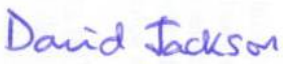
West Coast Main Line and Trans-Pennine Capacity and Performance Assessment

Controlled Copy Number	

Report Control Sheet

Prepared by 	**Name:**	**David Jackson**
	Job Title:	**Operational Planning Manager (Governance)**
	Date:	**22nd October 2013**
Approved by 	**Name:**	**Fiona Dolman**
	Job Title:	**Head of Capacity Planning**
	Date:	**22nd October 2013**

Issue Record

Issue No.	Brief History of Amendment	Date of Issue
1.0	Draft Issue	30/09/13
1.1	Final Issue	18/10/13
1.1.1	Final Issue (including minor clarification amendments)	22/10/13

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

1.1 The Office of Rail Regulation (ORR) asked Network Rail to provide a piece of capacity analysis work to help inform its decision on the allocation of additional Access Rights on both the West Coast Main Line (WCML) and Trans-Pennine routes from December 2016 onwards. Aspirations for additional services that have been considered as part of this study are as follows:

- Alliance Rail: 3 trains every 2 hours from Euston to either Blackpool North or Carlisle (via Cumbrian Coast) and to Bradford Interchange and Leeds.
- Virgin Trains: additional services from London Euston to Shrewsbury (via Stafford) and Blackpool.

1.2 This capacity study has examined whether additional paths can be accommodated on the WCML Fast Lines and Trans-Pennine routes. The capacity and performance analysis has shown that providing capacity for two or more additional services in the current timetable structure on the WCML will negatively affect the performance of the route. Network Rail does not believe that a robust plan can be developed with two or more additional off-peak services per hour within the current timetable structure.

1.3 Following the completion of the West Coast South Reliability Programme and Stafford Area Improvement Scheme (December 2016), Network Rail has high confidence that one additional Fast Line path can be operated on the WCML every off peak hour without a significant impact to performance. To achieve this Network Rail will work closely with operators to agree and implement a robust timetable in 2016.

1.4 The May 2014 timetable is based around a 20 minute frequency service to each of Birmingham and Manchester and without any change in this requirement; there is very little change that can be made to the overall timetable structure without changing journey opportunities and connectivity.

1.5 To understand what a completely different timetable structure could be on the WCML, a notional WCML timetable has been developed based on a 15 minute interval to both Birmingham and Manchester. This could deliver up to 15 off-peak paths per hour on the Fast Lines (3 additional paths above the May 2014 Fast Line quantum). Analysis of this notional timetable has shown that developing the timetable structure from scratch rather than adding additional services to the May 2014 structure allows for a more robust WCML Fast Line timetable south of Rugby. Network Rail believes that a full review of the WCML timetable from December 2016 may be appropriate, based on the potential opportunities described in this report. However, there are factors such as the utilisation of rolling stock and train crew resources and the potential impact of HS2 that will need to be considered here; therefore we would want to work with the industry to understand the benefits (not only in terms of capacity) that a revised timetable could realise.

1.6 Aspirations for paths to Bradford Interchange and Leeds have also been reviewed against the Northern Hub Indicative Train Service Specifications (ITSS) for December 2016 and December 2018. Paths to Bradford Interchange

and Leeds can not be accommodated in full alongside the ITSS, but could be in paths currently identified in the Northern Hub ITSS.

1.7 High Speed 2 (HS2) has not been taken into account in the capacity and performance analysis within this report. However, subject to progress with statutory processes, construction work is planned to start in 2015 at Euston and will have an impact on network capacity. Network Rail has low confidence that any additional services can be delivered robustly on the proposed phasing layouts above the December 2013 quantum.

1.8 Once an Access Rights decision has been made, it is the intention of Network Rail to include it within the work already being undertaken in the West Coast Main Line Event Steering Group (ESG) and the soon to commence North of England ESG.

2. BACKGROUND

2.1 Remit

2.1.1 The Office of Rail Regulation (ORR) has asked Network Rail to provide a piece of capacity analysis work to help inform their decision on the allocation of additional Access Rights on both the West Coast Main Line (WCML) and Trans-Pennine routes from December 2016 onwards.

- The remit for this work as agreed with the ORR, was to provide:
- A high level capacity analysis exercise which identifies the quantum of capacity that exists on the WCML and Trans-Pennine routes, and shows what spare capacity exists on each.
- Analysis that takes into account known capacity enhancement schemes to be delivered during CP5 on both the WCML and Trans-Pennine routes and describes the new or changed infrastructure capability and the additional capacity that each of these schemes is expected to deliver, both incrementally and collectively.

2.1.2 A choice of high-level indicative timetable specifications, which describe the quantum train service that could operate given the known performance characteristics of the assumed rolling stock. The report will also consider:

- The known implications of the applications from Alliance Rail and Virgin West Coast on the WCML, both against each other and in terms of their individual impact on capacity and performance.
- The known implications of the application from Alliance Rail and Trans-Pennine Express (TPE) across the Pennines, both against each other and in terms of their individual impact on capacity and performance. This will include a high level review of aspirations against proposed sample outputs from North of England Programmes and identification of the remaining uncertainties.

3. APPROACH AND ASSUMPTIONS

3.1 Approach

Our approach has been to divide the work into two main sections; the first covers the WCML and the second the Trans-Pennine routes via both Diggle and the Calder Valley.

3.1.1 For each of the main sections, we have divided work as follows:

3.1.1.1 West Coast Main Line: London Euston – Carnforth and Crewe – Heaton Norris Junction (just north of Stockport) on the WCML. Between London Euston – Nuneaton, only the Fast Lines have been considered in detail, since the aspirations being considered for additional trains relate only to Long Distance High Speed services.

- Base timetable (May 14)
- December 2016

3.1.1.2 Trans-Pennine: Liverpool – Newton-le-Willows – Manchester Piccadilly / Victoria – Bradford Interchange (via the Calder Valley) and Leeds (via Diggle) on the Trans-Pennine routes.

- Base timetable (May 14)
- December 2016
- December 2018

3.1.2 For each of these sections we include:

- A list of known capacity enhancement and other schemes, the timetable from which they are assumed to take effect and the impact on overall route capacity, both incrementally and collectively.
- A list of known constraints on the route that constrain the availability or use of capacity.
- One or more indicative train service specifications and other options, together with an explanation to describe them.
- Any caveats or key assumptions which need to be considered in understanding the outputs.

3.1.3 The results of performance analysis undertaken are outlined in Section 6 of the report.

3.1.4 Our work considers an off-peak standard hour, broadly between the hours of 1000 and 1600.

3.1.5 Notional journey timings are included through to Blackpool North, Barrow/Carlisle, Bradford Interchange and Leeds as an output from assessing where through paths to/from Euston for Alliance Rail are workable. This will allow ORR to carry out the Not Primarily Abstractive (NPA) Test.

