peaks with 9 per cent of passengers standing on departure from Euston in the Friday PM peak. The 'Higher Growth Case' forecasts suggest that on average, 14 per cent of passengers will be standing arriving at/departing from Euston during AM and PM peaks. This rises to 23 per cent of passengers standing in the Friday PM peak on trains leaving Euston.

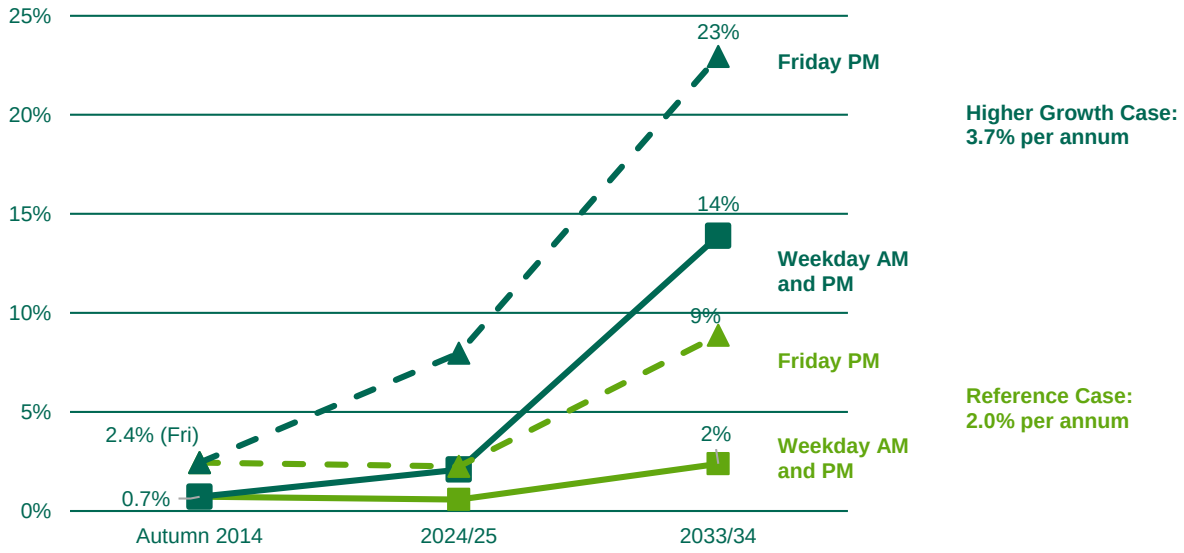


Figure 48 Projected % of Standard Class passengers standing (all 11-car, reconfigured trains)[57]

5.32 In practice, standing is likely to be more prevalent than simply the number of passengers in excess of the number of seats - unless of course the ICWC operator moves to a "reservations-only" system. This is because inter-city trains are typically over 250 metres in length with around 20 access doors. Passengers are not always able to spread evenly along trains to find available seats, especially when boarding at intermediate stops. In addition, loadings are not evenly distributed between services throughout the peak. For these reasons, once load factors are above 80 per cent, passengers are likely to be standing.

5.33 The long distance nature of the ICWC services means that many of the standing passengers identified in the analysis above will be standing for an hour or more. For each of the ICWC trains on which it is forecast that there will be standing passengers, the first stop on that service has been identified. This first stop is effectively the minimum period for which a passenger will stand – either because they leave the train at this station or because seats have become available due to other passengers alighting.

[57] Data sources: DfT Passengers in Excess of Capacity; DfT analysis

5.34 Figure 49, illustrates the position in 2033/34 on a typical weekday in the 'Higher Growth Case' scenario. Here, it is estimated that 3,200 passengers will stand on ICWC trains departing London in the PM peak. Of these, 1,350 (40 per cent) will be on trains with a first stop 59 minutes or more outside of London.

5.35 On a typical Friday, it is estimated that 5,900 passengers will be standing on departure from Euston in the PM Peak. Of these, 3,500 (60 per cent) will be on trains with a first stop 59 minutes or more outside London, of which around 1,300 (22 per cent) will stand for 90 minutes or more.

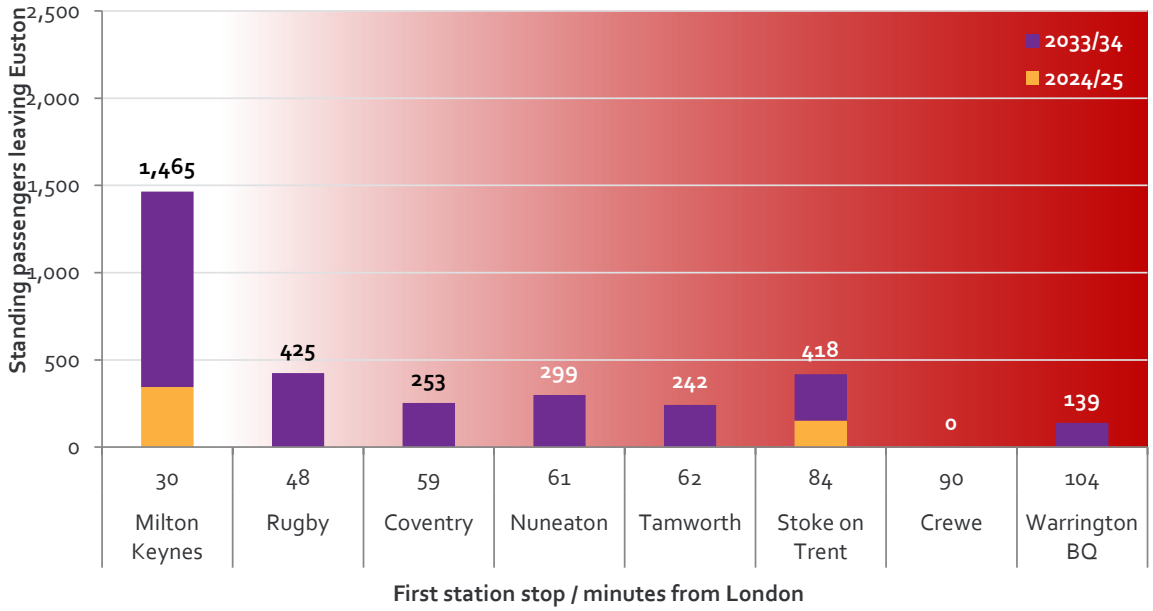


Figure 49 Midweek PM Peak analysis of likely duration of standing – Higher Growth Case (11-car reconfigured trains) [58]

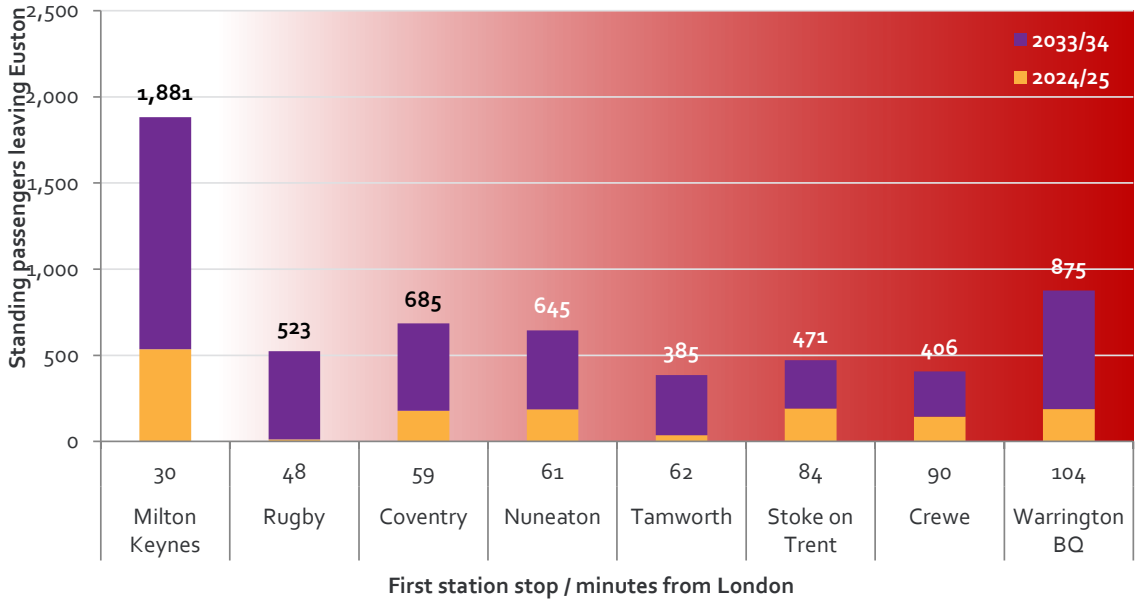


Figure 50 Friday PM analysis of likely duration of standing – Higher Growth Case (11-car reconfigured trains) [59]

[58] Data sources: Autumn 2014 counts: NMF growth rates
[59] Data sources: Autumn 2014 counts, NMF growth rates

5.36 A high proportion of the standing that is forecast in the PM peak would arise in the 19:00-19:59 hour, when peak fare restrictions do not apply. Today, Virgin West Coast manages peak demand by offering a quota of cheaper Advance Purchase fares as well as offering Peak Walk-up fares. Yield management is used by the operator to maximise revenue (returned as premium payments to DfT). The 'price ceiling' for Off Peak Walk-up fares is limited by regulation.

