



Review of Strategic Alternatives to High Speed Two

***Network Rail
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Review of strategic alternatives to High Speed Two

Executive summary

The Government's consultation on high speed rail proposed that a new line, called High Speed 2 (HS2), should be built initially between London and the West Midlands, to be extended to Manchester, the East Midlands and Yorkshire in a further phase of work. The new line would provide additional capacity as long distance services transfer from existing routes.

The Department for Transport (DfT) has asked Network Rail to review two proposals (produced by consultants for 51M¹ and the DfT) that suggest alternative strategies to HS2, both of which aim to provide additional capacity on the West Coast Main Line (WCML). The DfT has also asked Network Rail to review a high level proposal of an alternative option that aims to provide additional capacity on the Midland Main Line (MML) and the East Coast Main Line (ECML).

The work undertaken to review the proposals has considered the outputs, feasibility, deliverability and costs of the interventions suggested on the WCML. The proposals both clearly provide benefits to some flows on the route, although this is at a cost to particular locations through loss of capacity or connectivity. The key issues identified are as follows:

- neither proposal would provide sufficient capacity to meet forecast demand on the suburban commuter services at the south end of the WCML
- the intensive off-peak service pattern in the alternative strategy produced for the DfT would mean that freight growth could not be accommodated
- both proposals would likely necessitate remodelling at London Euston station
- both proposals would result in long periods of disruption along the route

while the infrastructure interventions are constructed

- the high utilisation of the fast lines in both proposals would negatively impact on route performance
- both service specifications increase long distance high speed (LDHS) connectivity on some flows, however this is at the expense of other intermediate flows, where connectivity severely worsens. In some cases this results in leaving stations without a train service.

The assessment of the proposals produced for the DfT to provide additional capacity on the ECML and the MML has also concluded that it is not a suitable long-term strategy for the corridors in question for the following reasons:

- it is considered that neither route option could deliver the stated outputs with the infrastructure that is proposed
- in some cases considerably more infrastructure could be required, such as terminal station remodelling or the building of additional running lines
- both routes would undergo a lengthy and disruptive programme of significant infrastructure upgrades
- the ECML proposition leaves no clear way to solve the capacity gap that is forecast on services from the outer suburban area.

Network Rail's assessment of the proposals has concluded that these incremental infrastructure and rolling stock enhancements are not the right solution to the overall capacity problem on the WCML. Whilst such improvements could provide some relief from overcrowding on certain services, they leave other issues unresolved and, as they fail to provide sufficient capacity for commuters at the south end of the WCML, do not solve the main capacity constraint that is the primary driver for intervention on the route.

There is a heavy disruption impact to deliver the enhancement projects in all three proposals, as each of the infrastructure interventions required to provide the proposed outputs necessarily affects the operational railway. This is on routes which are more popular and are being used more intensively than ever before.

¹ 51M is a group of 18 local authorities that has joined together in a national campaign to actively challenge the HS2 rail project.

Network Rail aims to provide a 'seven day railway' for its customers, minimising disruption, particularly on key interurban routes. When part of a route has to be closed diversionary routes are used where possible and if not, passenger journeys are transferred to buses. Freight traffic is even more difficult to accommodate elsewhere.

The cumulative impact of these separate schemes on current services (not including the growth expected in other markets that these outputs do not provide for) would be very significant, involving a sustained period of regular disruption on the WCML (and MML and ECML) similar to that required for the West Coast Route Modernisation (WCRM).

For some markets the proposals make the situation worse than today on the WCML, such as removing the capacity for freight growth in the strategy produced for DfT, leaving some stations without a train service (such as Stone and Atherstone) or the reduction in train service for stations south of Tring in 51M.

The cost estimates for the infrastructure interventions included in the proposals are broadly realistic, but the scope which has been priced is less than what would be required to deliver the proposed outputs (for example at London Euston station or for platform extensions), meaning the estimates are insufficient. The cost of disruption has also been underestimated.

The proposed interventions deliver considerably fewer benefits than a new line, particularly with regard to reduced journey times between urban centres and the ability to use the resultant freed capacity on the classic network to develop new markets and provide for continuing freight growth. So whilst some of the proposed enhancements may offer limited and short term opportunities for improving capacity on some areas of the route, the requirement for a new line to relieve capacity in the longer term remains and therefore would have to be delivered, in addition to these proposals, in any case.

1.0 Introduction

In February 2011, the Government commenced a public consultation on high speed rail in Britain.

The consultation included both the wider high speed rail strategy, and the proposed route of the first phase of a new high speed line, to be built between London and Birmingham. The Government has proposed that the line, to be called High Speed 2 (HS2), would be extended to Manchester, the East Midlands and Yorkshire in a further phase of work, which is to be consulted upon in 2012.

When completed, HS2 will provide additional capacity on the West Coast Main Line (WCML), the Midland Main Line (MML) and the East Coast Main Line (ECML), as long distance services will transfer to the new line.

This high speed line would release much needed additional passenger and freight capacity on the existing network and provide significant reductions in journey times, improvements in national and international connectivity and would provide wider regenerative and economic benefits.

While there is a strong business case for HS2, strategic alternatives have been developed to examine whether capacity and journey time improvements can be delivered over the existing rail routes. Of these alternatives, the first is a report prepared for the Department for Transport (DfT) by Atkins², which proposed several alternative options over the WCML, of which Rail Package 2 (RP2) has the best business case. The DfT then developed a number of options for the ECML and the MML as alternatives to the second phase of HS2³, of which Scenario B has the best business case. 51M⁴ remitted Chris Stokes to produce a separate proposal⁵, which also aims to provide additional capacity over the WCML.

The DfT has asked Network Rail to review a number of elements of these possible

alternative strategies to a new high speed rail line. Specifically, the review was required to focus on the outputs, the cost estimates and their feasibility/deliverability. In addition the DfT requested Network Rail provide an assessment of Scenario B to the extent that it provides a robust basis for the development of ECML and MML over the next 20-30 years.

Network Rail has carried out a high level analytical review of the strategic alternatives. The review supports Network Rail's conclusions derived through its New Lines Programme and the West Coast Main Line Route Utilisation Strategy (RUS) that in the long run, the most effective intervention to solve the capacity problem on the route would be the provision of a new high speed line. Selective enhancements may generate short term capacity, but will come at a high cost and increased performance risk during construction and operation, and may not be sustainable in the long run.

The remainder of this report is arranged as follows:

- section 2: Review of 51M proposal
- section 3: Review of RP2 proposal
- section 4: Assessment of Scenario B proposal.

The analysis was undertaken using current timetable planning rules, current technology and West Coast Main Line RUS demand forecasts.

There are common elements between the 51M report and the RP2 report and for consistency these elements are duplicated in both sections.

² [High Speed 2 Strategic Alternatives Study – Rail Interventions Report, March 2010](#)

³ [Strategic Alternatives to the proposed 'Y' network](#)

⁴ 51M is a group of 18 local authorities that has joined together in a national campaign to actively challenge the HS2 rail project.

⁵ [Optimised Alternative to HS2](#)

2.0 Review of 51M proposal

The 51M report proposes to meet demand growth to outer suburban stations and provide an increase in long distance capacity on the WCML by

- running longer, 12-car trains for long distance services⁶
- reconfiguring one first class carriage to standard class
- running additional peak long distance services
- running four fast line services to outer suburban destinations.

A number of infrastructure enhancements are proposed by the report to support the increase in service level.

2.1 Outputs

Network Rail was asked by DfT to examine 'whether the suggested outputs can be delivered by the proposed infrastructure and other interventions' in the 51M proposal.

The 51M information as presented appears broadly acceptable from a high level train planning point of view, provided the quantum of other services stay the same as today and subject to some minor timetable conflicts being resolved.

The analysis undertaken confirms that the timings assumed by 51M seem appropriate. The specification presented by 51M is in the northbound direction only and assumed to operate in the evening peak, but it is unclear what service is proposed in the off-peak or morning peak. The WCML has historically had a different morning peak specification to cater for passenger needs which is less standard than the evening peak. Further information would need to be provided and analysed to understand whether this proposal would work in the morning peak.

To achieve the proposed quantum of services, the other suburban services that utilise the fast lines would need to be operated using 125mph tilting suburban rolling stock. Such rolling stock does not currently exist and would need to be specified and purchased as new-build stock.

The 51M report states that the following infrastructure enhancements are required to deliver the proposed quantum of services:

- grade separation of Ledburn Junction
- construction of a fourth line between a section of Attleborough South Jn to Brinklow Jn
- Northampton linespeed improvements
- Stafford bypass.

The work undertaken in this review confirms that these infrastructure changes appear necessary to deliver the service that 51M are proposing, and that further enhancements may be required.

The 51M report proposes no infrastructure change to London Euston station to accommodate the increase in train services. The increase and lengthening of long distance services will constrain the platform capacity available at Euston and lengthening of platforms may be required.

The geographical constraints, and layout of the station, mean that extending the existing platforms would be a complicated and expensive exercise involving changes to the layout of the station throat or relocating the service access beneath the concourse, this is discussed further in section 2.3.

The specification by 51M does not consider the sleeper services on this route. Today, two sleeper services need to be accommodated in long platforms at London Euston station for a large proportion of the morning peak period. As no morning peak specification is provided, the impact on capacity available for the sleeper service cannot be assessed. Assuming the morning peak specification is similar to the evening peak specification presented, and that the sleeper services continue to occupy platforms at London Euston station to the extent that they do today, additional platforms are likely to be required to accommodate the specified train service.

Determining the scope of any work required at Euston would require more detailed assessment of a timetable, recognising also the flexibility that would be required to maintain performance on the WCML. The feasibility of providing this additional capacity at London Euston is considered in section 2.3.1.

⁶ With the exception of those to Liverpool Lime Street, which remain at 11-cars.

Platform lengthening will be required for many of the stations along the WCML. There will also need to be a change to depot layouts to accommodate 12-car Class 390 trains.

The 51M proposal shows all three West Midlands long distance trains terminating at Birmingham New Street. It is assumed that at least one of these would continue to Wolverhampton as today due to platform constraints at Birmingham New Street.

The 51M proposal concentrates on increasing the capacity on the fast lines. In the slow line proposal presented by 51M, the number of station calls south of Tring generally falls compared to the current service offering. The proposal does not provide any more capacity on the slow lines between London Euston and Rugby, or at London Euston station, therefore limiting the number of peak slow line services to something very close to the current position.

The 51M service specification has all outer suburban services operating north of Northampton running towards Birmingham New Street. Calls at Tamworth, Nuneaton and Lichfield are provided by the long distance services, but there is not an obvious replacement for the other Trent Valley stations (Rugeley Trent Valley and Atherstone). This would leave Rugeley Trent Valley without a connection to London and Atherstone completely unserved. This also results in a loss of connectivity on the Stoke-on-Trent route as no replacement service is proposed, and would leave Stone station completely unserved. Further timetable development work would be required to find a way to replace this capacity, though it would incur additional cost.