3.1.6 We have included references to other work previously completed by Network Rail as relevant.

3.2 Rolling Stock Assumptions

3.2.1 Long Distance High Speed (LDHS) paths on the Fast Line paths are operated by Class 390 Pendolinos, or equivalent, (and Class 221 Voyagers for the Chester / North Wales paths), capable of maintaining existing timings in tilt / EPS mode.

3.2.2 Other trains on the Fast Lines are assumed to be operated by Class 350 EMUs capable of a mix of 110mph and 100mph running (for Option 1) and 110mph only (for Option 2).

3.2.3 For Alliance Rail operating over non-electrified sections of route, a timing load corresponding to a Class 67 diesel locomotive hauling 300 tonnes trains (6-car Class 390 Pendolinos) was used. In the absence of detailed performance characteristic information for a Class 68 locomotive (which is thought likely to be the actual traction used) Network Rail have used the Class 67 as a proxy in this analysis. The attaching and detaching of diesel locomotives to the new services is assumed to take place at Crewe or Stockport for Leeds, Warrington Bank Quay for Bradford Interchange and Carnforth for Barrow/Carlisle. No assessment has been made on route clearance requirements for rolling stock of this type.

3.2.4 The proposed Alliance Rail services to and from London Euston were timed as Class 390s with tilt and EPS when operating on the WCML. Other rolling stock options would be required to have the equivalent operating characteristics.

3.2.5 Rolling stock for other services is as specified in the Northern Hub ITSS for December 2016 and December 2018. The Northern Hub ITSS sets out the planned quantum of service and makes assumptions about likely rolling stock and calling patterns, although it does not give details of the timings of individual trains.

4. WEST COAST MAIN LINE

4.1 Timetable Constraints in May 2014

4.1.1 Table 1 lists the constraints north of Rugby which impact on the May 2014 Timetable.

Table 1	
Constraints	**Capacity Impact**
Euston – Milton Keynes	Fast Lines comprised of a mixture of 125mph paths, 110mph paths and 100mph paths. This heterogeneity of paths constrains capacity south of Rugby.
Brinklow – Attleborough Junction	Down Fast Line shared with freight trains (max speeds 60-75mph) on the 3 track section.
Colwich Junction – Milford & Brockton / Whitehouse Junction	Two track section with flat junctions each end, with freight trains (max speeds 60-75mph) on this section.
Stafford – Crewe	Slow Lines limited to maximum line speed of 75mph. Constrains ability to operate LM services on Slow Lines.
Norton Bridge	Flat Junction. Timetable constrained by crossing moves of trains on/off the Norton Bridge Branch to/from Stone Junction.
Crewe	Flat junction moves with complex operation of services. Limited spare platform capacity.
Winsford South Junction – Acton Grange Junction	Predominantly a double track section with limited opportunity for passing moves. The mix of speed between different services on this section constrains the capacity available.
20min frequency timetable between Euston – West Midlands and Euston – Manchester	Interaction with other services on the Coventry Corridor, on the Stoke-on-Trent route and between Cheadle Hulme – Manchester Piccadilly.
New Measurement Train	This requires a path between Crewe – London Euston within the off-peak timetable once every 2 weeks (currently utilising the xx:30 arrival and xx:33 departure paths at London Euston)
Barrow – Carlisle (via Cumbrian Coast)	Long sections of absolute block signalling and single track railway between Barrow – Park South Junction and Sellafield – Bransty Junction (Whitehaven).

4.1.2 Whilst a number of these constraints will be removed by planned capacity enhancement and other schemes for the December 2016 timetable, others will remain. These include high capacity usage south of Rugby the three track section between Brinklow – Attleborough Junction, the two track section

between Colwich Junction – Milford & Brockton / Whitehouse Junction and the predominantly two track section between Winsford South Junction – Acton Grange Junction.

4.2 Capacity Enhancement and other Schemes

4.2.1 Table 2 shows the capacity enhancements and other schemes that are planned to be implemented on the WCML in the lead up to the December 2016 Timetable.

Table 2

Capacity Enhancement and Other Schemes	Completion Date[1]	Capacity Impact
West Coast South Reliability Programme	By Dec/14, although some elements delivered earlier	No capacity impact - will deliver improved reliability, asset resilience and PPM performance.
Power Upgrade between North Wembley – Whitmore (between Norton Bridge – Crewe) and between Whitmore – Great Strickland (between Tebay – Penrith)	Phase 3A in Jul/14. Phase 3B in Dec/15.	Supports an increase from 12 electric Fast Line paths per hour to 15 between North Wembley - Whitmore.
Procurement of additional 10 x Cl.350 EMU by London Midland capable of 110mph operation	By Dec/14 Timetable	Delivered during 2014. Enables additional 110mph services and strengthening of existing trains.
Stafford Resignalling & conversion of old Royal Mail platform into a freight loop	For Dec/15	Resignalling scheme has no impact on capacity – replacement of life expired equipment. Will deliver improved reliability. Freight loop provides additional capacity for recessing freight trains predominantly in the Down direction.
Norton Bridge Grade Separation	For Dec/16	Removes conflicts between crossing moves of trains on/off the Norton Bridge Branch to/from Stone Junction. Will support delivery of additional Fast Line paths.

[1] Based on the Draft Calendar of Events December 2014 published on 20 September 2013

Line Speed Increase (LSI) on Slow Lines from 75mph and 100mph: Doxey Junction – Norton Bridge. Norton Bridge – Crewe	For Dec/16	Allows more flexibility by enabling 100mph London Midland services to operate on the Slow Lines without journey time penalty, freeing up capacity on the Fast Lines. Journey times between Stafford – Crewe on Slow Line reduced by four minutes.
Procurement of 10 x Cl.350 EMUs by TPE capable of 110mph operation	By May/14 Timetable	To be delivered during 2013/14. Enables the operation of an hourly electric service between Manchester Airport – Scotland with accelerated journey times.
Preston – Blackpool North Electrification and journey time improvement scheme	For Dec/16	Delivers infrastructure to support through electric services from London Euston. Opportunity for accelerated journey times between Preston – Blackpool North.

4.3 Future Considerations

4.3.1 The import of biomass, for electricity generation, may require freight paths of up to 2,400 tonnes between Liverpool Bulk Terminal – Rugeley Power Station. Some initial work has been completed to identify paths via Colwich using the May 2013 timetable as a base. These paths have not been included in our analysis.

4.3.2 Timetable Participants attending the WCML ESG have provided a list of aspirations for the ESG to consider. Whilst the aspirations for additional Fast Line services for Alliance Rail and the Inter City West Coast franchisee have been included in the remit for this particular piece of work and are included in our analysis, the other aspirations have not been considered. They will be considered by the WCML ESG. These include:

- An increase in the number of strategic slots for freight.
- Postal Services.
- Extension of Marston Vale service to/from Milton Keynes.
- Cross Country services to/from the South Coast routed via Coventry.
- Extension of Birmingham – Rugeley services to/from Stafford.
- Improved journey times for Cross Country services between Birmingham New Street – Manchester Piccadilly.
- Extension of London Euston – Crewe 110mph services to/from Preston.
- Accelerated Anglo-Scottish services.