5.37 Figure 51 analyses weekday load factors and fare levels on ICWC services between London and Birmingham and London and Manchester. For London - Manchester the 'Anytime' peak fare is currently 300 per cent higher than the Off Peak fare (£329 vs £81.60 for a return trip). For London–Birmingham journeys, the 'Anytime' peak fare is 225 per cent higher (£168 vs £51.70). The chart demonstrates how higher peak fares ('Anytime' and 'Advance') help to control peak period demand, generally maintaining load factors at 60 per cent - 70 per cent. This load factor rises by about 10 per cent between 19:00 and 19:59 as the Walk-up fare and Advance fares fall in price at the end of the peak period restrictions.

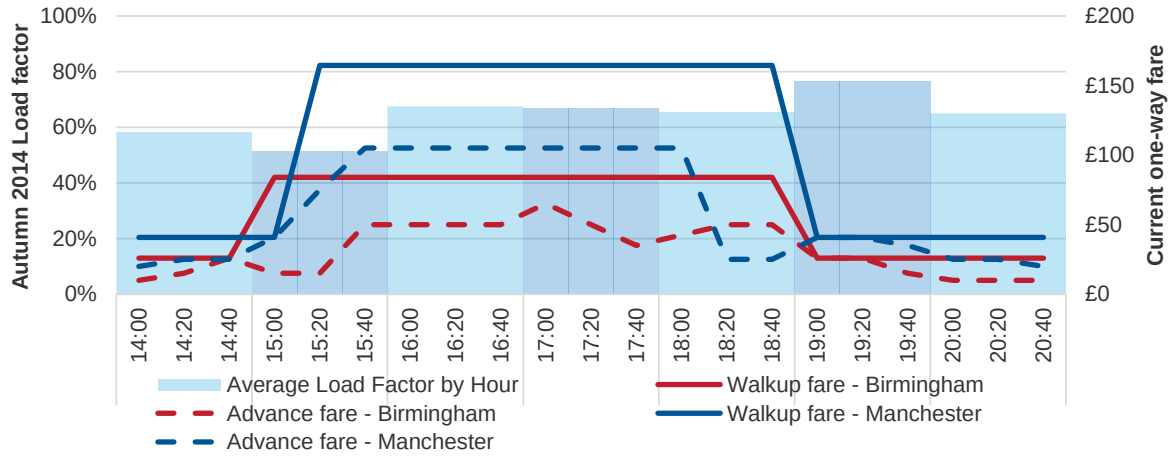


Figure 51 Weekday load factors and fare profiles - London-Birmingham and London-Manchester[60]

5.38 Potentially, therefore, future crowding could be managed through targeted changes to fares restrictions. However, analysis undertaken at a service group level (presented in Figure 52) shows that this would have limited effectiveness in materially reducing standing levels by 2033/34. For each service group, the average load factor across the PM peak period (16:00 – 19:59) is presented in 2033/34 under the 'Higher Growth Case' scenario. Key points of the analysis are:

- Average load factors are estimated to be 111 per cent to Birmingham and 109 per cent to North Wales across the PM peak four hours. As there are more passengers than seats, standing cannot be eliminated by relaxing fares restrictions to spread loadings more evenly
- There is also very little scope for manoeuvre on the other service groups, all of which are estimated to have average load factors of between 94 per cent-99 per cent. At these load factors, it would be difficult to limit/manage standing whilst still permitting "Walk Up" fares. This might mean making inter-city WCML services

[60] Data sources: Analysis of DfT Passengers in Excess of Capacity Statistics, Autumn 2014 combined with fares obtained from Virgin Trains website

"reservation only" which would change the nature of the railway and significantly impact upon the flexibility of business and leisure passengers alike

Average load factors across the entire Friday PM peak are forecast to be 116 per cent by 2033/34 under the 'Higher Growth Case' with all trains extended and reconfigured. Given that in aggregate, there would be 16 per cent more passengers than seats, it would be impossible to eliminate standing even by moving to a "reservations only" system. Even if such a type of system was adopted, demand is estimated to be such in the 'Higher Growth Case' that many people would not be able to find space to travel on what are some of Britain's key rail flows

Service group	No. PM peak trains (weekday/Friday)	Average weekday PM	Average Friday PM
Birmingham	11	111%	124%
Manchester	12/13	94%	105%
Liverpool	7	99%	123%
North Wales	4	109%	112%
Glasgow/Preston	7/8	98%	119%
Total	**41**	**102%**	**116%**

Figure 52 Weekday and Friday 2033/34 load factors by service group – Higher Growth Case (all 11-car, reconfigured trains)[61]

HS2 provides resilience for all future ICWC growth scenarios

5.39 Having illustrated the limitations of containing crowding on the ICWC services by increasing train capacity, Figure 53 extends the analysis to consider those options that involve investing in infrastructure. The yellow bars represent forecast load factors under the 'Higher Growth Case' and the blue bars load factors under the 'Reference Case'. The chart shows the following:

- Operating every service with 11 cars and reconfiguring the trains to eight Standard Class and three First Class cars leaves average load factors over 100 per cent in the 'Higher Growth Case' scenario. The load factor of 102 per cent translates into 14 per cent of peak passengers standing given the distribution of demand across the peak. In the 'Reference Case' weekday average load factors are 74 per cent, approaching the loading conditions currently experienced on a Friday
- The Strategic Alternative gives some increase in ICWC capacity by providing an additional five trains in the AM Peak and four trains in the PM peak. However, average load factors are forecast to be 91 per cent by 2033/34 in the 'Higher Growth Case'. Load factors would rise to 102 per cent by 2036/37 the same rate at which 14 per cent of peak weekday passengers are estimated to be standing in the analysis presented in Figure 48. Put simply, the Strategic Alternative would provide for approximately three years of additional growth in the 'Higher Growth Case'
- The step change in route capacity provided by HS2 allows crowding issues on inter-city services on the WCML corridor to be solved for the long term. This

[61] Data sources: December 2014 timetable, Autumn 2014 counts, NMF growth forecasts

includes accommodating the increase in total WCML inter-city demand which PFM forecasts will be generated by HS2 itself, primarily due to the step change in journey times

- Phase Two – which delivers the same quantum of services as Phase One to WCML destinations but would allow longer trains to run north of Birmingham – gives the potential to accommodate further growth in demand beyond 2033/34

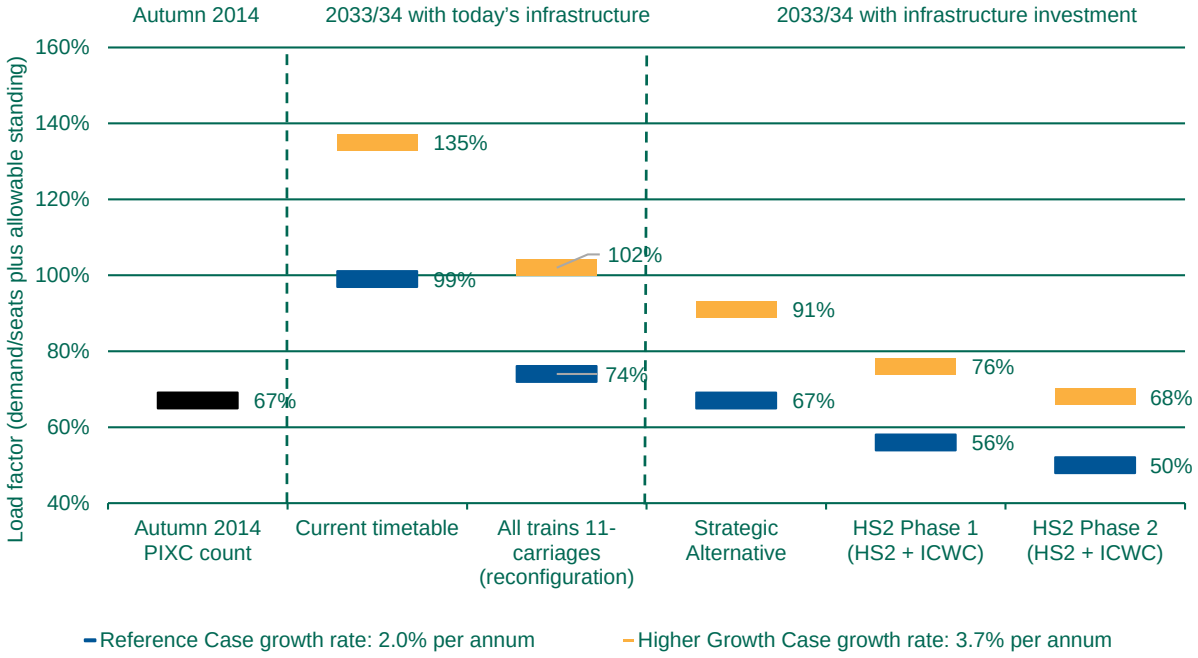


Figure 53 Forecast ICWC and HS2 2033/34 weekday PM Peak (16:00–19:59) load factors[62]

5.40 As stated above, as well as providing a step-change in route, and therefore train, capacity, HS2 will also generate significant new demand for rail travel to destinations on the WCML corridor. The primary driver of this new demand is the journey time improvements that HS2 Phases 1 and 2 will deliver. Figure 54 summarises the journey time improvements that HS2 will deliver to WCML destinations along with the increases in capacity.