The introduction of the WCML December 2008 timetable had a detrimental impact on 'local' services in the Manchester area. Increasing the long distance services to Manchester Piccadilly, without any infrastructure investment on the corridor, may cause a further detriment to the local services and will definitely restrict growth or any improvement in the local services in this area.

No additional capacity is provided on the Coventry – Birmingham New Street corridor. This route is currently at capacity and therefore the service level proposed will allow for no further growth. The RUS

recommendation to divert the Southampton Central – Newcastle service away from the Solihull corridor and onto this route could not be delivered under the 51M proposition.

No details are provided for the off-peak service offering by 51M, therefore any evaluation of capacity for freight is very difficult. In the peak, the slow line service specification is very similar to today's and it is therefore likely that the limited current freight capacity at that time of day could be retained. If the off-peak service was similar to today, then reasonable freight growth could be accommodated as per the findings of the West Coast Main Line RUS. The Strategic Freight Network forecasts used in the RUS assumed 640m length trains and six-day working⁷, but it should be noted that funding to achieve these efficiencies is not yet committed by the industry and if they fail to materialise, then the conclusions will have to be revisited.

2.2 Costs

Network Rail was asked to examine 'whether the costs of the interventions included in the economic appraisal of 51M are an accurate reflection of the likely costs of such works'.

Network Rail has reviewed the 51M infrastructure cost estimates, as well as any infrastructure that was deemed necessary as a result of the work outlined in section 2.1. Approximate estimates of the cost of each enhancement were prepared (based on the information available for each) using Network Rail's standard estimating methodology. An optimism bias allowance of 66 per cent has been included in all estimates to be consistent with the approach taken by 51M. Pre-delivery scheme development costs are not included in the estimates, again to be consistent with the 51M estimates.

Network Rail has not examined the effect of the 51M proposals on the rest of the network (in terms of the ability to run the services that either join or leave the route). It has been assumed that the interventions identified would suffice to enable through running of all these services but this would need to be examined further if the proposals were taken forward and additional

⁷ Referred to on page 9 of West Coast Main Line RUS

infrastructure costs (or disbenefits from disjointed services) could be incurred.

The 51M report assumes that 11-car Class 390s will have already been accommodated and that the introduction of 12-car Class 390s will require only modest infrastructure interventions. 51M assume all options are technically feasible, deliverable and built away from the running line wherever possible. No account for environmental impact has been included.

2.2.1 Infrastructure suggested in the 51M report

The table below summarises Network Rail's review of the cost of the interventions proposed in the 51M report:

51M infrastructure enhancement	51M suggested cost (£billions)
Grade separation of Ledburn Junction	0.24
<p><i>The estimated cost in the 51M report for delivery of the proposed enhancements is considered to be under-costed by approximately five per cent.</i></p>	
Construction of a fourth line between a section of Attleborough South Junction to Brinklow Junction	0.19
<p><i>Network Rail's assessment of the cost for this enhancement is significantly lower than that included in the 51M report (approximately 50%).</i></p> <p><i>A more detailed assessment of the proposed enhancement is required to fully assess the likely impact of the proposed works on the operation of Rugby and the Trent Valley lines.</i></p>	
Stafford bypass	1.23
<p><i>Network Rail has assessed the cost estimate for the Stafford bypass by reference to a previous proposal for an enhancement at Stafford which gives the same outputs as those proposed in the 51M report. It is our assessment that the 51M estimate is not significantly over or under-costed.</i></p>	
Northampton linespeed improvements	0.003
<p><i>The estimated cost in the 51M report for delivery of the proposed enhancements is considered to be only about a third of the likely cost, but the difference is not considered significant as the item is low cost, relative to the other enhancements. Any work at Northampton may involve significant disruption to train operations as this is a critical servicing location for London Midland.</i></p>	
Power supply, disruption and other items	24%
<p><i>The 51M report is not explicit about exactly what work is required so these three items cannot be evaluated in the same manner as the items above. However, 24 per cent of constructions costs is considered significantly too low to cover power supply, disruption and all other interventions that would be required on the route. This is discussed further in sections 2.2.2 and 2.3 below.</i></p>	

In total the cost estimates for Stafford bypass, Brinklow Junction – Attleborough South Junction, Ledburn Junction and Northampton linespeed improvements are not significantly over or under-costed. However, running the service proposition suggested by 51M would require considerably more infrastructure enhancement than is specified in the report.

2.2.2 Additional infrastructure required

Overall, it is considered that the costs of the infrastructure enhancements listed in the report are broadly acceptable. However, there are a large number of infrastructure enhancements not included and these costs also need to be considered when evaluating the proposal.

The table below summarises Network Rail's review of the interventions that are

necessary to deliver the service proposition, but were not included in the 51M report. The bulk of these additional costs are for platform lengthening. Selective Door Opening (SDO) is used on some areas of the rail network to avoid the need for platform lengthening at intermediate stations (SDO is not feasible at terminal stations). However, in this case it is not possible to operate SDO and extend beyond the platform by no more than one car at the majority of stations (with the exception of Sandwell and Dudley), so this is not a feasible alternative.

There are also a number of other costs that would have to be included in the proposal, but for which it is not possible to estimate a cost at this time as the scope of works is unknown. These issues are discussed further in section 2.3.

Infrastructure enhancement	NR estimate (£m)
Station enhancements	
Watford Junction	£5
Coventry	£70
Sandwell and Dudley	£1
Wolverhampton	£15
Lichfield Trent Valley	£35
Stoke-on-Trent	£10
Wilmslow	£15
Manchester Piccadilly	£2
Warrington Bank Quay	£15
Wigan North Western	£15
Preston	£10
Blackpool North	£30
Lancaster	£40
Oxenholme Lake District	£2
Windermere	£5
Penrith North Lakes	£5
Lockerbie	£15
Glasgow Central	£25
Other	
Oxenholme Lake District to Windermere electrification	£25
Conversion of first class coaches to standard class	£5
TOTAL	£345

2.3 Feasibility and delivery

This aspect of the proposal was examined from a number of angles. Firstly, the deliverability of the upgrades required to the route to accommodate the proposed service specification. Secondly, the effect that running this train service would have on the route; and, lastly, whether this service specification would provide adequate capacity to accommodate long-term demand on the route.

2.3.1 Construction feasibility and disruption

The following is a high level assessment of the feasibility of the infrastructure enhancements that have been suggested in the 51M report, along with any other interventions that may be necessary as a result.

Stations

The 51M report made no reference to the requirement to extend platforms at stations along the route as a result of extending Class 390 sets to 12-cars. Network Rail's assessment concludes that there are numerous stations that will require platforms to be extended to accommodate a 12-car Class 390 train.

Stations where work is required (except London Euston – see below) are listed in the table in section 2.2.2 above – this work could range from a relatively straight forward platform extension to a significant remodelling. The most complex locations are discussed in more detail below.

London Euston

Network Rail's initial review of the proposal has demonstrated that it is likely that a capability change would be required at London Euston to accommodate the 12-car long distance services along with the suburban services and the sleeper services in the morning peak.

This could involve longer platforms to accommodate 12-car Class 390 trains as well as any additional platforms that may be required. A more detailed timetabling exercise would be required to determine the precise scope of works.

Due to the restrictions of the track layout at the north end of London Euston station, and

the associated platform widths at this point, it would be necessary to extend the platforms towards the concourse. This would require encroachment into the station undercroft. This forms a key arterial route between platforms for station and train support services and would therefore need to be re-provided by moving it further towards the south. This, however, would involve complicated engineering works due to the structural columns in this area which support the station concourse, catering facilities, road access and British Transport Police offices. It may also be necessary to relocate the car park and taxi drop off area.

Therefore, any platform lengthening would require a major remodelling of London Euston station, including the phased closure of sections of the station with major demolition and rebuilding programmes.

The viability of installing additional platforms at London Euston is discussed in the review of RP2, which proposes installing new platforms at the station.

Coventry

Coventry was excluded from the 51M report, and whilst there are minor works on three platforms, Platform 4 gives cause for concern. This platform is used by Class 390s at weekends and in times of service perturbation, and hence would need to be 12-car capable. It is currently eight-car capable and an extension would require major reconstruction of the road overbridges and realignment of track.

Wolverhampton

A significant number of WCML services stop at Wolverhampton daily so it would be necessary to provide the appropriate platform lengths. In order to avoid significant disruption to the local area, the infrastructure works would involve moving Crane Street Junction further south, alternatively widening the rail bridge at the north end of the stations that span the road, thereby creating space to extend the northbound platform to accommodate 12-car Class 390s. The work would involve track, signalling and overhead line equipment (OLE) works and would require blockades and weeknight possessions.

Lichfield Trent Valley

Lichfield Trent Valley, like most intermediate stations, was excluded from the 51M report. The station has two platforms on the slow lines, and these would need to be extended to accommodate 12-car Class 390 trains. The freight line connection at the northern end of the southbound platform means the extension to this platform would have to be at the southern end, with associated track, signalling and OLE alterations. To deliver this, the road that crosses the WCML would have to be demolished and rebuilt.

Wilmslow

The platforms at Wilmslow are constrained at either end by road underbridges. Extending the platforms at both ends rather than at one is required to avoid property purchase or major track alterations on the northbound line. Full blockades would be required to carry out the work.

Wigan North Western

As the junction to the up and down Wallgate Lines is located at the southern end of the current platforms, any extension would have to be at the northern end of the station. By moving the southbound slow line at the northern end, with associated OLE alterations, it would be possible to accommodate the platform extensions, with OLE and signalling alterations.

Glasgow Central

Platforms 1 and 2 at Glasgow Central form an island platform at the east side of the station. Platform 1 is constrained by a building at the buffer ends and any change to the buffer ends would potentially require new buffer stop designs which would add dramatically to the amount of space required to accommodate an extension.

Conversion of the existing access ramp and a further minimal extension to Platform 1 will provide a platform of the required length. Alterations to OLE and signalling to accommodate the changes would also be required.

The proximity of the works on Platform 1 and 2 to the railway would necessitate a possession of both lines. The current overhead line switching arrangements would require an isolation of Platform 1 and 2 and the platform approach lines.

Grade separation of Ledburn Junction

In order to remove the conflict at Ledburn Junction of northbound trains (usually Northampton services) crossing the southbound fast lines and reducing available capacity, a grade separated junction would be necessary. The site has been inspected and it is clear that any junction rising above the level of the WCML would have severe visual intrusion as it would have to be raised approximately 25m above ground level. In order to maintain linespeed when exiting the junction, a high speed turn-out would be required and the gradients would need to be as shallow as possible. It would also be preferable to incorporate a larger land take on the eastern side to avoid expensive relocation costs for signalling and power equipment, although this would require powers acquired through a Transport and Works Act. A road closure would be necessary and the works could only be carried out with full weekend blockades and numerous weekend temporary road closures.