4.3.3 Table 3 lists the constraints which are expected to impact on the WCML timetable from December 2016.

Table 3	
Constraints	**Capacity Impact**
HS2 Project - Euston: Existing 6 running Lines on the approaches to Euston reduced to 4. Existing 18 platforms at Euston reduced to 13.	Work assumed to start in the December 2015 timetable. Reduced timetable resilience and ability to recover from perturbation. Tighter turnround times at Euston.

4.3.4 High Speed 2 (HS2) is not yet a committed scheme. However, construction work is planned to start in 2015 and it is important that the impact is understood. Our understanding of HS2 Ltd's proposals is that this will reduce the number of running lines on the approaches to London Euston from six to four and the number of WCML platforms at the station from 18 to 13, all of which will be able to accommodate 11-car Class 390s. Capacity analysis work undertaken by HS2 Ltd has assumed that there are no additional services operating on the WCML to and from London Euston. They have concluded that the peak hour timetables would have to be operated differently to that of today, with reduced turnround times needed to facilitate operation of the current service quantum. Network Rail has not assessed the impact of HS2 on capacity as part of this report. Network Rail has low confidence that any additional services can be delivered robustly on the proposed phasing layouts above the May 2014 quantum.

4.4 Capacity Analysis May 2014

4.4.1 The 'Service Map' (see Appendix A) shows the number of paths planned to operate in the May 2014 Timetable on the WCML.

4.4.2 An off-peak quantum of 12 paths per hour on the Fast Lines, made up of eight Class 390s Pendolinos, one Class 221 Voyager, two Class 350 EMUs at 110mph and one Class 350 EMU at 100mph currently operates. The latter path operates as far as Ledburn Junction on the Fast Lines.

4.4.3 The May 2014 timetable is based around a 20 minute departure pattern from Euston, providing a departure every 20 minutes to Birmingham and to Manchester.

4.4.4 The capacity enhancements and other schemes listed in Table 2, outline a number of capacity benefits due to be delivered by December 2016.

4.4.5 The starting point for understanding the quantum of route capacity on the Fast Lines south of Rugby is that, given a three minute planning headway, a theoretical maximum of 20 trains an hour is possible. This assumes Class

390 Pendolino trains with tilt and EPS, departing Euston on the minimum headway of three minutes and with no station calls south of Rugby.

4.4.6 Starting with a theoretical maximum use of capacity of 20 Pendolino paths an hour arriving/departing Euston at three minute intervals and travelling at maximum speed then the following timetable features reduce this number as follows:

- Calling at Watford Junction on the Fast Lines (one path)
- Running trains at 100mph or 110mph and weaving to Slow Lines south of Milton Keynes (one path, plus an additional Up path if the timetable is not constructed in such a way as to leave a corresponding gap to cross Up Fast).
- Calling at Milton Keynes or Rugby (one path, or no paths if accommodated in conjunction with 100/110mph trains weaving to Slow Lines south of Milton Keynes).

4.4.7 The May 2014 timetable has two trains calling at Watford Junction and three trains running at 100mph or 110mph on the Fast Lines in each direction. In the Down direction one weaves to the Slow Lines at Ledburn Junction, one crosses into platform five at Milton Keynes and is then routed onto the Slow Lines north of the station and the other stays on the Fast Lines to Rugby. In the Up direction, there is one path on the Fast Lines from Rugby and the other two weave at Ledburn Junction from the Slow Lines to Fast Lines. This gives a theoretical maximum of 15 trains per hour if current calling patterns / variable speeds remain as now.

4.4.8 Together this means there are theoretically three ‘spare’ 125mph tilt paths in an off peak standard hour.

4.5 Capacity Analysis - December 2016 Indicative Timetable Option 1

4.5.1 The 'Service Map' (see Appendix B) captures the existing Fast Line specification and includes the three potential additional paths for the WCML.

4.5.2 This option develops the existing May 2014 Timetable, introducing a further three Fast Line paths in each direction into the existing service pattern. The basic May 2014 timetable structure (including the changes made by Virgin Trains in the December 2013 timetable[2]) is maintained, although some re-timings have been made to specific trains in order to accommodate the additional services.

4.5.3 Table 4 shows a potential set of timings for three additional paths in each direction, which have been validated against the May 2014 base position. The Down trains would depart from London Euston at xx:33, xx:36 and xx:57 with Up trains arriving at London Euston at xx:02, xx:30 and xx:43.

Table 4	**Potential New Services on May 2014 timetable base**			
Down Direction				
Euston	d	10:33	10:36	10:57
Milton Keynes Central	a	-	11:05h	
	d	*11/01h*	11:10h	*11/25h*
Rugby	a	11:21	-	11:44h
	d	11:23	*11/30*	11:50
Nuneaton	a	-	11:38	
	d	*11/30h*	11:39h	*11/57h*
Colwich Jn		*11/47*	*11/57h*	*12/14h*
Stafford	a	11:53h	-	
	d	11:55h	*12/02*	*12/19*
Crewe	a	12:14	12:17h	12:34h

[2] Virgin Trains changes for the December 2013 Timetable include joining the existing xx:43 London Euston – Birmingham New Street service with the xx20 Birmingham New Street - Scotland service as a through service, starting the xx45 Wolverhampton – London Euston services back from Scotland, calling London Euston – Liverpool services at Crewe in both directions and swapping the Milton Keynes and Watford Junction calls in the Up direction so the xx:30 Birmingham New Street – London Euston now calls Watford Junction and the Scotland – London Euston service via Birmingham now calls at Milton Keynes.

Up Direction				
Crewe	d	10:17	10:40	10:54
Stafford	a	-	10:58h	-
	d	10/33h	11:00h	*11/12h*
Colwich Jn		10/38	*11/07h*	*11/17*
Nuneaton	a	10:54	-	-
	d	10:55h	*11/23h*	*11/32h*
Rugby	a	-	11:32h	11:42h
	d	11/06h	11:34h	11:45h
Milton Keynes Central	a	11:24	-	12:04-
	d	11:29	*11/52*	12:09
Euston	a	12:02	12:30	12:43

4.5.4 In order to provide a viable and attractive service, calling patterns are broadly balanced in each direction, although the xx:43 arrival is shown to call additionally at Milton Keynes Central in order to be overtaken.

4.5.5 There is a further option of operating the existing xx:13 100mph departure from London Euston using 110mph rolling stock and pushing back departure to xx:15. This would potentially free up capacity for an additional 125 mph Fast Line path departing at xx:12. The existing xx:07 and xx:10 services would need to depart 1 minute earlier too. However, this would lead to up to nine trains departing London Euston on minimum headways and would present a significant performance risk. The option has been discounted.