[62] Data sources: Analysis of DfT Passengers in Excess of Capacity Statistics, Autumn 2014, combined with PFM and NMF growth rates; "The Strategic Case for HS2" (DfT 2013)

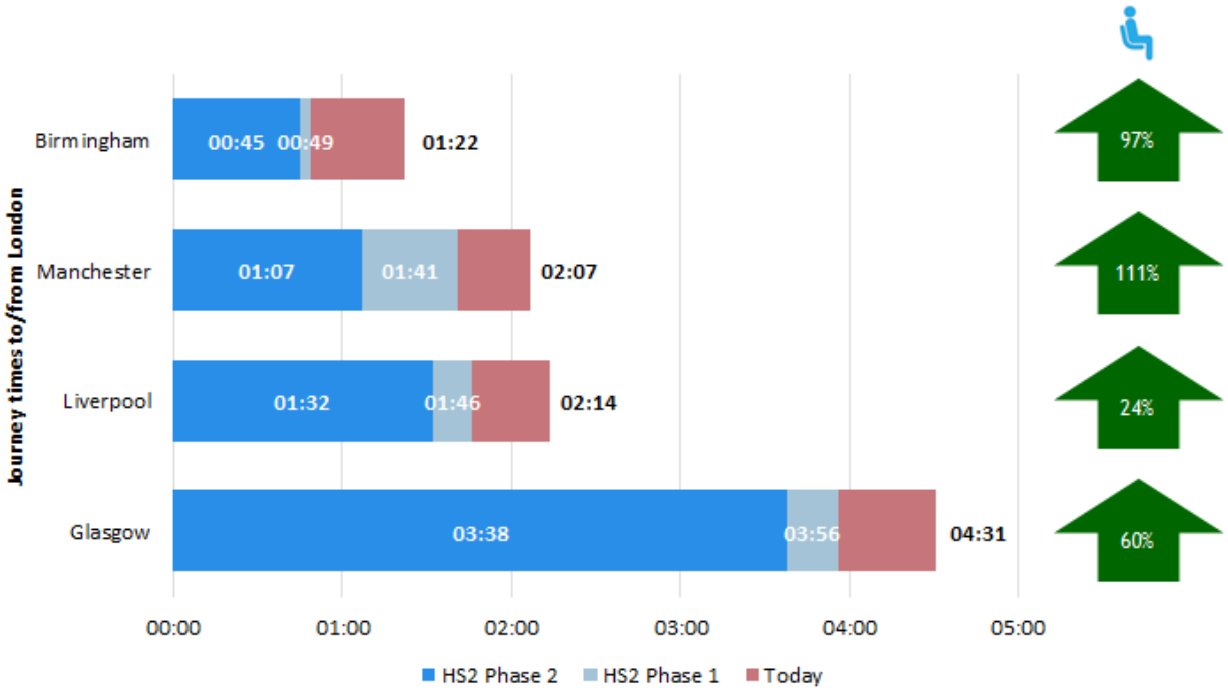


Figure 54 Western leg fastest journey times with and without HS2 and peak capacity increases (HS2 services only)[63]

5.41 Figure 55 illustrates the forecast impact of the faster HS2 journey times on demand between London and key WCML destinations. As can be seen from the chart, demand between London and Birmingham/Coventry and between London and Manchester/Stockport/Manchester Airport is forecast to grow by over 80 per cent and the market between London and Glasgow is forecast to more than double in size.

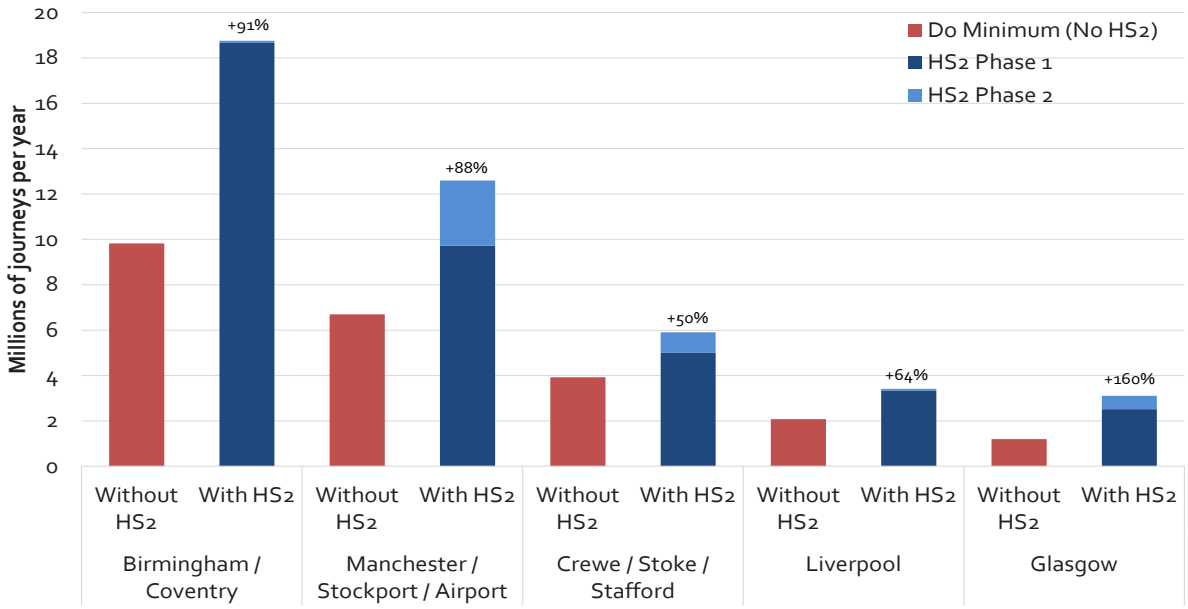


Figure 55 2036/37 demand to/from London by location under Do Minimum and HS2 operating scenarios[64]

[63] Data source: High Speed Two: East and West The next steps to Crewe and beyond (DfT, November 2015)
[64] Data source: PFM v4.2. Note: 'Birmingham/Coventry' includes Birmingham New Street, Moor Street, International, HS2 Curzon Street, HS2 Interchange, Coventry.

Crowding on peak services into/out of Birmingham

5.42 Figure 56 summarises AM and PM peak crowding on all peak services to/from Birmingham (not just WCML services). Whilst PixC is around 1.6 per cent in the AM peak and 0.8 per cent in the PM peak, across the peaks 10 per cent of passengers stand. In the high peak hour (08:00 to 08:59 in the AM and 17:00 to 17:59 in the PM) passengers stand on circa 60 per cent of services and 13 per cent of these services breach PiXC.

	Service provision				PiXC		Passengers standing		Services with PiXC		Services with passengers standing	
	Services	Seats	Capacity	Critical load	#	%	#	%	#	%	#	%
AM Peak												
1 hr	67	19,461	27,065	19,929	395	2.0%	3,111	16%	12	18%	42	63%
3 hr	179	48,919	67,121	40,349	627	1.6%	4,610	11%	17	9%	65	36%
PM peak												
1 hr	68	17,779	24,546	17,489	221	1.3%	1,889	11%	5	7%	36	53%
3 hr	186	48,970	66,840	40,960	330	0.8%	3,196	8%	10	5%	66	35%

Figure 56 Birmingham, Standard Class loads and crowding on a typical weekday: Autumn 2014[65]

West Midlands franchise services on the WCML Birmingham – Coventry corridor

5.43 London Midland currently operates four trains per hour in each direction along the Coventry corridor. These are predominantly run as 4-car trains[66]. At present, allowing for standing capacity, load factors are around 65 per cent across the AM peak and PM peak, rising to 89 per cent in the AM peak hour. This level of crowding translates to PiXC of 1.1 per cent in the Coventry corridor across the AM and PM peak combined.

5.44 Figure 56 shows future projections of AM and PM Peak PiXC on these services in 2024/25 and 2033/34. Without any intervention, under 'Reference Case' growth, it is estimated that PiXC on these services will rise to 4.4 per cent in 2024/25 and 12.4 per cent in 2033/34. In the 'Higher Growth Case', this rises to 13.7 per cent and 27.5 per cent.

5.45 In order to address these future crowding issues, capacity on commuter trains could potentially be increased, subject to suitable platforming being available at New Street station, by lengthening all peak Birmingham services to 8-cars. This would provide an overall increase in peak capacity of 77 per cent.

5.46 With this train lengthening, under 'Reference Case' growth average load factors in 2033/34 would be 50 per cent across the AM Peak and PM Peak, and PiXC would be 3.4 per cent. Under the 'Higher Growth Case' average load factors in 2033/34 would be 74 per cent across the AM Peak and PM Peak, and PiXC would be 8.0 per cent - comparable to today's level at the London end of the route.

[65] Data source: DfT Rail Statistics, Table RAI0212
[66] Two AM Peak services and one PM Peak service operate with 8-cars

5.47 Whilst train lengthening could potentially be effective mitigation for future crowding issues on WM services operating on the Coventry corridor, it would not address route capacity issues or improve wider network connectivity. Therefore the region might not benefit from the types of opportunities identified by Centro in its recent paper "HS2 – Unlocking the Benefits" (see Chapter 4, Figure 38) for improved service levels.