Stafford bypass

The objective was to significantly increase the number of trains that could pass through the Stafford area by addressing the assumed constraints of Colwich Junction, the two-track section through Shugborough, Milford and Brocton Junctions, Trent Valley Junction and Norton Bridge Junction.

The bypass solution previously considered by Network Rail, which provides the same outputs as that in the 51M report, comprises:

- a new line leaving the WCML between Rugeley and Colwich Junction and joining the existing Colwich Junction - Manchester route at Hixon
- a new line leaving the Colwich-Manchester route around Sandon and heading west across Staffordshire towards the existing WCML.

In terms of disruption to the existing railway, this would mostly be where new infrastructure interacts with the existing network:

- at the junction between Colwich Junction and Rugeley on WCML
- at the junction at Hixon on Colwich Junction - Manchester route

- at the junction at Sandon on Colwich Junction - Manchester route
- at the junction at Norton Bridge or Badnall Wharf on WCML.

Apart from a small section on the Colwich Junction - Manchester route between Hixon and Sandon, the bypass developed as part of the Network Rail proposition was intended to be all new railway built on a 'green field' site. As a result much of the construction, other than the four tie-ins, would not have an impact on the operational railway.

The environmental impact on the surrounding area would be significant, and a construction period of around four years would be extremely intrusive to the local community. Planning consent from the Infrastructure Planning Commission would be required if this option were pursued, the timing of which would need to be taken into account.

The Stafford area improvement project (including Norton Bridge Grade Separation) is currently being developed by Network Rail for delivery in Control Period 5 (CP5). This scheme will deliver two additional fast line paths to/from London in the off peak. The scheme does not provide an increase in peak capacity; therefore it is likely that further intervention in the Stafford area will be required. 51M acknowledge this and have included the costs for a Stafford bypass. Further development work and examination of the timetable would be required to understand whether the project planned in CP5 could help provide some of the capacity for the 51M requirements.

Construction of a fourth line between a section of Attleborough South Junction to Brinklow Junction

There is a three-tracked section of railway between Attleborough South Junction and Brinklow Junction. 51M propose four-tracking part of this section to reduce the length of the constraint. In order to do this, it would be possible to use some of the old alignment, however, a number of structures and residential properties would have to be demolished, and bridges extended. The works would require the relocation of signalling equipment and creation of new OLE structures (either stand alone or by extending the current masts). Most of the linear works are complicated but could be

executed within possessions and the structural elements would require blockades.

Depots

The requirement for additional facilities for train servicing at depots is seen as a critical issue to the development of the options for longer trains set out within the 51M proposal.

Initial findings show that extensive alterations and remodelling would be required at depot entry/exit connections and sidings and a general remodelling of the depot layouts would be necessary to accommodate the longer trains. The availability of additional land to allow depots to expand, where necessary, as a result of the remodelling required to accommodate the proposed increase in train length is likely to be a key issue.

Depot requirements and associated locations need to be investigated in more detail to ascertain future requirements of train servicing and future depot capability at key locations.

Power

The 51M report allocated 24 per cent of construction costs to 'other items', including disruption and power supply upgrades. It is not possible to know the exact cost of the power supply upgrade that would be required as it is not known what the base timetable will be when the 51M service specification is implemented. However, Network Rail estimated the cost of the power supply upgrade that would be required if the 51M specification were implemented on the current timetable, with committed interventions, to be c£150 million.

Disruption

A key consideration when evaluating the 51M proposal is the disruption caused to the operational railway during the construction phase of these interventions. Necessarily, each intervention affects the operational railway and would involve significant blockades, resulting in passengers experiencing extended journey times via diversionary routes (if there is capacity available) or transfer onto replacement bus services.

Some locations (Colwich Junction for example) are currently planned to be renewed on a like for like basis no more

than five years before the proposed interventions are built. Should the 51M proposals be taken forward, an integrated plan would need to be developed to avoid a doubling up of disruption for train operators and passengers in a short space of time due to the potential for duplication of work required at some locations.

Network Rail aims to provide a 'seven day railway' for its customers, and much of the WCML already operates as a seven day railway. However, using a less disruptive approach (for example multiple night time possessions instead of blockades) could severely increase the cost and duration of the works making them less efficient to deliver.

It has been proposed that delivery of the enhancements (and by definition the introduction of service benefits) could be phased over a period. Staging the infrastructure works themselves depends on the delivery strategy adopted. The more constraints that are applied on the timing of infrastructure delivery (in order to accommodate phasing, for example) mean the planning and sequencing of the work becomes more complex, and therefore more disruptive. However, there are some examples of where phasing work such as this can reduce disruption overall, and a more detailed analysis and constructability review would need to be undertaken to assess whether there might be a benefit to this approach.

The 51M report allocated 24 per cent of costs to 'other items', disruption and power supply upgrades. It is Network Rail's opinion that this is an insufficient allowance to account for all three of these items; a figure of 18 per cent should be allocated for disruption alone.

This is based on the experience of the West Coast Route Modernisation (WCRM) and the anticipated date of construction of the proposed interventions. For WCRM, compensation paid to TOCs for disruption to services amounted to approximately 10 per cent of costs (i.e. of costs excluding compensation); this was mainly to cover loss of fares revenue. However, it is likely the interventions suggested in the report would not be constructed until Control Period 6 (CP6). Revenue on the WCML has already increased substantially since WCRM, and further significant increases are

anticipated in future. We therefore estimate that, for the proposed interventions, it would be reasonable to allow for compensation amounting to 18 per cent of costs (i.e. of costs excluding compensation).

2.3.2 Reliability and performance

The performance impact of the 51M proposals has not been modelled in any detail but an initial view can be provided based on the proposed service specification.

The proposal presented is workable in terms of train planning but would introduce high performance risks to the route. The high utilisation of capacity on the fast lines means that any incident would have an effect on route performance due to the way reactionary delay spreads across services once an incident has occurred, and the increase is not necessarily proportionate to the rise in train services. The impact of an incident, and associated reactionary delay, are likely to rise rapidly in perturbation, and recovery is likely to take longer where there is less operational flexibility and limited infrastructure capable of handling longer trains.

Performance on the WCML is currently below its target level, partly due to the pressure arising from the increased volume of services using the route. Period 6 Public Performance Measure (PPM) was 82.1 per cent, compared to the same period the previous year at 91.3 per cent. The proposed increase in service quantum would leave very little capacity for recovery from perturbation. With services travelling significant distances, there is a requirement to build some recovery into the timetable plan. Therefore if the underlying route performance is not improved then Network Rail would have concerns with operating this increase in quantum of services with no space in the timetable for performance recovery.

The infrastructure proposed by 51M such as grade separation of Ledburn Junction will help support robust delivery of the additional services proposed by removing the performance risk which exists today at that location.

The 51M proposal makes no allowance for the cost of maintaining an acceptable level of performance on the route and the

implications this could have with respect to the adequacy of the existing railway system design.

Running the proposed number of additional services on the network would have a significant and detrimental effect on the reliability and maintainability of the underlying infrastructure due to the inclusion of more services on the fast lines in the 51M proposition.

The technical and operational reliability of the route would have to be strengthened to offset the greater intensity of asset use and likely increase in perturbation that would occur owing to the increased number of services operating on the railway. Given that the current level of infrastructure reliability is delivered on a largely modernised railway, the inclusion of such measures to achieve a nil detriment to performance is likely to be very expensive and would require more detailed investigation. Furthermore, with an increased number of trains operating on the network, the reliability of traction and rolling stock would have to improve markedly to offset the increased mileage achieved and resultant increase in number of failures caused (based upon Miles to Incident (MTIN)) due to the higher density operating pattern.

With regards to maintenance, the conventional operation of more train services would result in an increased level of wear to track and OLE infrastructure. As a result, additional maintenance provisions would be required beyond those currently in place, but the increase in services would reduce the access available to maintain the network, making a proof of maintainability an even more challenging proposition. Since the launch of the WCML 2008 timetable, Network Rail has spent c£80 million (through the Efficient Engineering Access Programme) mitigating asset deterioration on the route and doing this within the available provision allowed within the post December 2008 Engineering Access Statement. The cost of making the route maintainable clearly needs to be considered when evaluating the 51M proposal.

2.3.3 Demand and capacity

Network Rail has conducted an assessment of forecast passenger demand versus the capacity that would be provided under the 51M proposition.

This assessment of demand and capacity, which uses demand forecasts from the West Coast Main Line RUS and assumes no passengers are crowded off⁸, is more detailed than the work presented in the 51M report as it:

- concentrates on the busiest time of the day, when capacity is most constrained. The assessment is based on the evening peak, and it is assumed that demand in the morning peak is relatively similar
- differentiates between the long distance, outer and inner suburban markets, which are served by different trains and have bespoke demand projections
- estimates how the composition of the proposed timetables, particularly the difference in the speed of trains to the same destinations, will spread passenger loads across different trains.

The 51M report proposes the following interventions to cater for demand on long distance and suburban markets:

- lengthening of all Class 390 trains to 12-cars (except services to Liverpool where 11-car formation is assumed)
- conversion of one first class vehicle per Class 390 train to standard class in order to increase the number of standard class seats per train.
- operation of one additional long distance service per peak hour on the fast line from London Euston, giving 12 long distance trains per hour (tph) in each direction with the following service patterns:
 - | London Euston to Birmingham New Street, 3tph
 - | London Euston to Manchester Piccadilly, 4tph
 - | London Euston to Liverpool Lime Street, 2tph
 - | London Euston to Chester, 1tph
 - | London Euston to Windermere/Blackpool, 1tph
 - | London Euston to Glasgow Central, 1tph
- introduction of regular Milton Keynes Central calls in long distance services to accommodate commuter demand to/from London

⁸ Although in reality some passengers would be crowded off busy services, our analysis has not considered the impact of this.

- introduction of two additional peak outer suburban trains to Northampton on the fast lines, thus providing faster journey times to outer suburban stations north of Leighton Buzzard
- recast of the two semi-fast services on the fast lines to Birmingham New Street
- outer suburban services on the fast line would no longer call at stations in the Trent Valley. Calls at Nuneaton, Tamworth and Lichfield would be transferred to the additional hourly long distance service (a fourth London Euston – Manchester Piccadilly service via Crewe)
- the number of services on the slow lines that start at London Euston would be reduced by one train per hour, providing several stations south of Leighton Buzzard with a lower service frequency than today. The proposed slow line service pattern is as follows:
 - | London Euston to Watford Junction, all stations, 2tph
 - | London Euston to Tring, 2tph with one semi-fast service
 - | London Euston to Milton Keynes, 1tph calling at most intermediate stations
 - | London Euston to Northampton (stopping service), 1tph.

This specification has been used to develop two scenarios for the capacity assessment.

Scenario 1 assumes an eight-car formation for services to Watford Junction and Tring. The remaining suburban services on the slow and fast lines are assumed to be 12-car formation. This indicates their maximum length possible based on the platforming exercise undertaken at London Euston. All long distance services on the fast line would operate as 12-car Class 390s (with the exception of 11-car services to Liverpool Lime Street) with one first class coach converting to standard class.