4.5.6 Tables 5 and 6 show the base May 2014 position, with the potential new paths highlighted in green.

Table 5	Down Direction		
Time	**Euston To**	**Stops south of Rugby**	**Notes**
xx:00	Manchester	None	
xx:03	Birmingham	Rugby	
xx:07	Liverpool	None	
xx:10	Chester/North Wales	Milton Keynes Central	
xx:13	Birmingham (100mph)	Leighton Buzzard (SL), Bletchley (SL), Milton Keynes Central (SL) etc	FL to Ledburn Jn then SL via Northampton
xx:20	Manchester	Milton Keynes Central	Headway behind xx:13 at Ledburn Jn
xx:23	Wolverhampton	Watford Junction	
xx:30	Glasgow	None	Headway behind xx:23 at Bourne End Jn
xx:33	Possible Path	Can run at xx:34 if following path runs at xx:37 (or no xx:37 path)	
xx:36	Possible Path	Can run at xx:37 but must be non-stop to Crewe if impacting on xx:40 is to be avoided	
xx:40	Manchester	None	via Crewe
xx:43	Edinburgh/Glasgow via Birmingham	Milton Keynes Central	
xx:46	Crewe (110mph)	Milton Keynes Central, Rugby	
xx:49	Birmingham (110mph)	Watford Junction, Milton Keynes Central	SL via Northampton north of Milton Keynes Central xx:00 is headway behind by Milton Keynes Central
xx:57	Possible Path	Requires xx:49 to cross to SL at Ledburn Jn OR not stop at Watford Junction	

Table 6	Up Direction		
Time	**Arrive Euston From**	**Stops south of Rugby**	**Notes**
xx:02	Possible Path	Assumes existing xx:02 arrival from Manchester moves to xx:05 (by adding pathing time south of Ledburn Junction)	
xx:02	Manchester (dep xx:55)	None	via Crewe. See note above as requires 3 minutes pathing time to arrive at xx:05.
xx:10	Glasgow	None	
xx:14	Birmingham (dep xx:50)	None	
xx:21	Manchester (dep xx:15)	Milton Keynes Central	
xx:27	Birmingham (100mph)	SL to Leighton Buzzard then non-stop FL	Joins FL at Ledburn Jn 3 minutes behind xx:21
xx:30	Possible Path	Requires following three trains to be pathed slightly later	
xx:33	Scotland (via Birmingham)	Milton Keynes Central	
xx:37	Chester	Milton Keynes Central	
xx:40	Manchester (dep xx:35)	None	
xx:43	Possible Path	Requires xx:46 to be retimed to xx:49 and xx:50 to be retimed to xx:52	
xx:46	Birmingham (110mph)	Milton Keynes Central (SL), Watford Junction (FL)	joins FL at Ledburn Jn
xx:50	Crewe (110mph)	Milton Keynes Central	
xx:55	Birmingham (dep xx:30)	Watford Junction	
xx:59	Liverpool	None	

4.5.7 If both the xx:33 and xx:36 paths were to run in the same off-peak hour, then the destination north of Crewe becomes important. Ideally, one path would head towards Stockport and the other towards Warrington. If both paths were required to run north of Crewe towards Warrington, the xx:36 path would require an element of pathing time to follow the xx:33 path.

4.5.8 These paths have been projected to and from Heaton Norris Junction and Carnforth, to confirm that extensions to locations away from the WCML,

including Leeds, Bradford Interchange, Blackpool, Barrow and Stafford (for extension to Shrewsbury) are possible.

4.5.9 The notional plan takes into account the requirement for an hourly freight quantum of one Class 4 electrically hauled, one Class 4 diesel hauled and one Class 6 diesel hauled for the three track section between Brinklow and Attleborough Junction; the two track section between Colwich Junction and Milford & Brocton/Whitehouse Junction; and the predominantly two track section between Winsford and Acton Grange Junction. A gap of between 10 and 11½ minutes is required at Brinklow.

4.5.10 Between Winsford and Action Grange Junction, it was assumed for the purposes of this assessment that freight services were timed to pass Winsford in the Down direction or Acton Grange Junction in the Up direction at the minimum permitted planning headway behind the preceding train service. On this basis, it was possible to accommodate the required three freight paths per hour alongside the additional passenger services, although some freight trains would need to be retimed, compared to their current paths.

4.5.11 In this assessment, the four track section between Acton Bridge and Hartford Junction was not used for recessing freight trains and all freight trains were assumed to run non-stop through the section. The assessment therefore offers a robust analysis as, in reality, it will be possible to recess freight trains between these locations if necessary.

4.5.12 The work completed uses the current Timetable Planning Rules (TPR). It is noted that a review of WCML South TPR is currently underway. It is recommended that once the access decision has been made that further work will be required to understand the impact of the new rules.

4.5.13 Section 6 of this report describes the TRAIL modelling carried out on these paths.

4.5.14 There are currently two Timetable Participants – Virgin Trains, the current ICWC franchise operator and Alliance Rail – who have aspirations for new paths on the WCML. Provided the rolling stock assumptions for LDHS services are met, these paths (or parts thereof) could be used by either aspirant.

4.5.15 Sufficient capacity exists between Preston – Blackpool North and between Carnforth – Barrow for through services from London Euston. Timetables in the North-West area may change from December 2016 as line speed improvements are implemented and electric rolling stock introduced after the completion of electrification and other infrastructure works..

4.5.16 Using Option 1, Nominal journey times have been calculated for Alliance's proposed services to Blackpool and Carlisle (via Barrow) which can be found in Appendix I. These are based on validated paths as far as Preston and Carnforth respectively, using a Class 390 (with tilt) timing load.

4.6 Capacity Analysis - December 2016 Indicative Timetable Option 2

4.6.1 The 'Service Map' (see Appendix C) captures a new Fast Line train service specification for the WCML which shows a number of potential paths in the December 2016 Timetable. It includes all operators on the Fast Lines, including freight between Brinklow/Attleborough and Coventry/Stechford. This has been constructed by abandoning the current 20 minute frequency on the Manchester and Birmingham corridors in favour of a nominal 15 minute frequency. This increases the quantum of trains towards Manchester and Birmingham from three to four per hour.

4.6.2 There are specific advantages on the Coventry Corridor and Stoke-on-Trent routes in that this would facilitate a more even pattern of services for other Timetable Participants, which already rely on 15/30 minute intervals.

4.6.3 The analysis for Option 1 indicates that the maximum Fast Line route capacity is 15 trains per hour, based on the inclusion of two Watford Junction calls and three 100/110mph services.

4.6.4 This also takes into account the capacity enhancements and other schemes listed in Table 2.

4.6.5 With Option 2, a recast timetable starting from first principles, but subject to the same constraints, also gives a route capacity on the Fast Lines of 15 trains per hour. This is not surprising as the existing constraints (two Watford Junction calls and three 110mph paths) still reduce the maximum theoretical number of 20 paths by five. A benefit of this particular service pattern is that crossing movements from the Down Fast to the Down Slow south of Milton Keynes are removed. The off-peak quantum of 15 paths per hour on the Fast Line, is assumed to be made up of eleven Class 390 Pendolinos, one Class 221 Voyager and three Class 350 EMUs at 110mph.