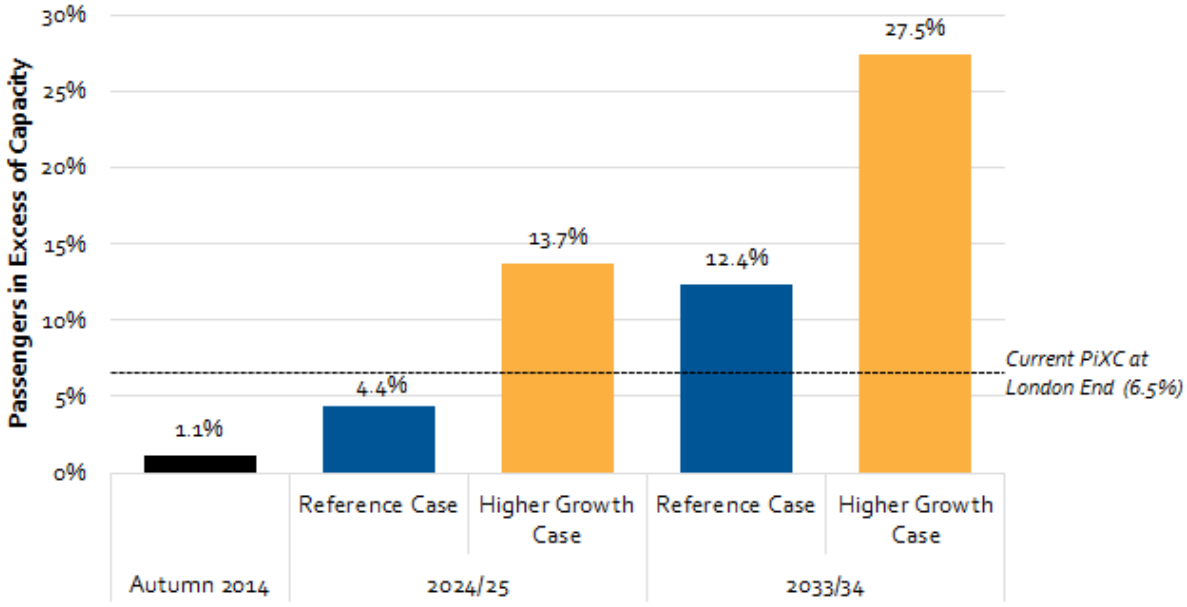


Figure 57 West Midlands franchise – current and projected PiXC at Birmingham New Street (AM and PM peak combined) with no intervention[67]

Inter City West Coast services on the Birmingham – Coventry corridor

5.48 ICWC also operates services along the Birmingham - Coventry corridor. Figure 58 summarises the load factors on these services based on Autumn 2014 counts. These average around 70 per cent across the AM and PM peak.

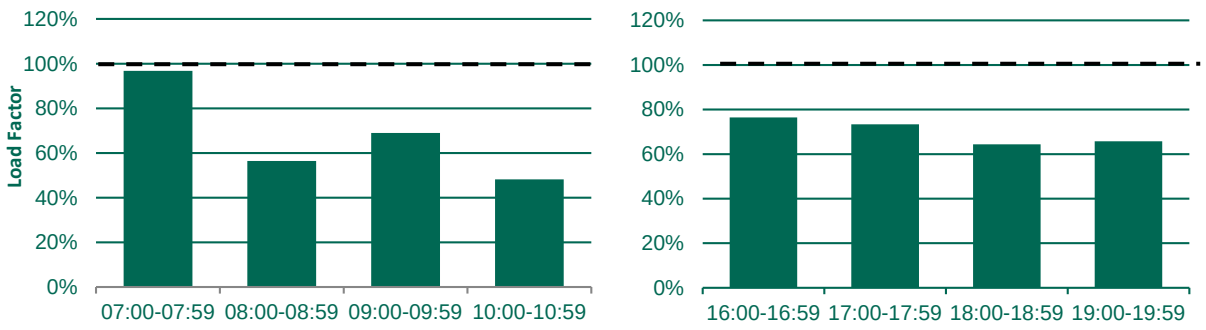


Figure 58 Virgin West Coast weekday peak Standard Class load factors along the Coventry corridor[68]

[67] Data source: DfT Passengers in Excess of Capacity Autumn 2014; PFM and NMF growth rates
[68] Data source: DfT Autumn 2014 count data

5.49 Some individual ICWC services have standing passengers, with 1.9 per cent of passengers standing on arrival at/departure from Birmingham New Street across the AM and PM peak. Many of these passengers are likely to be travelling relatively short distances, for example between Coventry, Birmingham International and Birmingham New Street – with journey times of less than 20 minutes. Others travelling longer distances in the PM peak are likely to be able to obtain a seat once shorter distance passengers have left the train.

5.50 Depending on future growth, crowding could potentially become an issue on ICWC services operating along this corridor. The following chart forecasts the proportion of peak ICWC passengers who would be on trains with a Standard Class load factor of over 100 per cent and therefore be standing on arrival at/departure from Birmingham New Street in 2033/34. This is assuming that all Pendolino trains are 11-car and have been reconfigured to have eight Standard Class carriages as per the 'All 11 car reconfigured trains' scenario described above.

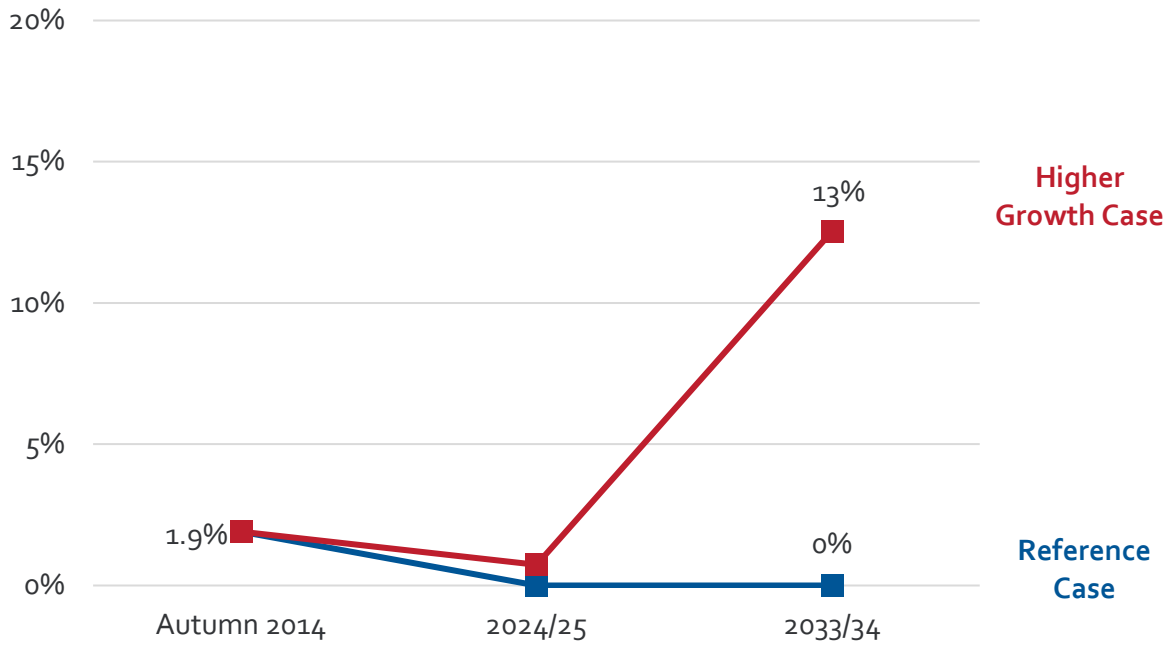


Figure 59 Projected % of Standard Class passengers standing (all 11-car, reconfigured trains)[69]

5.51 This shows that under the 'Reference Case' growth, standing on ICWC peak services to/from Birmingham would be eliminated for the foreseeable future if all ICWC trains are reconfigured in this way. However under the 'Higher Growth Case' 13 per cent of peak ICWC passengers would be standing on arrival/departure from Birmingham New Street by 2033/34.

Alternative infrastructure interventions

5.52 The Strategic Alternative 'P1' specification developed for the 2013 Strategic Case envisaged one additional peak train per hour to each of Birmingham and Manchester – that is two additional peak train paths. However one of the paths required to achieve this has been consumed by the London Midland service improvements south of Rugby that were introduced in the December 2014 timetable.

[69] Data source: DfT Passengers in Excess of Capacity; PFM,NMF growth rates

5.53 If the remaining additional train per hour available in the Strategic Alternative were operated to/from Birmingham rather than Manchester, it would increase ICWC frequency from 3tph to 4tph. Whilst this would provide a substantial boost to capacity - 33 per cent in most peak hours compared with the 'All 11 car reconfigured train' scenario, it would not provide a future-proof solution. Under the 'Higher Growth Case', combined AM and PM Peak load factors would be 77 per cent in 2033/34 – significantly higher than the 69 per cent seen today in autumn 2014.

5.54 In contrast, under the current Business Case assumption, HS2 Phase One would provide three High Speed services per hour operated with much longer (400 metre) trains and still have two ICWC services operating on the classic network.

Crowding on peak services into/out of Manchester

5.55 Figure 60 summarises AM and PM peak crowding on all peak services to/from Manchester (not just WCML services). PixC is 4.3 per cent in the AM peak and 2.3 per cent in the PM peak, and across the peaks, 12 per cent of passengers stand. In the high peak hours (08:00 to 08:59/17:00 to 17:59) passengers stand on 57 per cent of services and 20 per cent of these services breach PiXC.

	Service provision				PiXC		Passengers standing		Services with PiXC		Services with passengers standing	
	Services	Seats	Capacity	Crit. load	#	%	#	%	#	%	#	%
AM Peak												
1 hr	70	15,491	21,183	17,244	991	5.7%	3,496	20%	18	26%	43	61%
3 hr	186	38,942	53,927	33,643	1,452	4.3%	5,279	16%	29	16%	71	38%
PM peak												
1 hr	68	15,541	21,470	15,262	269	1.8%	1,944	13%	10	15%	35	51%
3 hr	193	40,793	55,908	35,879	832	2.3%	4,207	12%	22	11%	78	40%

Figure 60 Manchester Standard Class loads and crowding on a typical weekday: Autumn 2014[70]

5.56 The analysis of crowding on services into Manchester within this report focuses on WCML services running into Manchester from the Crewe and Stoke-on-Trent lines via the Stockport corridor. The analysis is segmented to cover an aggregation of local and regional services (comprising services operated by the Northern, Cross Country and Wales and Borders franchises), alongside an analysis of ICWC services operating through this corridor into Manchester Piccadilly.