Scenario 2 assumes that a capability change at London Euston has allowed the two slow line services to Tring to be 12-cars in length. The Watford Junction services remain at eight-car length due to platform constraints at Watford Junction.

In this assessment, suburban services are defined as those that run on the slow lines for some parts of their journeys; therefore services that operate on the fast lines and cross at Ledburn Junction to join the slow

lines are also referred to as suburban services. Inner suburban services are those that operate wholly on the slow lines, serving stations mainly to the south of Leighton Buzzard. Outer suburban services are those that operate on the fast lines for part of their journeys and serving demand mainly to Leighton Buzzard and stations to the north of it.

Long distance services are defined as those that operate wholly on the fast lines, and these are the services that are currently operated by Virgin Trains.

The 51M report predicts that with its proposed specification, the average load factor, that is the proportion of passengers compared to seats expressed in percentage, would be 52 per cent in 2043, which leads to its stated conclusion that the capacity proposed is sufficient to meet future demand.

However, this is an all day average figure that masks crowding on some services, especially in the peak. Furthermore, demand on suburban and long distance services should also be analysed separately since they are serving different markets, with suburban services provided to meet commuter demand to London while long distance services target demand for business and leisure travel to urban centres and cities outside London and the South East.

Network Rail's assessment shows that the level of capacity proposed by the 51M report is insufficient to accommodate peak demand growth on the outer and inner suburban services. The assessment predicts an average load factor (to seats) of 100 per cent in the evening high peak hour in 2026, increasing to 119 per cent in 2035 under Scenario 1. In reality this would equate to six out of ten peak hour suburban services from London Euston with more passengers than seats resulting in 1,300 suburban passengers standing in the busiest hour every evening in 2026⁹. By 2035 this will have increased to 2,200 passengers. Two of these overcrowded trains would be the outer suburban services to Northampton on the fast lines, resulting in passengers standing for half an hour or more based on the suggested calling pattern.

⁹ Currently about 800 passengers stand in the evening high peak hour on the London Midland services from London Euston.

In Scenario 2, where a 12-car formation is assumed on Tring services, the average load factor (to seats) at London Euston would be 93 per cent in the evening high-peak hour in 2026, increasing to 110 per cent in 2035. However, this average figure masks current and continued imbalances in passenger numbers on different trains, and it is estimated that approximately 1,200 passengers would be required to stand on the suburban services in the evening high peak hour in 2026, increasing to 1,900 passengers by 2035. Similarly to the previous scenario, passengers would regularly stand for around half an hour.

Under the 51M proposition, passengers travelling to stations north of Leighton Buzzard will generally have more and faster services than today. Network Rail's assessment shows that, due to the speed differential between the services on the fast and slow lines, passengers travelling further out would choose to travel on the fast line trains. As a result, passenger loads on the faster outer suburban services are expected to be high and would exceed the number of seats available in the peak. This imbalance between demand and supply would result in a situation similar to that at Reading, where currently there are more passengers than seats on the long distance services to London Paddington in the peak despite the fact that there is spare capacity on slower suburban trains that call at intermediate stations.

The 51M report states that capacity on 'fast commuter services' could be 'doubled in five years' through the interventions it proposes, however no evidence of the calculations that have generated this conclusion are provided. It appears that this statement simply refers to a doubling of the number of outer suburban services using the fast lines. Network Rail has undertaken detailed analysis for Milton Keynes Central, Watford Junction and Northampton stations to assess the impact of the 51M proposition on them. These stations were chosen because they are the busiest stations on the suburban lines, in terms of passenger volume.

Despite the additional outer suburban services proposed in the 51M report, the 'effective' capacity available to passengers travelling to stations north of Leighton Buzzard is not as much as it appears due to the mixture of stopping and non/limited stop

services. For example, there are five services per peak hour to Northampton under the 51M proposition, compared to four currently. Of these five services, four travel on the fast lines for part of their journey giving a superior journey time than the service that travels wholly on the slow lines. An assessment of train loading and how it would spread in the high peak hour shows that passengers travelling to Northampton would almost exclusively use the fast line trains. Under the 51M proposition, the total number of seats for Northampton passengers increases by 35 per cent in the high peak hour, however when the overtaken train is excluded, capacity increases by only eight per cent which is not sufficient to accommodate forecast demand growth to 2026.

Similarly, passengers travelling to Milton Keynes Central are unlikely to use the slow line trains, thereby further increasing demand for outer suburban services and exacerbating train crowding. In the 51M proposition there are nine services per peak hour to Milton Keynes Central, including the three long distance trains per hour. However, examination of service patterns shows that two of these services would be overtaken by the fast line trains. Network Rail's assessment of train loads shows that almost no passengers would use the slow line trains to travel to Milton Keynes Central. Some of the demand to Milton Keynes on the suburban services could potentially be transferred to the long distance services; however this could cause crowding on the long distance services. Network Rail's assessment of train loadings shows that supply does not match demand perfectly in the peak, as some commuters would choose to travel at the times they prefer despite spare capacity on other services.

Despite the increase in service frequency to Watford Junction, Network Rail's assessment shows that passengers travelling on the suburban services to Watford Junction would experience an average load factor of more than 120 per cent in the high peak hour due to the speed differential between non/limited stop and stopping services, and passengers' preference of when to travel. Furthermore, due to platform constraints at Watford Junction, services that terminate there can only be operated in a maximum of eight-car formation, limiting capacity growth. Some of the demand to Watford Junction on the

suburban services could potentially be transferred to the long distance services, however this would cause crowding on some of these trains.

Passengers travelling from London Euston to stations south of Leighton Buzzard will generally have fewer services in the 51M timetable compared with today. Demand to stations south of Leighton Buzzard is expected to grow at 1.9 per cent per annum. With this demand forecast and the limited increase in capacity to these stations under the 51M proposition, Network Rail estimates that half of the evening peak services to the inner suburban stations would have more passengers than seats in 2026.

The 51M report shows a 181 per cent increase in long distance capacity on the WCML when compared to the 2008 base. However, when compared to the committed plan to lengthen some Class 390 trains to operate in 11-car formation during the current control period, the 51M proposition is adding only 58 per cent more standard class seats. This 58 percent increase is achieved by lengthening all Class 390 trains to 12-car formation (except for services to Liverpool Lime Street which are assumed to be 11-car), converting one first class coach per train to standard class and operating an additional one train per hour in the peak. Network Rail's analysis shows that the average load factor on the long distance services in the evening high-peak hour is approximately 60 per cent in 2026 increasing to 75 per cent in 2035 when taking into account the increased capacity proposed by 51M.

This assessment identifies peaks in passenger numbers on certain services that coincide with the busiest times of the day. This would result in passengers standing for more than twenty minutes in the evening peak in 2026. The 51M report proposed that three long distance services per evening peak hour will also stop at Milton Keynes Central to meet commuter demand. Network Rail's assessment shows that demand from Milton Keynes Central commuters for these long distance services would be high, resulting in some long distance travellers having to stand in the peak. The level of crowding would be particularly bad on Friday evenings, which is the busiest time of the week when demand for leisure and business travel is highest and coincides with the commuter peak. The 51M report also

proposes that two long distance services per hour call at Watford Junction to serve commuter demand. Similarly, this will increase loadings on the long distance services so trains would be crowded, particularly on Friday evenings.

2.4 Conclusion

The previous section outlined the analysis undertaken of the 51M proposals. Though the analysis has shown that they do provide additional capacity on the WCML, for a variety of reasons these proposals are not the best long-term strategy for the route.

The additional capacity provided by the 51M outputs does not match the demand profile on the route as it leaves over 1,300 people standing on the suburban services in the high-peak hour in 2026, increasing to approximately 2,200 in 2035. This is a worse situation than today, as approximately 800 people currently stand in the high-peak hour on these services. Therefore, this option does not solve the main driver for a capacity intervention on the route, which is the overcrowding on suburban services at the southern end of the route in the peak.

Network Rail's initial review of the proposal has demonstrated that a capability change is likely to be required at London Euston to accommodate the longer long distance services along with the suburban services and the sleeper services in the morning peak. A more detailed timetabling exercise would be required to determine the precise scope of works required but it is felt that achieving longer platforms or additional platforms would require a major remodelling of London Euston station.

In addition to the works required at London Euston, the 51M report made no reference to the infrastructure requirements at the intermediate stations along the route. The majority of stations that would be served by longer Class 390s would require platform extensions, many of which would be complex to deliver due to the locations and available space within the railway footprint and/or surrounding buildings.

Under the 51M proposal, the West Midlands and Chilterns RUS recommendation with regard to delivering a capacity increase between Coventry and Birmingham New Street by diverting the Southampton Central – Newcastle service away from the Solihull

corridor to operate via Coventry would not be realised as there would be insufficient capacity along the route.

As there are no off-peak service details available in the report, it is not possible to fully understand the impact the 51M proposal would have on freight services.

One of the key considerations is the impact of disruption during the construction phase of the necessary infrastructure work. The suggested enhancements are significant infrastructure interventions that would almost certainly require total blockades of the line similar to that undertaken over a ten year period for the WCRM. Furthermore, usage of the WCML has grown considerably since the route modernisation and the impact of similarly disruptive works would therefore be considerably greater than it was then, and the logistics of moving passengers on alternative routes would be much more difficult. This also contradicts Network Rail's strategy to provide a 'seven day railway' for its customers. However, using a less disruptive approach would increase the cost, duration and inefficiency of the work.

Network Rail considers it unacceptable to undertake a programme of works that would cause this level of disruption on the route to deliver a service that would not solve overcrowding at the southern end of the route. It would also likely involve a remodelling of London Euston station.

Although the station would have to be remodelled as part of the construction plan for HS2, the 51M option would not offer the majority of the benefits provided by a new line.

3.0 Review of Rail Package 2 proposal

RP2 proposes to meet demand growth to outer suburban stations and provide a moderate increase in long distance capacity on the WCML by

- running 12 trains per hour throughout the day (compared to 11tph currently in the peak and nine in the off-peak)
- lengthening all Class 390 services to 11-cars
- running two additional services on the fast lines¹⁰.

A number of infrastructure enhancements are proposed by the report to support the increase in service level.

3.1 Outputs

Network Rail was asked by the DfT to examine 'whether the proposed outputs can be delivered by the proposed infrastructure and other interventions' in RP2.

The RP2 information as presented appears broadly acceptable from a high level train planning point of view, assuming the quantum of all other services stays the same as today and subject to some minor timetable conflicts being resolved. Some calling patterns would also have to be revised in order to flight the specified service quantum.

The analysis undertaken confirms that the timings assumed by RP2 seem appropriate. The journey time savings assumed by RP2 appear to be predominantly delivered through removal of station calls, for example, two of the three station calls are removed from the London Euston – Birmingham New Street service. The journey time savings are also reliant on the procurement of higher performing rolling stock as suggested by RP2.