4.6.6 This option develops a recast timetable for the WCML. These are shown in Tables 10 and 11 below. A copy of the notional plan for both directions is attached at Appendix G.

Table 10	Down Direction		
Time	**Euston To**	**Stops south of Rugby inclusive**	**Notes**
xx:00	Manchester	None	
xx:03	Birmingham	Rugby	
xx:07	Liverpool	None	
xx:10	Chester / North Wales	Milton Keynes Central	
xx:13	North West	None	
xx:16	Manchester	Milton Keynes Central	
xx:19	Birmingham	Watford Junction	
xx:23	Northampton (110mph path)	Milton Keynes Central	FL to Milton Keynes Central then SL to Northampton
xx:30	Manchester	None	
xx:33	Birmingham	Rugby	
xx:36	Glasgow	None	
xx:39	Crewe (110mph path)	Milton Keynes Central, Rugby	
xx:45	Manchester	None	
xx:48	Birmingham	Watford Junction, Milton Keynes Central	
xx:53	Northampton (110mph path)	Milton Keynes Central	FL to Milton Keynes Central then SL to Northampton

Table 11	Up Direction		
Time	**Arrive Euston From**	**Stops south of Rugby inclusive**	**Notes**
xx:00	Liverpool	None	
xx:03	Manchester	None	
xx:06	Birmingham	Rugby	
xx:09	North West	None	
xx:13	Northampton (110mph path)	Milton Keynes Central	Slow Line to Ledburn Junction
xx:17	Manchester	None	
xx:27	Birmingham	Milton Keynes Central, Watford Junction	
xx:31	Crewe (110mph path)	Rugby, Milton Keynes Central	
xx:34	Manchester	Milton Keynes Central	
xx:37	Birmingham	Rugby	
xx:40	Glasgow	None	
xx:44	Northampton (110mph path)	Milton Keynes Central	Slow Line to Ledburn Junction
xx:48	Manchester	None	
xx:54	Birmingham	Watford Junction	
xx:57	North Wales / Chester	Milton Keynes Central	

4.6.7 No work has been carried out on platforming at London Euston, nor have rolling stock turnrounds been considered.

4.6.8 The current quantum level of calling patterns and connectivity for the 125mph services have been maintained.

4.6.9 Four services are included to/from Birmingham New Street. Paths could be extended through to Wolverhampton or beyond to suit commercial requirements.

4.6.10 At this stage no attempt has been made to assess what through train connectivity can be assumed for Euston – Northampton – Birmingham. High-level indicative timetable work on the Coventry Corridor (see Appendix G) assumes the existing quantum between Northampton – Birmingham is maintained. This work also shows that the quantum of calls at local stations between Coventry – Birmingham can be maintained, but there may be

alternative ways of configuring the timetable pattern to suit commercial requirements.

4.6.11 None of the 110mph Fast Line paths call at Watford Junction. However, the two calls that are in the May 2014 Timetable, are included in two of the four 125mph West Midlands services, with as close to a 30 minute gap between them as possible.

4.6.12 In the Down direction the 110mph paths to Northampton run Fast Line to Platform 5 at Milton Keynes and then cross to the Slow Lines. This removes the constraint in the current timetable of crossing to the Down Slow Line at Ledburn Junction, but means that they are unable to call at Leighton Buzzard or Bletchley which current services do once per hour. In the Up direction, the 110mph services from Northampton continue on the Slow Lines from Milton Keynes and join the Up Fast at Ledburn Junction. This report has not assessed how Leighton Buzzard or Bletchley could be served as part of this option.

4.6.13 Rugby calls have increased from one to two in the 125mph services, again with as close to a 30 minute gap between them as possible. The call at Rugby in the 110mph service is maintained.

4.6.14 The quantum of station calls at Milton Keynes remains the same as in the current timetable at six per hour – three paths at 125mph and three paths at 110mph.

4.6.15 The four services to/from Manchester are split evenly between the Stoke and Crewe routes (two each), 30 minutes apart. One of the Crewe paths is an additional service via Wilmslow . This path could be extended through to Leeds from Heaton Norris Junction, via Guide Bridge and not serve Manchester Piccadilly.

4.6.16 On the Coventry Corridor and the route via Stoke (in particular), a 15/30 minute frequency could assist other operators who currently operate services to a similar pattern.

4.6.17 The notional plan takes into account the requirement for an hourly freight quantum of one Class 4 electrically hauled, one Class 4 diesel hauled and one Class 6 diesel hauled for the three track section between Brinklow – Attleborough Junction and predominantly two track section between Winsford – Acton Grange Junction. A gap of between 10 and 11½ minutes is required at Brinklow.

4.6.18 The additional North West path (shown to call at Nuneaton and Crewe) could be used by an ICWC Operator or Open Access Operator. This path could be extended through to Bradford Interchange, Blackpool North or Barrow/Carlisle. For demonstration purposes, it is shown on the notional plan (Appendix G) as timed to/from Carnforth.

4.6.19 No work has been undertaken to understand the stock and train crew resourcing implications of this timetable.

4.6.20 It is unclear whether a recast of the WCML is desirable and there are potential issues such as calls at Leighton Buzzard and Bletchley to resolve. If the industry decides a WCML recast is appropriate then further work will be required to understand the benefits and commercial requirements of a recast timetable.

4.6.21 More work would be required to demonstrate platform occupation times at key destinations, including Birmingham New Street and Manchester Piccadilly.

4.6.22 Existing Timetable Planning Rules (TPR) have been applied on the WCML, although there is an exercise on-going to check and test existing values. If a recast is taken forward then the revised TPRs would need to be taken into account.

4.6.23 There are currently two Timetable Participants – Virgin Trains, the current ICWC franchise operator and Alliance Rail – who have aspirations for new paths on the WCML. Provided the rolling stock assumptions for LDHS services are met, additional paths to the West Midlands, North West and Manchester (or parts thereof) could be used by either aspirant.

4.6.24 Sufficient capacity exists between Preston – Blackpool North and between Carnforth – Barrow for through services from London Euston. Timetables in the North West area may change from December 2016 as line speed improvements are implemented and electric rolling stock introduced after the completion of electrification and other infrastructure works.

4.6.25 Using Option 2, Nominal journey times have been calculated for Alliance's proposed services to Blackpool and Carlisle (via Barrow) which can be found in Appendix I. These are based on validated paths as far as Preston and Carnforth respectively, using a Class 390 (with tilt) timing load.