Local and regional services on the WCML Stockport-Manchester corridor

5.57 Currently, there are between 6-8 peak trains per hour operated by local and regional operators on the WCML Stockport-Manchester corridor. In Autumn 2014, allowing for standing capacity, load factors are around 65 per cent across the AM peak and PM Peak, rising to around 90 per cent in the AM peak hour. This level of crowding translates to PiXC of 1.4 per cent on this corridor across the AM and PM peak combined.

[70] Data source: DfT Rail Statistics, Table RAI0212

5.58 Figure 61 shows future projections of AM Peak and PM Peak PiXC on these services in 2024/25 and 2033/34. Without any intervention, under 'Reference Case' growth, it is estimated that PiXC on these services will rise to 4.3 per cent in 2024/25 and 9.3 per cent in 2033/34. In the 'Higher Growth Case', this rises to 10.4 per cent and 24.9 per cent.

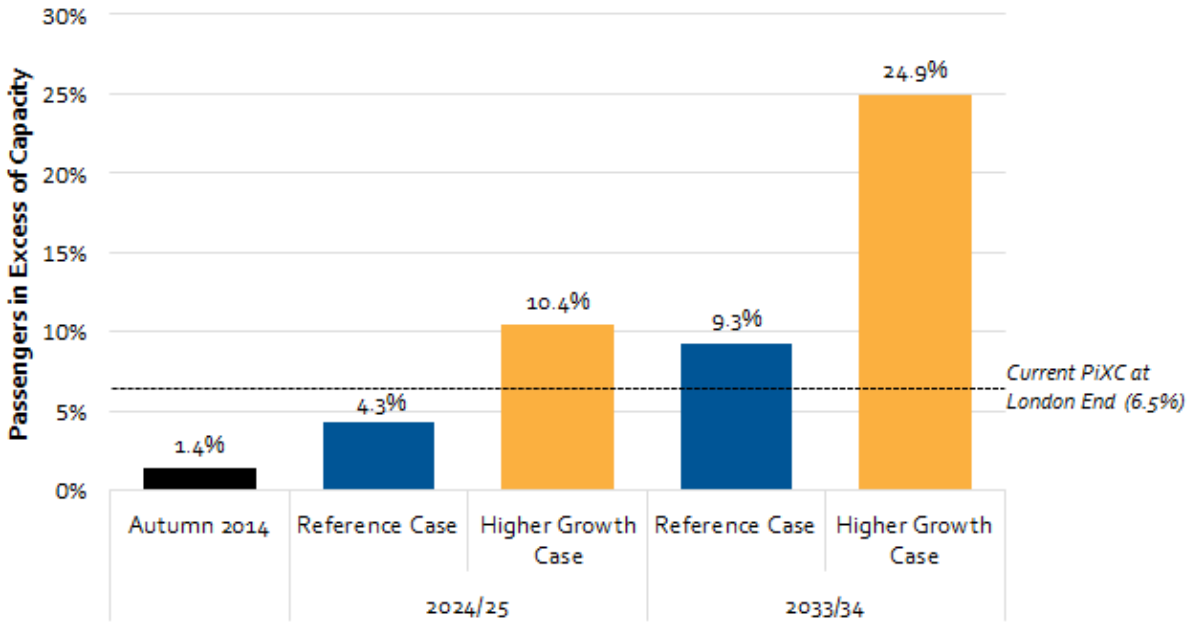


Figure 61 Current and projected PiXC by train on Stockport-Manchester corridor (AM and PM peak combined)[71]

5.59 This future crowding issue could potentially be addressed by lengthening trains. It should be noted that this solution is likely to require platform lengthening at individual stations, and could also be subject to finding a solution to the limitations of terminating platform capacity at Manchester Piccadilly. The full 'Northern Hub' scheme could help to address this as it provides for a doubling in the number of through platforms.

5.60 An indicative train lengthening scenario could see:

- All Northern trains (currently operated using 3-car Class 323s) lengthened to 6-car
- Wales and Borders trains (currently a mix of 2-car and 3-car Class 170s) operated with 3-car units
- Cross Country trains (currently operated using a mix of 4-car and 5-car Voyager Class 220/1s) operated using 10-car trains

5.61 This scenario would broadly double peak capacity into Manchester Piccadilly. This would contain 2033/34 PIXC in the 'Higher Growth Case' to 2.7 per cent, compared to 24.9 per cent with no intervention.

5.62 Whilst train lengthening can potentially mitigate future on-train crowding issues on local and regional services operating on this corridor, it would not improve wider connectivity into and around Manchester.

[71] Data source: DfT Autumn 2014 count data; PFM, and NMF growth rates

5.63 In contrast, the potential released capacity from HS2 Phase Two in the Crewe-Stoke-Manchester corridor could allow the reshaping of services as identified in Chapter 4.

Inter City West Coast services on the Stockport-Manchester corridor

5.64 ICWC also operates three services per hour along the Stockport-Manchester corridor. Figure 62 summarises the load factors on these services based on Autumn 2014 counts. Given the journey time from London of over 2 hours, AM peak services do not start to arrive until after 8am, with average load factors of around 50 per cent. In the PM peak, these services typically carry a mix of local and regional commuters to Stockport, Macclesfield, Crewe, Stafford and Stoke-on-Trent as well as longer distance business travellers to London and the south east. As a consequence, load factors of above 70 per cent are commonplace on services leaving Manchester Piccadilly. While some of these passengers will be travelling short distances (e.g. from Manchester to Stockport), there are also significant commuter flows from Manchester to Crewe and Stoke-on-Trent, with journey times of around 40 minutes.

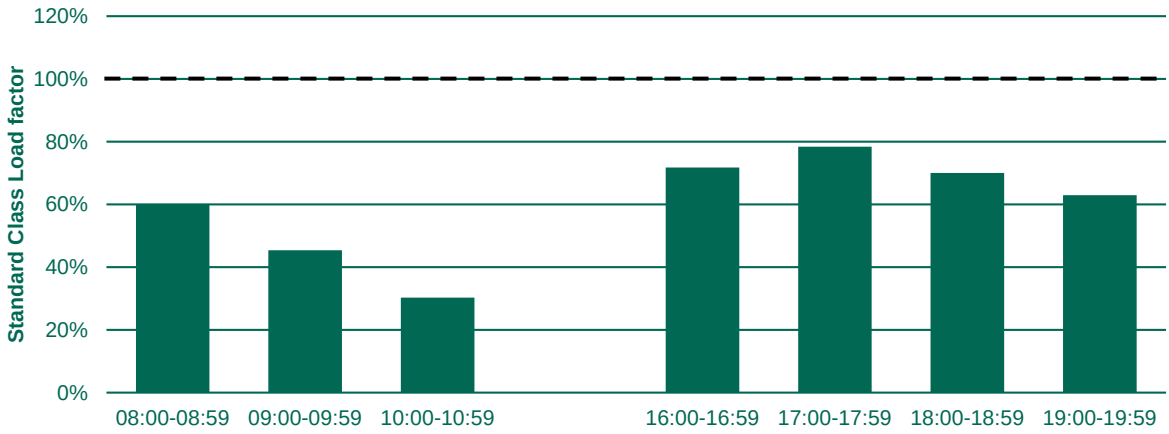


Figure 62 Virgin West Coast weekday peak Standard Class load factors along the Stockport-Manchester corridor[72]

5.65 With future growth, crowding could potentially become a significant issue on ICWC services operating along this corridor. The following chart forecasts the proportion of peak ICWC passengers who would be on trains with a Standard Class load factor of >100 per cent and therefore be standing on arrival at/departure from Manchester Piccadilly. This is assuming that all Pendolino trains are 11-car and have been reconfigured to have eight Standard Class carriages as per the 'All 11-car reconfigured trains' scenario described above.

5.66 Under the 'Reference Case' growth, 2 per cent of peak passengers are estimated to be standing on arrival/departure from Manchester Piccadilly by 2033/34. However under the 'Higher Growth Case' this increases to 16 per cent of peak passengers for a large part of their journey.