It was also found that to achieve the proposed quantum of services, the outer suburban services that utilise the fast lines would need to be operated using 125mph tilting suburban rolling stock. Such rolling stock does not currently exist and would

need to be specified and purchased as new-build stock.

RP2 states that the following infrastructure enhancements are required to deliver the proposed quantum of services:

- grade separation of Ledburn Junction
- construction of a fourth line between a section of Attleborough South Junction to Brinklow Junction
- Stafford bypass
- additional platforms at London Euston
- additional platforms at Manchester Piccadilly
- grade separation at Ardwick Junction
- four-tracking between Beechwood and Stechford.

The work undertaken confirms that the majority of this infrastructure is required to deliver the specified train services, though in Manchester the enhancements proposed are not essential.

The additional platforms at Manchester Piccadilly and the Ardwick flyover were deemed necessary in the RP2 report. However, this was published prior to the Government's announcement of funding for the Ordsall Chord¹¹ infrastructure. The implementation of this project will result in the removal of a number of complex crossing moves at the throat of Manchester Piccadilly and a reduction in the quantum of trains in the platforms. A platforming exercise has demonstrated that after delivery of the Ordsall Chord infrastructure, the LDHS services specified in RP2 can be accommodated at Manchester Piccadilly without the need for additional platforms or the Ardwick flyover.

The introduction of the WCML December 2008 timetable had a detrimental impact on 'local' services in the Manchester area. Increasing the long distance services to Manchester, without any infrastructure investment on the corridor, may cause a further detriment to the local services and will definitely restrict growth or any improvement in the local services in this area.

The RP2 proposal suggests constructing three additional platforms at London Euston

¹⁰ The proposal is silent on the slow line services thus it is assumed that it is the same service as today.

¹¹ The Ordsall Chord will be an approximately 1km section of track over a newly built viaduct that will connect Manchester Piccadilly, Manchester Oxford Road and Manchester Victoria stations.

to provide additional capacity in the morning peak to help accommodate the additional fast line services, alongside the sleeper trains from Scotland.

The initial assessment undertaken by Network Rail agrees that additional capacity would be required at London Euston to support the increased level of long distance service alongside the current slow line service and sleeper service.

The key platform constraint at London Euston is the capacity on platforms which can support 12-car inner suburban services alongside the long distance and outer suburban services. To deliver the service level new platforms or lengthening of the remaining short platforms at London Euston may be required.

The specification by RP2 proposes additional platforms at London Euston to accommodate the sleeper service. Today, two sleeper services need to be accommodated in long platforms at London Euston station for a large proportion of the morning peak period. Therefore Network Rail agrees that additional platforms are likely to be required to accommodate the specified train service on the assumption that the sleeper services continue to occupy platforms at London Euston for the same periods as they do currently.

Determining the scope of any work required at London Euston would require more detailed assessment of a timetable, recognising also the flexibility that would be required to maintain performance on the WCML. The feasibility of providing this additional capacity at London Euston is considered in section 3.3.1.

Platform capacity at Glasgow Central is also likely to be problematic. Accommodating the increase in long distance services from London may have a detrimental impact on other services in the area.

The RP2 proposal includes an additional two-hourly passenger service north of Preston (London Euston to Glasgow). This will put more pressure on the capacity available on this two-track section of railway, where providing robust daytime freight paths is already difficult. Network Rail has included an enhancement to the infrastructure north of Preston within the CP5 IIP. The RP2 proposal would require at

least this infrastructure to be delivered to allow for freight traffic alongside this level of passenger service. A more detailed study of the flighting of passenger paths over this section would be required to fully understand the impact on freight growth. Infrastructure enhancements would also be required in this area to accommodate the proposed HS2 service.

As stated above, the RP2 proposal concentrates on increasing capacity on the fast lines. The proposal does not provide any opportunity for growth above today's level of service on the slow lines. Even with the proposed additional platforms at London Euston, the capacity on the slow lines themselves mean that the only possible way to increase the quantum of services on the slow lines would be to adopt a metro style service, with all services calling at all stations which would result in undesirable journey times.

The proposal also reroutes the current semi-fast service that runs to Crewe to run via Stafford directly on the WCML to Crewe, instead of via Stoke-on-Trent. This would remove a significant amount of capacity and connectivity on the corridor and remove all services from Stone station. RP2 does not attempt to replace this capacity and work undertaken in the West Coast Main Line RUS to examine this proposition could not find a value-for-money option to replace this lost capacity.

This is not the sole case of connectivity being lost as a result of the RP2 service specification. The RP2 proposal appears to concentrate on improving journey times and frequency of LDHS services, but in some cases this is to the detriment of intermediate flows.

Though Watford Junction gains a fast service to Manchester Piccadilly, it replaces the existing connectivity to the West Midlands. Watford Junction also loses all fast services to Northampton, Milton Keynes Central and Rugby.

Milton Keynes also loses fast services to Birmingham (via Weedon) and there is an overall reduction in the quantum of services to the West Midlands. Milton Keynes Central gains a direct service to Glasgow but this is at the expense of the existing direct service to Chester and North Wales. Rugby also

loses a significant quantum of services to the Coventry corridor.

Birmingham New Street and Wolverhampton both gain one train per hour, but the number of services from Coventry and Birmingham International to London is reduced by one train per hour. The entire corridor loses direct fast connectivity to Rugby, Milton Keynes Central and Watford Junction.

London Euston to Glasgow Central services become hourly with a further additional train in every second hour. This increase in quantum is offset by slower journey times from London to Wigan North Western, Lancaster, Oxenholme Lake District and Penrith North Lakes which result from additional stops at Milton Keynes Central and Crewe (though the connectivity benefits of this are noted).

Finally, the RP2 proposal does not have the capability to accommodate the forecast number of freight services on the route due to the intensive off-peak proposal, which is the same as that in the peak. Freight traffic generally runs in the off-peak today, when there is a reduction in the long distance service quantum.

It has been assumed that as a result of the interventions identified in the RP2 report that there is no detrimental effect to the rest of the network in terms of the ability to run services that either join or leave the route (which has not been examined) at differing locations.

3.2 Costings

Network Rail was asked to examine 'whether the costs of the interventions included in the economic appraisal of Rail Package 2, as prepared by Atkins, are an accurate reflection of the likely costs of such works'.

This section gives an overview of Network Rail's view of the costs in the RP2 report, along with any other costs that would need to be taken into account when considering this option.

Network Rail has reviewed the RP2 infrastructure cost estimates. Approximate estimates of the cost of each enhancement were prepared (based on the information available for each) using Network Rail's standard estimating methodology. An optimism bias allowance of 66 per cent has been included in all estimates to be consistent with the approach taken by RP2. Pre-delivery scheme development costs are not included in the estimates, again to be consistent with the RP2 estimates.

3.2.1 Infrastructure suggested in the RP2 report

The table below summarises Network Rail's review of the cost of the interventions proposed in the RP2 report.

RP2 infrastructure enhancement	RP2 suggested cost (£billions)
Grade separation of Ledburn Junction	0.24
<i>The estimated cost in the RP2 report for delivery of the proposed enhancements is considered to be under-costed by approximately five per cent.</i>	
Construction of a fourth line between a section of Attleborough South Junction to Brinklow Junction	0.19
<p><i>Network Rail's assessment of the cost for this enhancement is significantly lower than that included in the 51M report (approximately 50%).</i></p> <p><i>A more detailed assessment of the proposed enhancement is required to fully assess the likely impact of the proposed works on the operation of Rugby and the Trent Valley lines.</i></p>	
Stafford bypass	1.23
<i>Network Rail has assessed the cost estimate for the Stafford bypass by reference to a previous proposal for an enhancement at Stafford which gives the same outputs as those proposed in the RP2 report. It is our assessment that the RP2 estimate is not significantly over or under-costed.</i>	
Four-tracking between Beechwood and Stechford	0.90
<i>The estimated cost in the RP2 report for delivery of the proposed enhancements is considered to be under-costed by approximately 10 per cent.</i>	
Northampton linespeed improvements	0.003
<i>The estimated cost in the RP2 report for delivery of the proposed enhancements is considered to be only about a third of the likely cost, but the difference is not considered significant as the item is low cost, relative to the other enhancements. Any work at Northampton may involve significant disruption to train operations as this is a critical servicing location for London Midland.</i>	

Additional platforms at London Euston	0.06
<i>As detailed in section 3.3 below, the RP2 proposal to provide three additional platforms at London Euston station is considered not to be possible without triggering a major remodelling of the station. This cannot be costed without a clearly defined scope of works. The provision in the RP2 report is inadequate as a major station remodelling would be expected to cost several hundred million pounds.</i>	
Additional platforms at Manchester Piccadilly and grade separation of Ardwick flyover	0.40
<i>Analysis has shown that this enhancement is unlikely to be required to deliver the outputs stated in the RP2 report.</i>	
Other WCML locations	0.29
<i>The RP2 report is not explicit about exactly what work is required; therefore this estimate can not be evaluated. However, section 3.3 highlights other areas where a cost provision should be made, such as reliability strengthening and depots.</i>	
Power supply	0.29
<i>The RP2 report allocated 10 per cent of construction costs to power supply upgrades. It is not possible to know the exact cost of the power supply upgrade that would be required as it is not known what the base timetable will be when the RP2 service specification is implemented. However, Network Rail estimated the cost of the power supply upgrade that would be required if the RP2 specification were implemented on the current timetable, with committed interventions, and this produced a figure of c£150 million.</i>	
Disruption costs	10%
<i>Network Rail considers 10 per cent to be too low a provision for disruption costs, a figure of 18 per cent would be more appropriate. This is discussed further in section 3.3.1.</i>	

Overall, the cost estimates of Stafford bypass, Beechwood to Stechford, Brinklow Junction – Attleborough South Junction, Ledburn Junction and Northampton linespeed improvements are not significantly over or under-costed. However, the cost for additional capacity at London Euston does not account for the size of the intervention proposed. This is further discussed in section 3.3. There are also a number of other areas that would require investment that are not specifically mentioned by RP2, these are also discussed in section 3.3.

3.3 Feasibility and deliverability

This aspect of the proposal was examined from a number of angles. Firstly, the deliverability of the upgrades required to the route to accommodate the proposed service specification. Secondly, the effect that running this train service would have on the route; and, lastly, whether this service specification would provide adequate capacity to accommodate long-term demand on the route.

3.3.1 Construction feasibility and disruption

The following is a high level assessment of the feasibility of the infrastructure enhancements that have been suggested in the RP2 report, along with any other interventions that may be necessary as a result.

Additional capacity at London Euston

As discussed in section 3.1, the RP2 proposition would require a capability change at London Euston. The extent of this capability change would need to be determined by more extensive timetable development work. The RP2 proposition suggests three additional platforms would be required. As it is not possible to state exactly what would be necessary at London Euston without more detailed timetable development work, Network Rail has assessed the scheme as suggested by RP2.