4.7 Other Options which could be applied to a December 2016 timetable

4.7.1 Table 12 is intended to outline other options which could be applied to the notional plan already developed.

Table 12

Scenario	Trade-off Required	Cost
20 trains per hour on Fast Lines (all Cl.390 or equivalent with tilt and EPS), with no calls on the	No Fast Line station calls at Watford Junction, Milton Keynes and Rugby resulting in significantly	Not thought feasible due to loss of connectivity at Watford, Milton Keynes and Rugby.

Fast Lines between Euston – Rugby inclusive.	reduced connectivity from these locations	Uses 100% of route capacity in every hour.

Reduced number calls at Watford Junction	Creates an additional path, but only where train is not immediately following a service which calls at Milton Keynes, or is timed at 110mph.	Net loss of calls at Watford Junction and associated connectivity.
Reduced number of calls at Milton Keynes	Creates an additional path, but only where train is not immediately followed by a service which calls at Watford Junction.	Net loss of call at Milton Keynes and associated connectivity.
Introduce 125mph rolling stock on Northampton, Birmingham & Crewe services	Faster between London Euston – Ledburn Junction / Milton Keynes, saving up to 2½ minutes between Euston – Milton Keynes, creating capacity for additional Fast Line trains.	Not enough 125mph rolling stock currently available and a further build would be required. London Euston – Northampton services currently run through to Birmingham and form the stopping services on the Coventry Corridor. Operating 125mph capable rolling stock on these local services may not be desirable.
All 110mph services to use Slow Lines	Removal of the three 110mph Fast Line paths would release up to three 125mph paths (depending on stopping pattern). Requires flighting of LM on the Slow Lines, retiming to fit in with the Slow Line pattern. Runs through several standard freight paths.	Impact on journey times between London and Northampton; LM service to Crewe would operate via Northampton increasing its journey time. Reduced capacity for freight. Would not work in peak hours.

Divert some freight onto MML and/or ECML	Conceptually it is an option, but need to be aware of steeper gradients on MML, capacity south of Bedford and no electrification from the MML to connecting routes. The locations of WCML freight destinations (for example. Wembley, Daventry, West Midlands, Basford Hall, Merseyside, Trafford Park and Mossend) are not easily accessed from the MML and ECML.	Use of scarce freight capacity on MML and ECML routes. Some significant extended journey times.
Reduce planning headways on the WCML to 2½ minutes.	Technical headways are between 90 and 120 seconds for WCML South	Would release capacity but remove performance buffer and impact on PPM. Further work would be needed to understand the impact on the approaches to London Euston.
Reduce maximum speed of Cl.390s to the maximum speed of the slowest services on the Fast Lines – to 110mph. (Euston – Milton Keynes only)	Would give a uniform speed on the WCML. Reduces the impact of Watford Junction & Milton Keynes stations calls. Gain paths between Euston and Milton Keynes – 3 minutes headways at 110mph, with no Watford Junction call.	Increase in journey times. Need more rolling stock to operate the service. Fails to utilise past infrastructure and rolling stock investment. Cost is 3 minutes per train non-stop. Every stop costs capacity.
Call all trains at Milton Keynes Central in both directions, using Platform 5 and alternating between Platform 6 and 5 on the Down and Platform 4 and 5 on the Up.	Allow all trains to call at Milton Keynes. Improved connectivity. Uniformity of running speeds, without unduly impacting on following trains.	Insufficient capacity as Platform 5 would be required simultaneously by services in both directions.

Join 100/110mph paths together to form 8-12 car sets on the Fast Line between Euston – Northampton. Splits into Crewe and Birmingham New Street portions at Northampton.	Releases 1 additional Fast Line Path each hour.	Risk of performance delay with splitting / joining operations at Northampton. Crewe service would be diverted back to run via Northampton with a corresponding increase in journey times.

4.7.2 These options have been put together to show different ways which network capacity could be used. All options require a trade-off between the service outcome, journey time or performance. No further analysis has been undertaken on these options within this study.

5. TRANS-PENNINE ROUTES

5.1 Timetable Constraints in May 2014

5.1.1 Table 15 lists the constraints which impact on the May 2014 Timetable.

Table 15	
Constraints	**Capacity Impact**
Diesel operated services on Trans-Pennine routes via Diggle and Calder Valley.	Slow moving local stopping services. Hourly freight path (via Diggle) with max trailing load of 900 tonnes. Heavier freight services would require passenger services to be flexed.
Manchester Piccadilly / Victoria – Huddersfield – Leeds (via Diggle)	Double track section with some opportunity for overtaking moves, at Stalybridge, Marsden (westbound), Huddersfield, Dewsbury (eastbound) and Mirfield (westbound).
Manchester Victoria – Bradford (via Calder Valley)	Double track section with some opportunity for overtaking moves between Brewery Junction – Thorpes Bridge Junction (both directions).
Leeds station	Limited number of through platforms or platforms with sufficient length for diesel plus 6-car Cl.390s. Interventions to improve capacity at Leeds are in the early stages of development.

5.2 Capacity Enhancements

5.2.1 The Northern Hub Project is about helping to stimulate economic growth by improving connectivity between key towns and cities in the North. The plan for the North is to provide the rail services to grow the local economy. A target quantum level of services was used to develop the infrastructure interventions which are required.

5.2.2 The following capacity enhancements and other schemes outlined in Table 16 are planned to be implemented on the Trans-Pennine routes in the lead up to the December 2016 Timetable.

Table 16		
Capacity Enhancement and Other Schemes	**Completion Date**	**Capacity Impact**
Northern Hub Phase 1. Edge Hill – Earlestown and Huyton – Spring's Branch Junction Electrification	By Dec/14	Delivers infrastructure to support through electric services from Liverpool – Manchester Piccadilly / Victoria. Opportunity for accelerated journey times Liverpool – Manchester. Planning headway is expected to be agreed at 3 minutes on the Chat Moss throughout. This gives some additional capacity.
Northern Hub Phase 1. Ordsall Lane – Manchester Victoria – Stalybridge Electrification	By Dec/16	Allows cross-Manchester Victoria electric trains to operate.
Northern Hub Phase 1. Ordsall Chord	By Dec/16	Delivers infrastructure to support through Trans-Pennine services via Manchester Victoria, Manchester Oxford Road and Manchester Piccadilly to Manchester Airport and removes need to reverse at Manchester Piccadilly. Removes four crossing moves per hour between Ardwick Junction – Manchester Piccadilly.
Northern Hub Phase 1. Manchester Victoria	By Dec/16	Infrastructure work to increase the flexibility of operation.
Todmorden Curve	By May/14	Enables the operation of services between East Lancashire – Manchester via Rochdale.
Ordsall Lane – Bolton – Preston Electrification	By Dec/16	Opportunity for accelerated journey times with electric rolling stock.
Preston Fylde Junction – Blackpool North Electrification	By Dec/16	Opportunity for accelerated journey times with electric rolling stock.
Oxenholme – Windermere Branch Electrification	By Dec/16?	Scheme not yet committed. Opportunity to operate through electric services.