[72] Data source: DfT Autumn 2014 count data

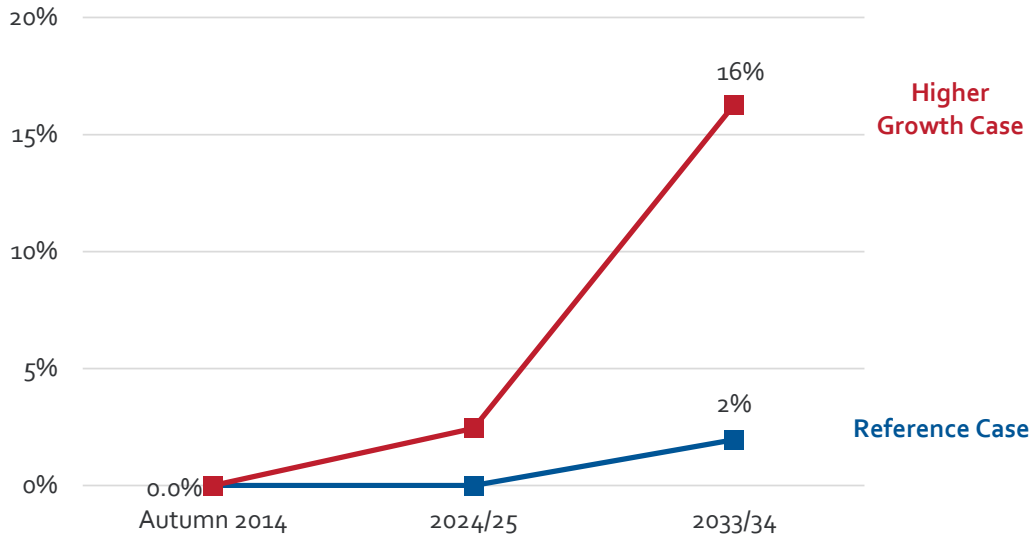


Figure 63 Projected per cent of Standard Class passengers standing (all 11-car, reconfigured trains)[73]

Alternative infrastructure interventions

5.67 As set out above, the Strategic Alternative P1 specification could potentially deliver an additional ICWC train per hour to Manchester Piccadilly. This would deliver 33 per cent additional capacity in most peak hours compared with the 'All 11-car reconfigured trains' scenario. However, this is not a future-proof solution – under the 'Higher Growth Case', PM Peak load actors are estimated be 91 per cent in 2033/34 – significantly higher than the 74 per cent seen in the Autumn 2014 passenger counts.

5.68 By contrast, under the current Business Case assumptions HS2 Phase One would provide three High Speed services per hour operated with 200 metre trains plus two inter-city services operating on the conventional network. Phase Two would further boost capacity by allowing longer HS2 trains to operate to/from Manchester.

[73] Data source: DfT Passengers in Excess of Capacity; PFM, NMF growth rates

6. Freight

- It is estimated that around 40 per cent of all Britain's rail freight services use the West Coast Main Line (WCML) at some point in their journey. Network Rail forecast that total freight volumes will grow at 3 per cent per annum for the next 30 years; with the intermodal market expected to grow at 7 per cent per annum
- Around 40 additional freight paths per day need to be found on the WCML by 2033/34 in order to accommodate this growth
- HS2 Phase One could unlock 20-40 additional freight paths per day between London and the South East and the West Midlands
- Phase Two and Phase 2a will release further capacity between the West Midlands and North West England on the WCML – as well as potentially on the Midland Main Line and East Coast Main Line (ECML) corridors
- The precise level of capacity released depends on the balance that is ultimately struck between passenger and freight use of the capacity released by HS2. This will be resolved by the industry's access planning process. Decisions on this will not be made until near the time that HS2 opens
- In addition, some investment in other routes (for example between the North West and Scotland) is needed in order to allow all of the capacity released by HS2 to be utilised fully by freight operators. This because the HS2 corridor is only part of the wider national freight network.

6.1 This chapter sets out:

- The role of the WCML in transporting rail freight today
- The level of growth in rail freight volumes that is forecast and how this will impact on demand for freight paths on the WCML
- How the different phases of HS2 will release capacity on the WCML which, in combination with investment in feeder routes, could help accommodate growth in freight demand. Freight benefits on the Midland Main Line and East Coast Main Line are not considered in this document

6.2 In reading this section it is important to note that Network Rail is currently leading a strategic rail study ("Capacity Plus") with the objective of identifying strategic options for rail services to operate after the implementation of HS Phase One. This will include options for train services made possible through the released capacity on the WCML. Options being assessed include new long distance services (to enhance inter

regional connectivity and potentially through services to London from new origins), additional capacity for freight growth and accommodating further commuting growth into London.

6.3 At this stage, no decisions have been taken on the introduction of these new services. Well established statutory, regulatory, and administrative processes will be used to build an open and shared evidence base, consult passengers, communities and freight users, establish options and take decisions ahead of the introduction of a new timetable.

Freight on the WCML Today

6.4 It is estimated that around 40 per cent of all freight journeys currently use the WCML at some point. The WCML corridor is the back bone of Britain's rail network, carrying large volumes of both passenger and freight traffic. At some points, the WCML is highly congested. This is despite the capacity increases that followed the West Coast Route Modernisation, some of which (such as the widening of the line from Nuneaton to north of Lichfield) were undertaken in order to more fully segregate freight and fast passenger services and provide more capacity for freight.

6.5 Figure 64 divides the core WCML network into three sections and highlights the key factors that affect freight in each, as well as the typical number of freight trains operated in each direction per day. This is drawn from 2011 operational data; the actual number of trains operated varies on a daily basis according to the needs of the market.

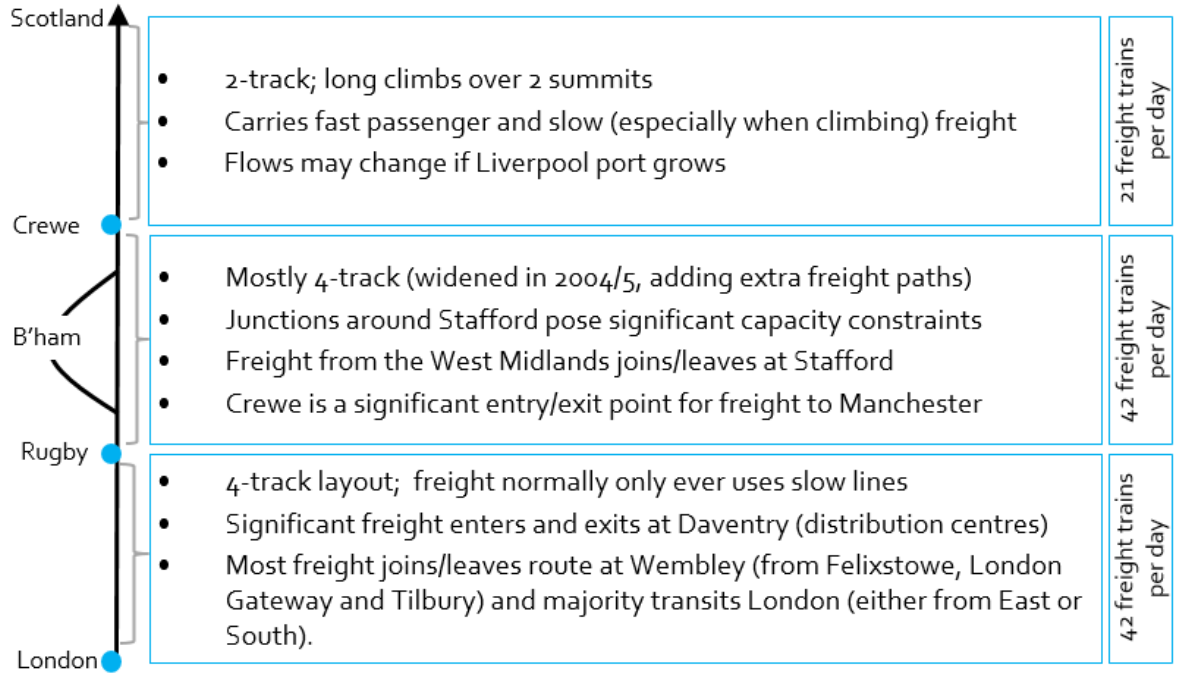


Figure 64 Helicopter view of freight on the WCML (Source: Network Rail, 2013)

6.6 Freight in the WCML corridor takes three forms:

- Intermodal – both international (to/from ports), which is the largest sector, and domestic (to/from major distribution centres). These flows join/leave the WCML at a number of points but typically have a lengthy segment along the WCML itself

- Other major flows along significant sections of the route – aggregates and coal traffic, for example. These trains have a diverse flow pattern using a large number of entry/exit points to the WCML
- Other traffic that only uses short sections of the WCML, but which interacts with the general north-south flows and so also has a bearing on capacity assessments

6.7 Freight traffic on the WCML is subject to a different set of uncertainties to passenger demand. It is a fully commercial sector and the volume of traffic is affected by many factors outside the control of the freight companies such as trends in the road haulage sector, the commercial policies of individual ports and shipping companies and the wider commercial strategies adopted by key customers. The sharp fall-off in coal movements in 2014-15 was not widely foreseen, for example – although a gradual, long-term decline in this sector was expected.

6.8 Freight trains, which are generally less time sensitive than passenger, can sometimes be routed in different ways across the country as circumstances change. For example, freight trains from Southampton had to be re-routed earlier this year, including on to the WCML, because of a landslip near Banbury which closed that particular freight route for almost a month. To provide this flexibility, it is important that track capacity on key routes such as WCML is not completely committed at all times.

6.9 Freight demand varies through the year (there is a seasonal peak related to consumer goods, for example, affecting the Autumn period) and freight trains only run when there is demand, which is often less than on a daily basis. Freight paths are therefore allocated to accommodate the best estimates of demand available, but this cannot be as precise as is the case when planning for passenger demand.

6.10 Taken together, this means that there are a broader range of options and choices open on freight routing and capacity than there are for passenger services.

6.11 In addition to this, current policy is that when new infrastructure is put in place it should be designed to support 775 metre train lengths. This is considerably longer than the historic UK norms which apply to the existing WCML freight loops. This limits the ability of full length freight trains to be overtaken by faster passenger trains on the WCML, which historically was a key operating principle.