The proposed RP2 scheme involves building three additional platforms within the current station footprint, on the west side of the station. However, constructing additional platforms in this manner would not be possible without the demolition of the columns which support the station parcels deck. This would in turn necessitate the removal of a large amount of the London Euston station roof along with the overhead line equipment and signalling structure which is supported by the roof structure.

The RP2 proposal would also necessitate cutting into the undercroft of London Euston station. This forms a key arterial route between platforms for station and train support services and would therefore need to be re-provided by moving it further towards the south. This would involve

complicated engineering works due to the location of structural columns which support the station concourse, catering facilities, road access and British Transport Police offices.

Achieving these three additional platforms in the manner suggested by the RP2 report would probably involve a major remodelling of Euston station, including the phased closure of sections of the station with major demolition and rebuilding programmes. A detailed survey and assessment of whether there is sufficient width for fully compliant platforms has not been undertaken, but it is considered highly improbable that three additional platforms could fit within the current footprint of the station.

As mentioned previously, analysis has demonstrated that all three of these additional platforms may not be necessary but additional longer platforms would be required either by platform lengthening or perhaps one additional long platform.

Lengthening platforms at London Euston is not possible without either relocating the station throat or cutting into the station undercroft. Either of these propositions would result in a major remodelling of London Euston station, as described above.

Fitting one additional long platform into the current station footprint is still unlikely to be possible without the removal of the support columns and parcel deck and therefore the roof and overhead line equipment.

To avoid this level of operational disruption, additional capacity could be provided at London Euston by building additional platforms to the west side of the station. This would involve the acquisition of land and property adjacent to Melton Street, whether one or three additional platforms were built. Network Rail has estimated the cost of the scheme to provide three additional platforms which would involve the purchase of land and property, the demolition of two hotels and associated buildings and the demolition of the former Euston Power Signal Box (which is no longer used for operational purposes) as costing over £1 billion. The cost of the scheme could be reduced if only one platform was required, but some land take would still be needed and it is this that forms the majority of the cost estimate.

Grade separation of Ledburn Junction

In order to remove the conflict at Ledburn Junction of northbound trains (usually Northampton services) crossing the southbound fast lines and reducing available capacity, a grade separated junction would be necessary. The site has been inspected and it is clear that any junction rising above the level of the WCML would have severe visual intrusion as it would have to be raised approximately 25m above ground level. In order to maintain linespeed when exiting the junction, a high speed turn-out would be required and the gradients would need to be as shallow as possible. It would also be preferable to incorporate a larger land take on the eastern side to avoid expensive relocation costs for signalling and power equipment, although this would require powers through a Transport and Works Act. A road closure would be necessary and the works could only be carried out with full weekend blockades and numerous weekend temporary road closures.

Stafford bypass

The objective was to significantly increase the number of trains that could pass through the Stafford area by addressing the assumed constraints of Colwich Junction, the two-track section through Shugborough, Milford and Brocton Junction, Trent Valley Junction and Norton Bridge Junction.

The bypass solution previously considered by Network Rail, which provides the same outputs as that in the RP2 report, comprises:

- a new line leaving the WCML between Rugeley and Colwich Junction and joining the existing Colwich Junction - Manchester route at Hixon
- a new line leaving the Colwich Junction - Manchester route around Sandon and heading west across Staffordshire towards the existing WCML.

In terms of disruption to the existing railway, this would mostly be where the new infrastructure interacts with the existing network:

- at the junction between Colwich Junction and Rugeley on WCML
- at the junction at Hixon on Colwich Junction - Manchester route
- at the junction at Sandon on Colwich Junction - Manchester route

- at the junction at Norton Bridge or Badnall Wharf on WCML.

Apart from a small section on the Colwich Junction - Manchester route between Hixon and Sandon, the bypass was intended to be all new railway and built on a green field site. As a result much of the construction, other than the four tie-ins would not have had an impact on the operational railway.

The environmental impact on the surrounding area would be significant, and a construction period of around four years would be extremely intrusive to the local community. Planning consent from the Infrastructure Planning Commission would be required if this option were pursued, the timing of which would need to be taken into account.

The Stafford area improvement project (including Norton Bridge Grade Separation) is currently being developed by Network Rail for delivery in CP5. This scheme will deliver two additional fast line paths to/from London in the off-peak. The scheme does not provide an increase in peak capacity. The RP2 quantum of long distance services in the Stafford area in the peak is the same as today; therefore the full Stafford Bypass scheme may not be required. Further development work and examination of the timetable would be required to understand the scope of the intervention required at Stafford to support the RP2 service proposal.

Construction of a fourth line between a section of Attleborough South Junction to Brinklow Junction

There is a three-tracked section of railway between Attleborough South Junction and Brinklow Junction. The RP2 report proposes four-tracking part of this section to reduce the length of the constraint. In order to do this, it would be possible to use some of the old alignment, however, a number of structures and residential properties would have to be demolished and bridges extended. The works would require the relocation of signalling equipment and creation of new OLE structures (either stand alone or by extending the current masts). Most of the linear works are complicated but could be executed within possessions and the structural elements would require blockades.

Four-tracking between Beechwood and Stechford

An assessment was carried out of the installation of two additional tracks over the 16km between Stechford station (inclusive) and the western end of Beechwood tunnel (hence excluding Beechwood tunnel), near to Tile Hill station. This assessment includes additional platforms at all stations between these locations.

The increased traffic levels would require a local upgrade of the electrification power supply system however this is described separately in the section titled 'Electric Traction Power Supply System'.

It should be noted that, in addition to the financial cost, this proposal would result in significant land take of rural areas and substantial disturbance for a distance of approximately 7km of urban corridor (residential, commercial and industrial) with the associated planning risk to the project.

Significant construction disturbance would occur at the following locations where construction of a new railway bridge is required at the road/rail crossing point:

- A45 dual carriageway
- M42 Motorway
- A452 dual carriageway.

Partial closures would be required due to construction works at the following stations:

- Berkswell
- Hampton In Arden
- Birmingham International
- Marston Green
- Lea Hall
- Stechford.

Liverpool Lime Street

An enhancement to Liverpool Lime Street is included in the Control Period 5 Initial Industry Plan (IIP). This intervention would deliver three 11-car capable platforms at Liverpool Lime Street and improve the layout of the station.

RP2 suggests running two trains per hour to Liverpool Lime Street in some hours. Due to the current infrastructure capability at Liverpool Lime Street and the interaction between the LDHS services and local services, it is doubtful that this would be

achievable without the enhancement proposed in the IIP.

Depots

The requirement for additional facilities for train servicing at depots is an issue that would require consideration and investment when running the additional train sets that would be required to implement RP2's level of service.

After the introduction of the planned additional train sets on the WCML in Control Period 4, most depots will be near capacity. The additional train sets required by RP2 would likely require a new depot or a significant increase to the existing depots, although available land is likely to be an issue.

Depot requirements and associated locations would need to be investigated in more detail to ascertain future requirements of train servicing and future depot capability at key locations.

Disruption

A key consideration when evaluating the RP2 proposal is the disruption caused to the operational railway during the construction phase of these interventions. Necessarily, each intervention affects the operational railway and would involve significant blockades, resulting in passengers experiencing extended journey times via diversionary routes (if there is capacity available) or transfer onto replacement bus services.

Some locations (Colwich Junction for example) are currently planned to be renewed on a like for like basis no more than five years before the proposed interventions are built. Should the RP2 proposals be taken forward, an integrated plan would need to be developed to avoid a doubling up of disruption for train operators and passengers in a short space of time due to the potential for duplication of work required at some locations.

Network Rail aims to provide a 'seven day railway' for its customers, and much of the WCML already operates as a seven day railway. However, using a less disruptive approach (for example multiple night time possessions instead of blockades) in these instances would severely increase the cost and duration of the works making them less efficient to deliver.

It has been proposed that delivery of the enhancements (and by definition the introduction of service benefits) could be phased over a period. Staging the infrastructure works themselves depends on the delivery strategy adopted. The more constraints that are applied on the timing of infrastructure delivery (in order to accommodate phasing for example) mean the planning and sequencing of the work becomes more complex, and therefore more disruptive. However, there are some examples of where phasing work such as this can reduce disruption overall, and a more detailed analysis and constructability review would need to be undertaken to assess whether there might be a benefit to this approach.

The RP2 report allocated 10 per cent of construction costs to disruption. It is Network Rail's opinion that this is an insufficient allowance.

This is based on the experience of the West Coast Route Modernisation (WCRM) and the anticipated date of construction of the proposed interventions. For WCRM, compensation paid to TOCs for disruption to services amounted to approximately 10 per cent of costs (i.e. of costs excluding compensation); this was mainly to cover loss of fares revenue. However, it is likely the interventions suggested in the report would not be constructed until CP6. Revenue on the WCML has already increased substantially since WCRM, and further significant increases are anticipated in future. We therefore estimate that, for the proposed interventions, it would be reasonable to allow for compensation amounting to 18 per cent of costs (i.e. of costs excluding compensation).

3.3.2 Reliability and performance

The performance impact of the RP2 proposals has not been modelled in any detail but an initial view can be provided based on the proposed service specification.

The proposal presented is workable in terms of train planning but would introduce high performance risks to the route. The high utilisation of capacity on the fast lines means that any incident would have an effect on route performance due to the way reactionary delay spreads across services once an incident has occurred. The

intensive all day service in RP2 would exacerbate this issue.

Performance on the WCML is currently below its target level, partly due to the pressure arising from the increased volume of services using the route. Period 6 PPM was 82.1 per cent, compared to the same period the previous year at 91.3 per cent. The proposed increase in service quantum would leave very little capacity for recovery from perturbation. With services travelling significant distances, there is a requirement to build some recovery into the timetable plan. Therefore if the underlying route performance is not improved then Network Rail would have concerns with operating this increase in quantum of services with no space in the timetable for performance recovery.

The infrastructure proposed by RP2 such as grade separation of Ledburn Junction will support robust delivery of the additional services proposed by removing the performance risk which exists today at that location.

The journey time improvements proposed by RP2 include a reduction in timetable allowances. There is a risk to route performance with the increase in service quantum on sections where no additional infrastructure is provided. Therefore Network Rail would not support the removal of performance allowance in the timetable without evidence to quantify the performance of the RP2 proposal.

The RP2 proposal makes no allowance for the cost of maintaining an acceptable level of performance on the route and the implications this could have with respect to the adequacy of the existing railway system design. Running the proposed number of additional services on the network would have a significant and detrimental effect on the reliability and maintainability of the underlying infrastructure due to the inclusion of more services on the fast lines in the RP2 proposition, especially in the off-peak.