5.2.3 The following capacity enhancements and other schemes, listed in Table 17 below, are planned to be implemented on the Trans-Pennine in the lead up to the December 2018 Timetable.

Table 17

Capacity Enhancement and Other Schemes	Completion Date	Capacity Impact
Northern Hub Phase 2. Completion of 4 tracking between Huyton – Roby	By Dec/18	Provides the opportunity for local stopping services to be overtaken between Liverpool – Earlestown. Allows for 2 additional semi-fast services on the Chat Moss route which are in the ITSS.
Northern Hub Phase 2. Linespeed improvements between Salford Crescent – Bolton – Euxton Junction	By Dec/18	Opportunity for accelerated journey times.
Northern Hub Phase 2. Castlefield Corridor including: ▪ Remodelling and longer platforms at Manchester Oxford Road. ▪ 2 additional through platforms at Manchester Piccadilly. ▪ Changes to signal spacing.	By Dec/18	Enables up to 16 trains per hour to operate on Castlefield Corridor.
Northern Hub Phase 2. Additional platform at Manchester Airport	By Dec/18	Additional services to operate and greater operational flexibility.
Northern Hub Phase 2. Recontrolling signalling at Huddersfield and lengthening of bay platforms	By Dec/18	Recontrol gives no capacity impact. Lengthening of bay platforms permits longer trains on local services.

Northern Hub Phase 2. Stalybridge – Huddersfield – Leeds – Colton Junction / Selby Electrification	By Dec/18	Delivers infrastructure to support through electric Trans-Pennine services between Liverpool – Leeds (via Diggle) – York – Newcastle. Opportunity for accelerated journey times with electric trains.
Northern Hub Phase 2. Rochdale Bay Platform	By Dec/18	Allows reversals of trains to/from the Manchester direction at Rochdale without shunting – gives capacity and performance benefits.
Leeds	By Dec/18?	Potential provision of an additional through platform (combining current bay platforms 13 & 14), allowing for additional through trains and/or overtaking moves.
Mill Lane (Bradford) resignalling	By Dec/17	Capacity improvement by permitting more parallel moves at Bradford Interchange.

5.2.4 There are no plans to electrify the route between Heaton Norris Junction – Guide Bridge by December 2018.

5.3 Capacity Analysis - May 2014 Timetable

5.3.1 The following capacity enhancements and other schemes (see Table 18) are to be implemented on the Trans-Pennine routes and are included in the May 2014 Timetable.

Table 18

Capacity Enhancement and Other Schemes	Completion Date	Capacity Impact
Lowton Junction – Castlefield Junction (via Chat Moss) Electrification. Line speed improvements on the Chat Moss route.	By Dec/13	Delivers infrastructure to support through electric services from Manchester Airport – Scotland and opportunity for accelerated journey times.
Procurement of 10 x Cl.350 EMUs by TPE capable of 110mph operation.	By May/14 Timetable	To be delivered during 2013/14. Enables the operation of electric services between Manchester Airport – Scotland, releasing Cl.185 DMUs to operate an additional hourly path between Liverpool – Manchester Victoria (via Chat Moss) – Huddersfield – Leeds – York.

5.3.2 The 'Service Map' (see Appendix D) shows the number of current paths planned to operate in the May 2014 Timetable on the Trans-Pennine routes via Diggle and Calder Valley. It includes all operators on the route.

5.3.3 The Northern Hub project is planned to deliver a different timetable pattern from the start of the December 2016 Timetable, so no further work has taken place to identify current route quantum.

5.3.4 There are two key freight aspirations to note. These have not formed part of our analysis for this report.

- With the import of biomass for electricity generation, there is an aspiration for freight paths of up to 2,400 tonnes between Liverpool Bulk Terminal – Drax Power Station. Some initial work has been completed to identify paths using the May 2013 timetable as a base. These paths have been developed as 'Y' paths on the Chat Moss route, with destinations of either Drax or Rugeley. However, no plan has been agreed yet and strategies for Trans-Pennine routing are being considered. Heavy trains would not fit in the existing notional freight path developed in the ITSS for the Northern Hub via Diggle.
- There are longer term aspirations for a freight terminal at Port Salford in Manchester. This is a consented scheme, where Network Rail has signed

a basic services agreement and has consented to a connection to the Chat Moss line east of Patricroft.

5.4 Capacity Analysis - December 2016 Timetable

5.4.1 The capacity analysis for the Trans-Pennine route has been undertaken in two sections; Stockport – Leeds (via Diggle) and Earlestown – Bradford Interchange (via the Calder Valley).

5.4.2 The Northern Hub Project involves major timetable changes in both December 2016 and December 2018. The Northern Hub / Industry Planning Group (IPG) has agreed a number of intended outputs for these timetables. The IPG has been made up of representatives from all relevant Timetable Participants, including Train Operating Companies (TOCs), Freight Operating Companies (FOCs), Open Access Operators, the Department for Transport, Passenger Transport Executives (Merseyside, TfGM, West Yorkshire and South Yorkshire), Rail North and Network Rail. The IPG has worked up an agreed Indicative Train Service Specification (ITSS) for each timetable year.

5.4.3 The ITSS developed by the Northern Hub Project for December 2016 and December 2018 have been used as the base for our analysis on Trans-Pennine routes via Diggle and the Calder Valley. It is based on a standard hourly pattern. This ITSS is used as a reference for the quantum of services which the DfT may (or may not) wish to specify in future franchises and is not to be regarded as a formal timetable.

5.4.4 A number of uncertainties remain on the detail of the final ITSS for December 2016 and beyond, not least because the Northern Hub Project is at various stages of GRIP 3 (Single Option Selection) or GRIP 4 (Single Option Development) and decisions about infrastructure interventions have yet to be finalised.

5.4.5 Once work is complete, the North of England Event Steering Group (ESG) will agree a project plan to achieve a smooth transition for the necessary timetable changes arising from the Northern Hub Project and oversee and facilitate delivery of the project into the timetable.

Stockport – Leeds

5.4.6 The 'Service Map' (see Appendix E) shows the number of paths in the December 2016 ITSS on Trans-Pennine routes. It includes all operators on the route.

5.4.7 The December 2016 ITSS has four fast trains in each direction per hour between Manchester Victoria and Leeds, calling at Huddersfield only (two of these will extend to/from Liverpool Lime Street and two will extend to/from Manchester Airport). These are planned to operate at strict 15 minute intervals and effectively divide the hour into four quadrants.

5.4.8 One effect of this is that the 15 minute window between fast passenger trains does not allow sufficient time for the operation an all-station stopping service operated by a Diesel Multiple Unit (DMU). For this reason, the December 2016 ITSS includes two semi-fast trains per hour, currently assumed to be worked by Class 185s. These trains are planned to operate between Manchester Piccadilly and Leeds (with extensions to Selby and/or Hull) and to have a skip-stop pattern such that Mossley, Greenfield, Marsden and Slaithwaite are each served once per hour. These semi-fast trains occupy two of the four quadrants.