6.12 The main constraints that face freight traffic on the WCML today are:

- At the southern end of the WCML, freight is very largely restricted from operation between 7-10am and between 4-7pm – the commuter peak periods. Because no further freight trains can practically be operated to/from London during the peaks, freight must use off peak times, potentially meaning that goods arrive or depart at inconvenient times for customers
- Limited capacity at the junctions at Stafford and the two-track section near Colwich makes further expansion of services challenging
- Finding further paths to serve terminals in Manchester is a challenge because the network from Crewe northwards is highly constrained
- Paths from Crewe to Scotland are also constrained by the need to fit in around fast passenger trains to Glasgow and Edinburgh
- Whilst the WCML is electrified, by no means all freight services use electric traction, in part because not all connections to terminals are electrified. On the northern hillier sections of route in particular, this erodes capacity by extending the sectional running time differentials between freight and passenger services

6.13 More generally, freight demand on the WCML, and the capacity available to accommodate it, cannot be considered in isolation from the capacity on the feeder routes which freight services must use in order to connect with the WCML. Especially in the major urban areas, capacity on these routes can be the binding constraint.

6.14 The key feeder routes that connect to the WCML are illustrated in Figure 65. At the southern end of the route these are:

- The North London Line (NLL) which feeds in traffic from Felixstowe, London Gateway and other Thameside ports
- The West London Line (WLL) which feeds in traffic from the Channel Tunnel

6.15 Further north, significant entry/exit points for freight on the WCML are at Crewe, Stafford and Daventry.

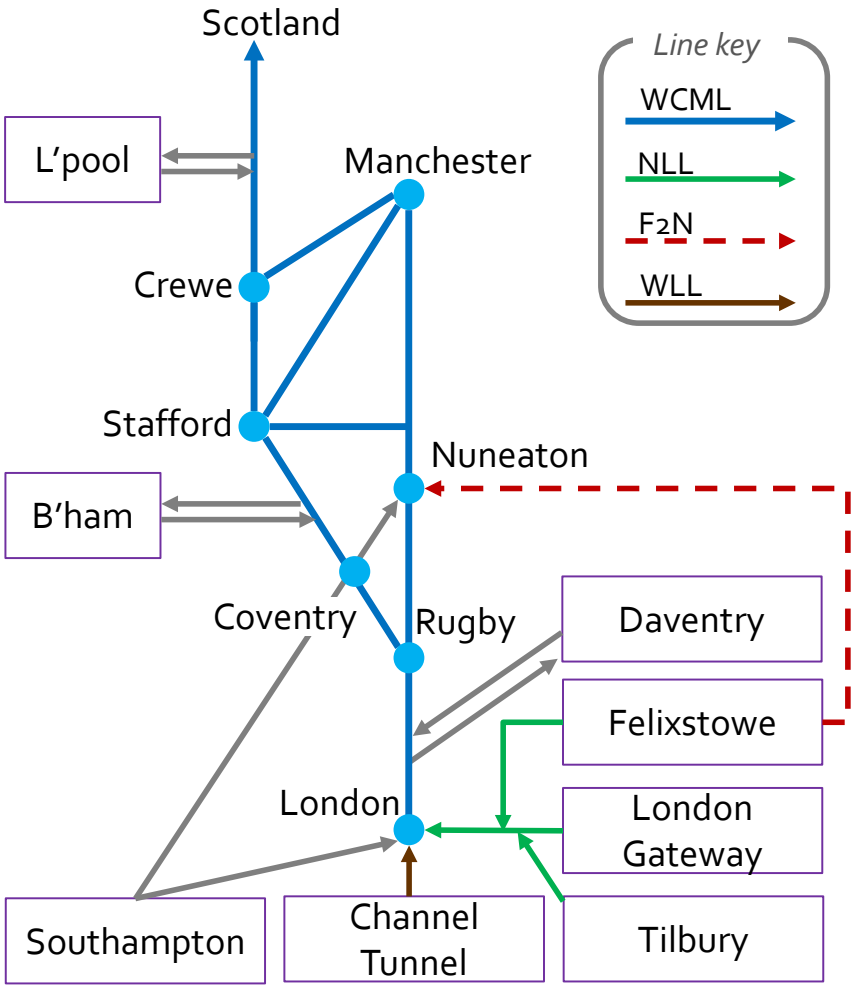


Figure 65 WCML and major freight feeder routes

6.16 To address problems with capacity on the feeder routes (and at the southern end of WCML), the Felixstowe to Nuneaton (F2N) project has been developed and is due to be completed in CP6. This could provide an additional 24 paths per day by 2023, allowing the growing traffic from Felixstowe to join the WCML at Nuneaton without placing additional demand on the southern end of the route.

6.17 Going forwards, proposals to develop port facilities in the North may increase the freight traffic fed into the WCML from the "top end" of the route. Most notable are the

proposed Liverpool 2 and SuperPort schemes in Liverpool that could see a 'reverse flow' of intermodal freight, with it being moved from north to south rather than the other way around which is more usual at present.

Forecast growth in rail freight volumes

6.18 Network Rail published its 'Long Term Planning Process: Freight Market Study' in October 2013, which forecasts freight volumes for the next 30 years and remains the most up-to-date assessment. The report was developed in consultation with the rail freight industry including the FOCs and relevant bodies such as ATOC, DfT and the Rail Freight Group.

6.19 The forecasts set out in the Freight Market Study were prepared by MDS Transmodal, a specialist rail freight consultancy, and provide an unconstrained view of demand – i.e. the work assumed that freight growth is not constrained by available train paths on Britain's rail network. Forecasts illustrated in Figure 66 show that total rail freight volumes are expected to grow at 3 per cent per annum over the next 30 years. This is largely driven by a forecast annual growth of 7 per cent per annum in intermodal traffic.

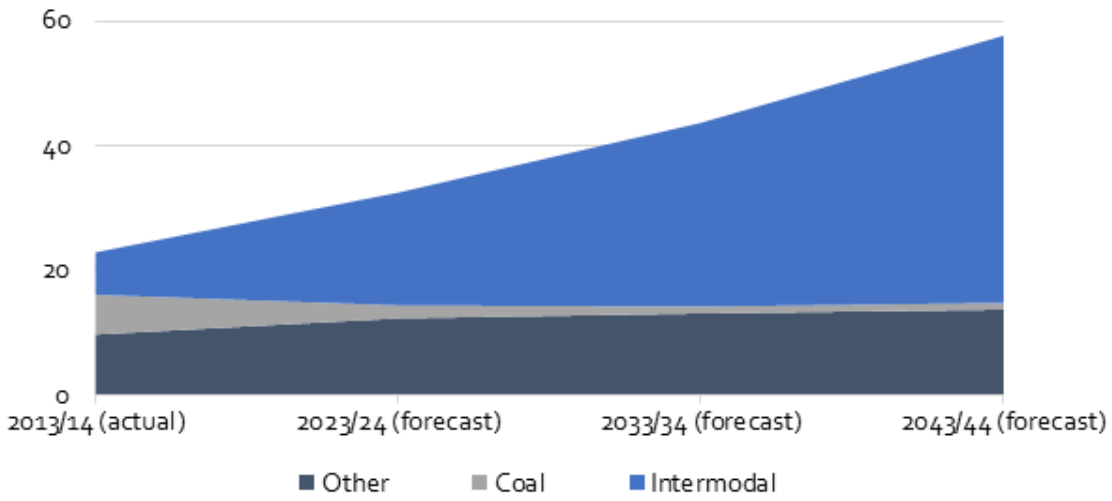


Figure 66 Rail freight forecast by sector[74]

6.20 Intermodal traffic can be defined as "the movement of goods in one and the same loading unit or road vehicle, using successively two or more modes of transport without handling the goods themselves in changing modes"[75]. Not all intermodal traffic travels by rail; freight moved by ship and road is also regarded as intermodal as well if it is in a container that can easily be transferred from mode to mode. Typically, intermodal traffic is freight moved in rigid metal containers, which come in a number of internationally-agreed standard sizes.

6.21 Domestic intermodal is the movement of freight between UK distribution centres. This market is currently dominated by road (98 per cent market share) but rail's competitive position is better over longer distances, which is one reason why the WCML is so important to the intermodal rail freight market.

6.22 International intermodal traffic comes from sea ports and the Channel Tunnel. In essence, intermodal trains from the Channel Tunnel and the ports in the South East

[74] Data source: "Freight Market Study" (Network Rail, 2013)
[75] Rail Freight Portal (ECMT/UN definition)

travel via London, to use the WCML to reach the West Midlands and the North West. In addition, trains from the port at Southampton join the WCML at Coventry either to access Birmingham or the North West via Crewe. The market for moving containers between UK ports and inland distribution centres is expected to grow considerably as long term trade growth is anticipated to outperform UK economic growth.

6.23 Network Rail's overall forecasts, when applied to current West Coast demand, suggest that the requirement for WCML paths could nearly double by 2033 from 42 to 80 freight paths per day on the southern section of the WCML. This rises still further to over 100 paths in 2044.

6.24 Within this, demand for paths for intermodal freight traffic is expected to grow from 32 to 58 paths a day in 2033/34, by which point it will comprise approximately three quarters of total freight trains.

HS2 Phase One could unlock 20-40 additional freight paths per day

6.25 Figure 67 illustrates schematically the route of HS2 Phase One and shows, in strategic terms, how it could help release capacity for freight. Following the completion of HS2 Phase One and prior to the completion of Phases 2a or 2b, high speed services will join the existing four-track railway at Handsacre Junction to the north of Lichfield, and travel on to Colwich Junction about 20 kilometres north, where the routes to Crewe and Stoke-on-Trent diverge.