The technical and operational reliability of the route would have to be strengthened to offset the greater intensity of asset use and likely increase in perturbation that would occur owing to the increased number of services operating on the railway. This is compounded by the significant increase in traffic in the off-peak periods that would

hinder service recovery between the morning and evening peak periods. Given that the current level of infrastructure reliability is delivered on a largely modernised railway, the inclusion of such measures to achieve a nil detriment to performance is likely to be very expensive and would require more detailed investigation. Furthermore, with an increased number of trains operating on the network, the reliability of traction and rolling stock would have to improve markedly to offset the increased mileage achieved and resultant increase in number of failures caused (based upon Miles to Incident (MTIN)) due to the higher density operating pattern.

With regards to maintenance, the conventional operation of more train services would result in an increased level of wear to track and OLE infrastructure. As a result, additional maintenance provisions would be required beyond those currently in place, but the increase in services would reduce the access available to maintain the network, making a proof of maintainability an even more challenging proposition. Since the launch of the WCML 2008 timetable, Network Rail has spent c£80 million (through the Efficient Engineering Access Programme) mitigating asset deterioration on the route and doing this within the available provision allowed within the post December 2008 Engineering Access Statement. The cost of making the route maintainable clearly needs to be considered when evaluating the RP2 proposal.

3.3.3 Demand and capacity

Network Rail has conducted an assessment of forecast passenger demand versus the capacity that would be provided under the RP2 proposition.

The interventions proposed in RP2 are designed as alternatives to the long distance services being proposed by HS2 Ltd and the report does not discuss the suburban services on the slow lines. As a result, this analysis assumes that the timetable on the slow lines is the same as today, giving seven trains per hour from London Euston in the peak on the slow lines. Therefore the service pattern assumed on the slow lines in this assessment is as follows:

- London Euston – Watford Junction, 1tph

- London Euston – Tring, 2tph
- London Euston – Milton Keynes Central, stopping services, 2tph
- London Euston – Northampton, calling at inner suburban stations, 1tph
- London Euston – Rugby, calling at inner suburban stations, 1tph

RP2 proposes two additional outer suburban services on the fast lines compared to today, thus giving a total of four outer suburban services on the fast lines. This consists of:

- 2tph to Birmingham New Street, stopping at intermediate stations
- 1tph terminating at Rugby
- 1tph providing connections along the Trent Valley, calling at Tamworth and Nuneaton.

The fast line standard hour timetable proposed by RP2 is:

- London Euston – Manchester Piccadilly, 4tph
- London Euston – Birmingham New Street, 4tph
- London Euston – Glasgow Central, 1tph
- London Euston – Liverpool Lime Street 1.5tph (0.5tph alternates with train below)
- London Euston – Glasgow, 0.5tph (alternates with the train above)
- London Euston – North Wales, 1tph

The RP2 report presents capacity figures that aggregate peak and off-peak services. However, capacity requirements are not the same throughout the day and providing additional capacity in the off-peak will not solve the overcrowding problems that are at their worst in today's peak and drive the need for intervention on the route.

This assessment of demand and capacity, which uses demand forecasts from the West Coast Main Line RUS and assumes no passengers are crowded off¹², is more detailed than the work presented in the RP2 report as it:

- concentrates on the busiest time of the day, when capacity is most constrained. The assessment is based on the evening peak, and it is assumed that

¹² Although in reality some passengers would be crowded off busy services, our analysis has not considered the impact of this.

demand in the morning peak is relatively similar

- differentiates between the long distance, outer and inner suburban markets, which are served by different trains and have bespoke demand projections
- estimates how the composition of the proposed timetables, particularly the difference in the speed of trains to the same destinations, will spread passenger loads across different trains.

The assessment of suburban services shows that evening peak demand for both the fast line outer suburban services and inner suburban services would exceed the capacity proposed by RP2. The estimated evening high-peak hour load factor (to seats) on the suburban services would be 96 per cent in 2026, increasing to 122 per cent in 2035. These average figures hide imbalances in passenger numbers across trains.

Three out of 11 high-peak hour suburban services from London Euston would have more passengers than seats in 2026, of which one is the additional fast line service to Crewe where the first stop is Milton Keynes with a minimum standing time of around 30 minutes. The number of suburban services with more passengers than seats would increase to eight out of ten services in 2035. This indicates a high level of crowding on suburban services, with approximately 1,100 passengers standing in the high-peak hour in 2026, increasing to 2,000 passengers by 2035.

The proposed specification leads to speed differentials between services that use the fast lines and the slow lines. This would encourage passengers who travel further out to favour use the faster trains causing some trains to be extremely busy. Consequently, peak demand for the faster outer suburban trains would exceed the capacity proposed on the fast line suburban services. Furthermore, calling one of the additional fast suburban services at Tamworth and Nuneaton, as proposed in the RP2 report, would increase loadings on this service and exacerbates crowding on the outer suburban services. This train would be very crowded with a load factor exceeding 150 per cent in 2026.

Operating additional fast line suburban services would help to release on-train capacity on the slow line trains; however this

additional slow line capacity would not be sufficient to meet demand growth to inner suburban stations.

The analysis is based on the slow line suburban train services maintaining their current train lengths, as the RP2 proposal does not specify anything beyond the current level of service on these lines.

The West Coast Main Line RUS recommends that suburban services which are not currently operating at their maximum possible length are extended to run in 12-car formation. In the high-peak hour that comprises two services to Milton Keynes Central and two services to Tring. Analysis shows that even if it were possible to accommodate this service proposition at London Euston, it would not solve the suburban capacity problem. Lengthening these four services would result in 800 passengers standing in 2026, increasing to 1,500 passengers by 2035.

Analysis shows that the average load factor on the long distance services in the evening high-peak hour would be approximately 73 per cent in 2026 increasing to 92 per cent in 2035 when taking into account the increased capacity proposed in RP2. With these load factors, imbalances between passenger numbers on different trains would mean that some long distance services would have more passengers than seats on Fridays (usually the busiest day of the week) in 2026. By 2035, it is expected that there would be more passengers than seats on some long distance peak services throughout the week.

The RP2 report also proposes that two long distance services per evening high-peak hour stop at Milton Keynes Central to meet commuter demand. Network Rail's assessment shows that demand from Milton Keynes commuters for these long distance services would be high, resulting in some long distance passengers having to stand in the peak. The level of crowding would be worst on Friday evenings, which is the busiest time of the week when demand for leisure and business travel is highest and coincides with the commuter peak.

3.4 Conclusion

The previous section outlined the analysis undertaken of the RP2 report proposals as an alternative to HS2.

Though the analysis has shown that the proposals would provide additional capacity on the WCML, for a variety of reasons these proposals are not the best long-term strategy for the route.

Although there would be a considerable increase in the number of services proposed on the fast lines throughout the day, the slow line service would remain the same as today. Network Rail's assessment suggests that this additional capacity would not match the demand growth on the route and would result in over 1,000 people standing in the evening peak on the suburban services in the high-peak hour in 2026, increasing to 2,000 in 2035. This is a worse situation than today, as approximately 800 people currently stand in the high-peak hour on these services. Therefore, this option does not solve the main driver for a capacity intervention, which is the overcrowding on suburban services at the southern end of the route in the peak.

The additional all day capacity described above is achieved by a significant increase in fast line services in the off-peak. Freight services are largely accommodated in the off-peak and the intensive off-peak service proposed in RP2 means that freight growth cannot be accommodated. This is an extremely undesirable proposition.

Network Rail's initial review of the proposal has demonstrated that a capability change would be required at London Euston to accommodate the additional long distance services alongside the suburban services and the sleeper services in the morning peak. A more detailed timetabling exercise would be necessary to determine the extent of the works required but Network Rail's initial conclusion is that if longer or additional platforms were required, this is likely to trigger a major remodelling of London Euston station.

One of the key considerations is the impact of disruption during the construction phase of the necessary infrastructure work. The suggested enhancements are significant infrastructure interventions that would almost certainly require total blockades of

the line similar to that undertaken over a ten year period for the WCRM. Furthermore, usage of the WCML has grown considerably since the Route Modernisation and the impact of similarly disruptive works would therefore be considerably greater than it was then, and the logistics of moving passengers on alternative routes would be much more difficult. This also contradicts Network Rail's strategy to provide a 'seven day railway' for its customers. However, using a less disruptive approach would increase the cost, duration and inefficiency of the work.

Network Rail considers it unacceptable to undertake a programme of works that would cause this level of disruption on the route to deliver a service that would inhibit rail freight whilst not solving the overcrowding at the southern end of the route. It would also likely involve a remodelling of London Euston station.

Although the station would have to be remodelled as part of the construction plan for HS2, the RP2 option would not offer the majority of the benefits provided by a new line.

4.0 Assessment of Scenario B proposal

Scenario B of the 'Strategic Alternatives to the Proposed 'Y' Network' work comprises the RP2 interventions described in the previous section along with further interventions on the ECML and MML.

Scenario B aims to increase Long Distance High Speed (LDHS) capacity on the ECML and MML by increasing the service proposition to 10 LDHS trains per hour on the ECML and six LDHS trains per hour on the MML. This is proposed to be achieved by a programme of additional infrastructure enhancements.

Network Rail were not requested by DfT to undertake a detailed analysis but were asked to provide an 'assessment of the extent to which the proposed interventions provide a robust and sufficient basis for the development of the East Coast Main Line and Midland Main Lines over the next 20-30 years'.

4.1 East Coast Main Line

4.1.1 Feasibility

Following a high level review, Network Rail considers that the desired quantum of services could not be achieved solely by the enhancements proposed in Scenario B. It is considered that the following infrastructure enhancements would also be required, though this is subject to further timetable development work.

- re-modelling and additional platforms at Doncaster station may also require a grade separated flyover at the north end of the station to segregate north-south movements from those operating east-west across the ECML
- possible capacity enhancements between Doncaster and Colton Jn to accommodate the increased level of London services, cross-country trains from the Midlands to the North East via Doncaster and intermodal freight growth
- Nunnery Main Line Jn – Sheffield station third track to accommodate London King's Cross to Sheffield via Retford services, which would require major works to open up a cutting, with

retaining walls and overbridges. It is not clear from the Atkins report whether or not this enhancement is included in the Scenario B cost estimates

- there will need to be a major programme of level crossing improvements to maintain safety risk mitigations as low as reasonably practical with the proposed increase in train service.

In addition, an assessment would be required to check whether there would be sufficient capacity in the platforms and station approach at London King's Cross to accommodate the 10 trains proposed in Scenario B, along with Cambridge fast services, other suburban services that would not be using the Thameslink route and any Open Access services. If the number of platforms proves insufficient, it would be extremely difficult to provide any more platforms at the station.

The above does not consider the performance effects of running more passenger and freight services with a mix of operating speeds and stopping patterns and whether further infrastructure improvements are necessary to mitigate such effects.