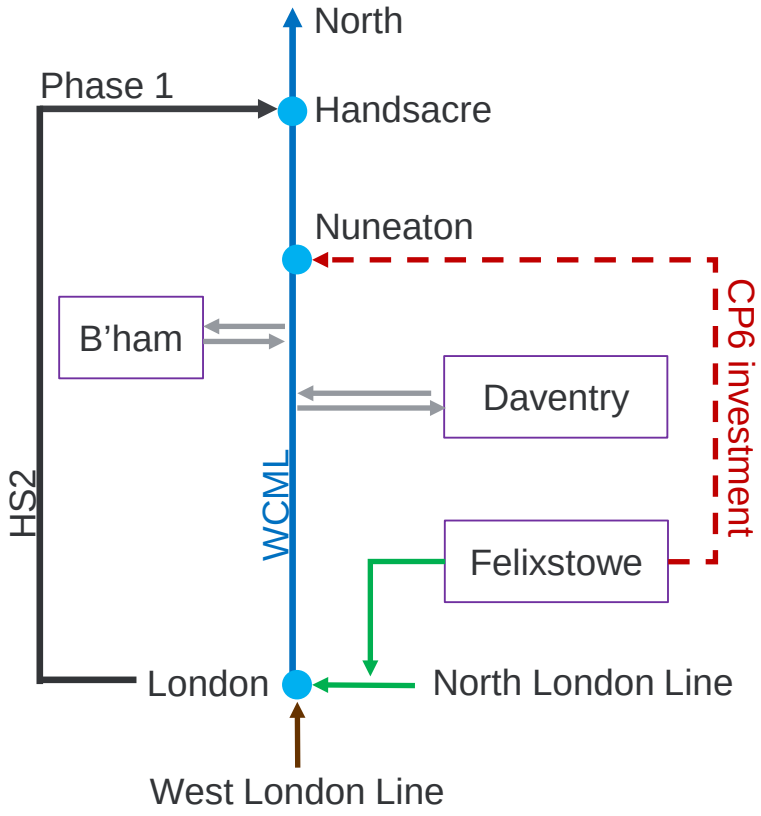


Figure 67 Schematic of WCML and HS2 Phase One

6.26 In essence, the available information frHS2 Limited and the Train Service Specification (TSS) presented to the hybrid Bill committee in January 2015 suggests

that at least one extra freight train each hour – in each direction - could potentially operate post Phase One and that a second might be possible as well. This is due to the greater space that will be available on the Slow Lines from Euston once all “fast commuter” services to Milton Keynes and beyond switch to the Fast Lines to take the space currently used by inter-city trains.

6.27 Because freight north of Rugby can use either the WCML or other routes in the West Midlands area, it is possible that the section between Rugby and Crewe will not be as significant a constraint as at present once HS2 opens. However, the number of trains on the two-track section from Colwich to Stafford means that timetables would need to be orientated around this section to avoid performance risks.

6.28 Once freight trains reach Crewe, there are also a number of further capacity constraints in the north of England that restrict the ability to provide additional paths to freight terminals.

Phase Two and 2a will release further capacity

6.29 The track north of Crewe remains a problem for freight as it is only two-tracks, with freight loops that are too short to accommodate today’s freight demand, with slow exit and entry speeds and, in some cases, poor locations, at the foot of lengthy (and therefore slow) inclines.

6.30 Figure 68 considers the impact, in very schematic terms, of the Western leg of Phase Two that would rejoin the WCML at Golborne Junction, near Wigan, as well as the proposed potential Phase 2a scheme where HS2 would join the WCML at Crewe.

6.31 The key benefit of Phase 2a for freight is that it would allow fast passenger trains to bypass three bottlenecks (the junction at Colwich, the two-track section south of Stafford and the junction at Stafford itself) thus opening up more capacity for freight (and slower passenger) trains in these areas. The freight centre at Basford Hall, just south of Crewe, is a key location for re-forming trains and changing train crew. The approaches to it from Stafford are operationally complex, with non grade-separated junctions. The Phase 2a junction would bypass these crossovers, helping provide capacity for freight traffic between Basford Hall and London/the West Midlands.

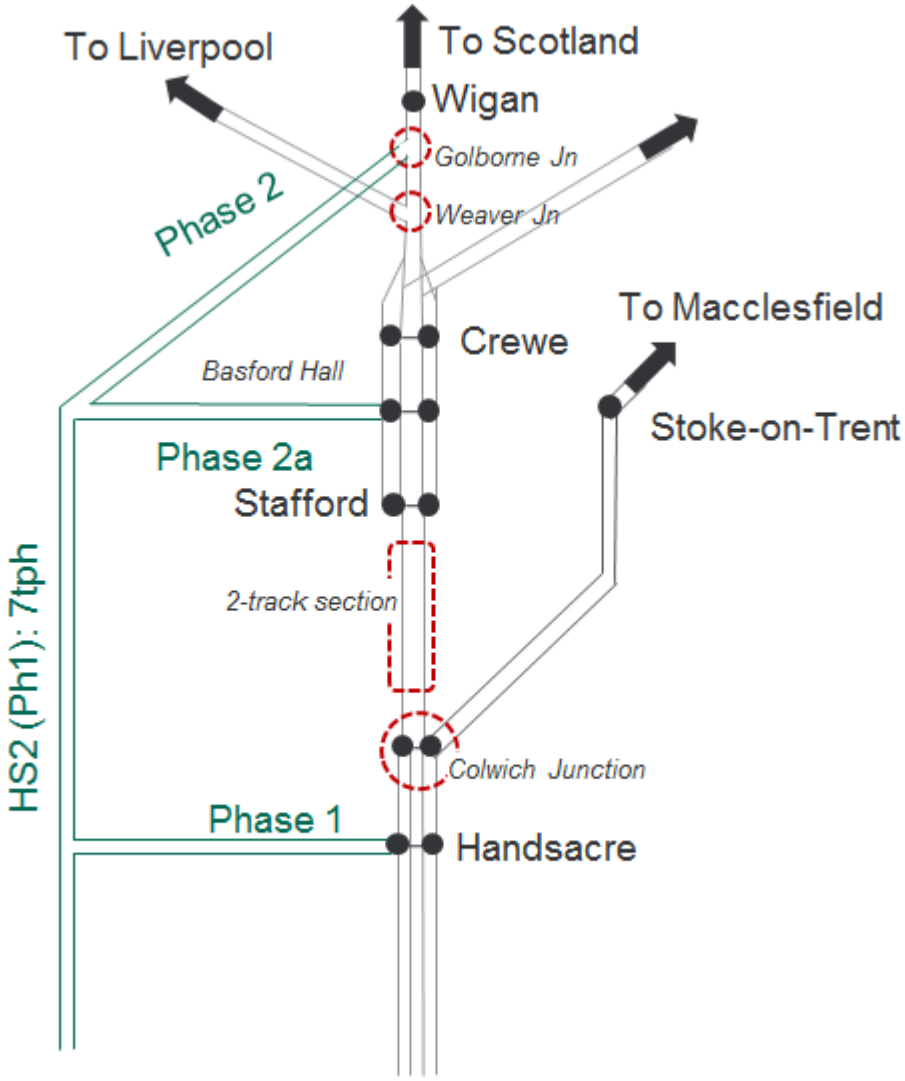


Figure 68 Schematic of WCML and HS2 Phases 1, 2a and 2

6.32 Full Phase Two will include a further extension of the high speed line from Crewe to Golborne Junction, just south of Wigan, as well as to Manchester. The link to Golborne will provide some further potential freight capacity between Crewe and Weaver Junction, where the route to Liverpool leaves the WCML since Phase Two effectively bypasses today's line, and between Crewe and Warrington. At present, the Crewe - Weaver - Warrington section is heavily constrained, with up to 10tph in each direction comprising a diverse mix of fast passenger, stopping passenger and freight trains of various speeds that is a challenge to timetable. There are three small passenger stations on this section which have an hourly service that is particularly capacity-heavy. With Phase Two, up to two London-Preston/Glasgow inter-city trains per hour would divert from the WCML and potentially also the hourly Birmingham - Glasgow trains. The capacity released by this could be used by freight. This could potentially be useful for services to the West Midlands, Daventry and London from expanded port facilities at Liverpool, once complete.

6.33 In essence, the further north HS2 joins the WCML, the greater the benefit for freight. This is for three reasons:

- The greater the length of classic network that HS2 releases capacity from, the greater the benefits

- The classic network is less crowded (due to lower population and thus passenger demand) the further north you travel
- The Phase One junction (Handsacre) is just south of a particularly busy two-track section around Colwich Junction

WCML Feeder Routes

6.34 To take full advantage of the capacity released on the WCML by HS2, it is important to look at investment options to accommodate freight growth on WCML feeder routes – in particular at the southern end of the route. Work suggests that there could well be sufficient existing or planned capacity, depending on the resources available to Network Rail and the extent of use of the North London routes by TfL. In particular:

- There appears to be sufficient capacity for the identified future growth in demand between Felixstowe and London via the Great Eastern Main Line, subject to sufficient capability being available to stage trains between the Great Eastern Main Line and North London Lines
- On the North London Line the Anglia Route Study suggests that infrastructure planned for Control Period 5 (CP5) will be sufficient to deliver freight capacity in CP6, with a signalling scheme to reduce headways required to accommodate long term growth and maintain performance. This will allow an additional hourly freight path to operate
- There is significant growth anticipated on the Gospel Oak - Barking route. A number of infrastructure enhancements are committed for CP5 to help deliver this additional capacity. These include electrification which will speed up passenger services. These enhancements are anticipated to give two or three additional freight paths each hour