Scenario B will require capacity enhancements north of York to accommodate the additional services operating on this section, which may also be required in the event that the second phase of HS2 is implemented. Exactly what is required for Scenario B will be subject to more detailed timetable development work, but the following are likely:

- grade separation in the Skelton Bridge area (just north of York) – estimate included in the Atkins report
- capacity improvements between Northallerton and Ferryhill South Jn – an estimate for enhancements at Darlington station was included in the Atkins report but further interventions or the diversion of some services (passenger and/or freight) via the Stillington route may be necessary
- capacity improvements between TurSDale Jn and Newcastle, or the re-instatement of the Leamside route between Ferryhill South Jn and Pelaw Jn – estimate included in the Atkins report.

4.1.2 Deliverability

Serious consideration must be given to the impact that such a major programme of enhancement works would have on existing users of the ECML. The ECML is one of the two main north-south routes in the UK (along with the WCML), and passenger and freight demand is continuing to grow.

In addition, the ECML has even fewer diversionary options (in particular, electrified options) than the WCML.

Despite the diversionary options available, the WCRM at various stages of its delivery was heavily disruptive and a significant part of its c£9bn cost was attributable to the issues associated with working on the operational railway. This included not only compensation to operators for planned disruption to services, but also the higher delivery costs of working around the services that did run.

Depending on the solution chosen, the four-tracking of the largely two-track sections between Huntingdon and Peterborough, and Stoke Jn and Doncaster are the two infrastructure schemes which would be most disruptive, comparable with four-tracking of the Trent Valley under WCRM.

The diversionary route for the first scheme (via Cambridge) is not electrified between Ely and Peterborough and will be very busy with passenger services from London King's Cross, the Thameslink routes and London Liverpool Street together with cross-country trains. The section between Ely and Peterborough will also see a lot of intermodal freight from the Haven Ports.

Between Peterborough and Doncaster the GN/GE Joint Line will have been upgraded by the end of CP4, although it will have a maximum speed of 75mph, will not be electrified and is expected to be heavily used by freight traffic. North of Doncaster to York, the alternative routes are all relatively slow, of limited capacity and as yet not electrified.

4.1.3 Capacity provided by Scenario B

If deliverable, the proposition in Scenario B would provide a significant increase in LDHS train capacity between London and South Yorkshire, Leeds, the North East and Edinburgh. It would also allow a significant

increase in intermodal freight from the Haven Ports and London Gateway to Yorkshire and the North East (assuming that further track capacity improvements to those funded in CP4 on the GN/GE Joint Line are added to Scenario B).

Scenario B is silent on how additional capacity would be provided on London outer suburban services. The London and South East RUS identifies that even in the event that all outer suburban services become 12-cars in length, there will still be a crowding gap in the high-peak hour. Even with the Scenario B track capacity intervention in the Welwyn area, the mix of inner and outer suburban services and high speed services are unlikely to permit an increase in outer suburban train paths, leaving no clear way to overcome the crowding gap on these services.

The East Coast Main Line 2016 Capacity Review, published by Network Rail, notes that the four-tracking of the Welwyn viaduct is not expected to fully resolve the capacity constraints on the southern end of the route. Four-tracking would allow the trains calling at Welwyn North to use the slow lines providing an increase in fast line capacity of approximately two to three trains per hour. Any other trains using the slow lines through the Welwyn area would either need to run along the slow lines from Finsbury Park (incurring significant pathing time and consequential increases in journey time and potential alterations to service intervals or frequencies) or weave to the slow lines north of Potters Bar. Weaving at Potters Bar (assuming an upgraded fast – slow line crossover is provided) would result in capacity issues on the slow lines and extension of journey times unless the linespeed on the slow lines was increased. Weaving services at Welwyn Garden City (assuming an upgraded crossover is provided) would be possible; however, the running time differential between long distance high speed and outer suburban services between Welwyn Garden City and Woolmer Green Junction is only 30 seconds and thus only a minimal capacity gain would result.

4.2 Midland Main Line

4.2.1 Feasibility

The Scenario B infrastructure proposals do not provide sufficient track capacity south of Bedford to allow eight LDHS services to operate alongside the 16 peak hour services and 10 off-peak hour Thameslink services whilst still accommodating freight (in the off-peak hours) and maintaining competitive long distance journey times. Increasing the maximum speed of the Thameslink rolling stock or resignalling the route to reduce the planning headways may provide the additional track capacity, otherwise further running lines would be necessary. The extent and location of these would need to be determined by timetable development work.

The proposal does not include providing additional platforms at London St Pancras International high level which may be required to enable an eight train per hour operation. This would be a major construction project as the station is above ground level. Even if eight trains could be accommodated with minimum turnrounds in the current number of platforms, this level of utilisation would leave no scope to recover from perturbation on the MML long distance and low level Thameslink services.

Running six trains per hour through Leicester alongside freight (especially after the completion of the Felixstowe to Nuneaton project) would be likely to require grade separation at Wigston Junction. It is not clear if this is included in the Atkins costs for Leicester remodelling.

North of Kettering, the service proposition would require an additional southbound running line from at least the Market Harborough area to Desborough summit, with at least one loop in the northbound direction.

There may also need to be a major programme of level crossing improvements to maintain safety risk mitigations as low as reasonably practical with the proposed increase in train service.

The above does not consider the performance effects of running more passenger and freight services with a mix of maximum speeds and stopping patterns and

whether further infrastructure improvements are necessary to mitigate such effects.

4.2.2 Deliverability

As with the ECML, consideration must be given to the disruption impact for existing users of the MML during the significant programme of upgrade works. Again, traffic is growing considerably and the route has even fewer suitable diversionary routes than the WCML, although at the northern end of the route there are more alternatives available than for the ECML.

4.2.3 Capacity provided by Scenario B

If deliverable, the proposition in Scenario B would provide a significant increase in LDHS train capacity between London, the East Midlands and South Yorkshire. It would also provide a limited amount of additional capacity for intermodal freight services.

4.3 Comparison of Scenario B with HS2 on the East Coast Main Line and Midland Main Line

As noted above, if it were deliverable, Scenario B would provide an increase in LDHS and freight capacity on the ECML and MML. However, assessing whether this provides a robust and sufficient basis for development of these routes in the longer term is not possible without considering the alternative option available.

The second phase of the proposed high speed line would provide a number of benefits above those in Scenario B.

The new line would provide significantly improved journey times between London and the East Midlands, Yorkshire and the North East. For example, the London to Leeds journey time in Scenario B is the same as today, whereas via HS2 this would be reduced to around 80 minutes, a 38 minute journey time reduction. Even where journey times are reduced in Scenario B, such as London to Sheffield where the journey time is reduced from 127 minutes to 105 minutes, HS2 would provide a considerable improvement upon this with a journey time of 75 minutes.

The Y-shaped network would provide capacity for additional services connecting West Yorkshire with the West Midlands as discussed in the Yorkshire and Humber RUS. This would be very difficult to achieve on the current network, even if it were enhanced as described in Scenario B.

The new line would enable a connection between HS1 and HS2 which would allow services to run directly from the north of England to regions south of London and Europe.

The connectivity improvements resulting from HS2 will provide a platform for a step change in economic activity for the north, plus wider benefits such as taking significant traffic off the road and reducing domestic air travel, both of which provide environmental benefits by reducing carbon emissions.

Constructing the interventions described in Scenario B would involve a long and highly disruptive build phase on these two intensively used routes, whereas the construction of a new line would be largely away from the operational railway, leaving the existing routes to operate normally.

4.4 Long-term strategy

4.4.1 East Coast Main Line

Some of the interventions in Scenario B formed the short- to medium-term strategy for the ECML in the Northern RUS and timetable development work is currently underway to establish which are required in the current decade to deliver the next expected major timetable change following the introduction of Intercity Express (IEP) trains on the route which will see the replacement of the current High Speed Train (HST) fleet.

The cost of these infrastructure interventions is anticipated to be of the order of 10-15 per cent of the proposed infrastructure costs in Scenario B and is included in the IIP. As described in the London and South East RUS, the next step would be the replacement of the current electric fleet with new IEP trains, which would allow a further capacity increase on LDHS services as they will have a greater seating capacity. These interventions aim to bridge the capacity gap in the medium term.

Going beyond this point, the interventions required on the ECML as listed in Scenario B increase considerably in scale, cost and the disruption they would cause on the operational railway and yet do not offer the majority of the benefits provided by a new line.

It is for this reason that in the longer-term strategy of the Northern RUS, it is recommended that meeting long distance passenger growth and a significant increase in intermodal freight traffic is addressed by the completion of a new high speed rail network. This would remove a significant proportion of long distance passenger flows from the ECML, and enable use of the freed up capacity on the route to meet passenger growth for flows that would not naturally pass to services on the new line, provide increased freight capacity, and allow new journey opportunities and significant journey time improvements.

This conclusion is also supported by the London and South East RUS and Network Rail's New Lines Programme, which identified that even with a separate high speed rail line from Yorkshire and the East Midlands to London, there was a BCR (benefit to cost ratio) of 1.5 for a route to provide the capacity relief that is required on both the ECML and MML routes. The route currently proposed by the Government removes a considerable amount of cost from this proposition by having the eastern section of HS2 diverge from that completed in phase one just north of Birmingham, on this basis the business case would be expected to improve significantly.

4.4.2 Midland Main Line

Some of the interventions in Scenario B were recommended in the East Midlands and Northern RUSs as being required in the short to medium-term to provide industry cost savings (electrification), synergies with major planned renewals, train lengthening (to provide LDHS peak hour train capacity), and increased freight capacity between the Haven ports and the WCML. These interventions are included in the IIP. However, this does not include any of the capacity enhancements between Bedford and Kettering or Kettering and Corby included in Scenario B. Furthermore, it does not include the additional schemes described above to provide major track capacity enhancements in the London area or between Kettering and Wigston Junction.

The longer-term strategy for improving the capacity of LDHS services on the route between London and the East Midlands and South Yorkshire and for improving journey times on these flows should be the completion of a new high speed rail network. This would allow the removal of a significant proportion of long distance passenger flows from the MML and to use the freed up capacity to meet passenger growth for flows that would not naturally pass to services on the new high speed line, for new service opportunities, and to provide increased freight capacity.

4.5 Conclusion

If they could be realised, the quantum of services proposed for the ECML and MML in Scenario B would provide additional capacity on these routes. Whilst the report identifies some of the current constraints on the routes where infrastructure intervention would be necessary, the high level analysis conducted by Network Rail has identified a number of other locations where significant and expensive intervention would be required to deliver the train services proposed.

The scale of the required interventions are significant in terms of cost and also in terms of the disruption that they would cause to passengers, an issue shared with the 51M and RP2 proposals on the WCML. They deliver considerably fewer benefits than a new high speed rail line, particularly with regard to reduced journey times between urban centres and the ability to use the resultant freed capacity on the classic network to develop new markets and provide for continuing freight growth.

After delivery, changes to the service pattern on one route would have an implied, if not direct, impact on the other routes which has not been considered in any detail. The railway network is a system, and as such there are interdependencies between the three key routes considered here. It would not be possible to implement all the enhancements proposed in an efficient way without significant disruption to customers on one or all of these routes.

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