5.4.9 It is assumed that a third quadrant will be used for freight trains (up to 950 tonnes) or ancillary movements. This leaves a fourth quadrant which could potentially be used by an additional service from December 2016.

5.4.10 The theoretical route capacity between Stalybridge – Huddersfield is 10 trains per hour, calculated on the fastest running time (four minutes) through Standedge Tunnel plus two minutes for route resetting under the TPR. Trains not meeting this criteria (local stopping services and freight) will reduce this quantum as does the application of a strict 15 minute frequency fast service. The ITSS is made up of seven paths (leaving 'spare' capacity of one path):

- Four fast trains (Liverpool/Manchester Airport – the North East).
- Two Manchester Piccadilly – Leeds (semi-fast skip-stopping).
- One freight.

5.4.11 The complex nature of the service specification between Huddersfield – Ravensthorpe, which includes services leaving and joining the route at different locations, and varying mixes of traffic, means that route capacity is difficult to calculate. The ITSS specifies:

- Four fast trains (Liverpool/Manchester Airport – the North East).
- Two Manchester Piccadilly – Leeds (semi-fast, calling at Dewsbury).
- One Huddersfield – Leeds (all station stopper).
- One Southport – Leeds via Brighouse and Dewsbury.
- One Huddersfield – Wakefield Westgate.
- One Huddersfield – Leeds via Brighouse and Bradford Interchange.
- One London Kings Cross – Bradford Interchange (not in all hours).
- Two freight (via Healey Mills and either Brighouse or Huddersfield).

5.4.12 The theoretical route capacity between Ravensthorpe – Leeds is 12 trains per hour. However, as there are various different headways, traction types and stopping patterns – the actual route capacity is somewhere closer to eight or nine trains per hour. The ITSS between Ravensthorpe – Leeds is made up of:

- Four fast trains (Liverpool/Manchester Airport – the North East).
- Two Manchester Piccadilly – Leeds (semi-fast, calling at Dewsbury).
- One Huddersfield – Leeds (all station stopper).
- One Southport – Leeds via Brighouse and Dewsbury.

Analysis of Alliance Rail and TPE Aspirations

5.4.13 There is capacity for an additional train above the level of service included in the ITSS between Stalybridge and Huddersfield in the December 2016 Timetable, utilising the unused 'fourth quadrant', which could be formed of a 6-car Class 390, hauled by a Class 67 or Class 68 diesel locomotive and provided this same path can be extended through to Leeds. Further work would be required to assess the impact on connectivity and calling patterns specified in the Northern Hub ITSS.

5.4.14 However, the construction of the timetable and the pattern of ITSS services east of Huddersfield may mean that the 'fourth quadrant' path may not be able to have a clean path across Huddersfield and match with spare capacity towards Leeds. This might require an overtaking move at Huddersfield.

5.4.15 The layout of Huddersfield station is such that an overtaking move in either direction would most likely need to use Platform 4. The availability of Platform 4 for this purpose would depend very much on the detail of the timetable structure. Both the current timetable and the ITSS have three trains per hour to/from the east which start/terminate at Huddersfield (Wakefield, Leeds via Dewsbury and Leeds via Bradford Interchange). In the current timetable, all three of these trains are in Huddersfield station simultaneously, necessitating the use of Platform 4 in addition to the two bay platforms (Platforms 5 and 6). This means that an overtaking manoeuvre at Huddersfield may require re-timing of services to/from the east.

5.4.16 If there is no clean path from Stalybridge – Leeds and it is not possible to carry out an overtaking manoeuvre at Huddersfield, then the additional path may conflict with an ITSS semi-fast path between Huddersfield – Leeds.

5.4.17 Leeds station will provide an additional capacity challenge for terminating services arriving from the Huddersfield direction. Trains of more than four vehicles in length would be too long to be accommodated in bay Platforms 10, 13 or 17; they would also be too long to be accommodated on either side of the mid-platform signals on the through platforms, meaning that occupancy of the full length of a through platform would be required. Use of bay Platforms 1-6 by such a train would require it to cross almost all lines of the Leeds station throat and so has been ruled out. Current Timetable Planning

Rules specify a minimum turnround time of 25 minutes for trains to and from London Kings Cross; given that the route from London Euston is longer, it can be assumed that a turnround time of at least this length would be desirable. The additional occupation of a through platform at Leeds for 25 minutes in every two hours would cause significant performance and capacity pressures.

5.4.18 A solution to the platform occupancy issue identified may be to run empty to Neville Hill Depot for turnround purposes, after arriving at Leeds, although there is very limited capacity to do this.

5.4.19 Nominal journey times have been calculated for Alliance's proposed services to Leeds which can be found in Appendix I. These are based on validated paths as far as Heaton Norris Junction, using a Class 390 (with tilt) timing load.

Earlestown – Bradford Interchange

5.4.20 The 'Service Map' (see Appendix E) shows the number of paths in a December 2016 ITSS on Trans-Pennine Routes. The ITSS variant that has been used for this analysis is expected to be endorsed by the North of England IPG in early November 2013 and includes one service from Manchester Airport – Calder Valley. It includes all operators on the route.

5.4.21 The December 2016 ITSS includes the following services operating over the section of the Chat Moss route between Earlestown – Ordsall Lane Junction in each off-peak hour:

- Two Liverpool – North East (Fast)
- One Liverpool – Manchester Victoria or Stalybridge (Stopping)
- One North Wales – Manchester (Semi-fast)
- One freight (Warrington Arpley – Yorkshire)

5.4.22 The Manchester Airport – Scotland (Fast) services have been assumed to return to run via the Bolton Corridor from December 2016.

5.4.23 In addition, the following are shown to operate between Earlestown West – Earlestown South Junctions (these are included because they introduce crossing moves between Earlestown South Junction and Winwick Junction):

- One Liverpool – Warrington Bank Quay (Stopping)
- Two freight (Liverpool Docks – WCML)

5.4.24 This service pattern represents a small uplift in the number of services from the May 2014 Timetable on the Chat Moss route. This comes mainly as a result of using Victoria as the main Trans-Pennine station in Manchester.

5.4.25 Whilst the technical route capacity between Earlestown – Ordsall Lane Junction is 20 paths per hour on a three minute headway, it is also dependent on the number of crossing moves at Ordsall Lane Junction (from the Bolton Line – Castlefield Corridor) and by the number of services using the new Ordsall Curve. A mix of fast, stopping and freight trains reduce this number closer to nine. In December 2016, there is enough spare capacity for a London Euston – Bradford Interchange service.

5.4.26 The December 2016 ITSS shows the following trains operating per hour on the Calder Valley route between Miles Platting Junction [Manchester] and Mill Lane Junction [Bradford] (both exclusive):

- One Manchester Airport – Leeds via Bradford Interchange.
- One Wigan Wallgate – Burnley/Blackburn via Todmorden.
- One Southport / Manchester Victoria – Leeds via Brighouse.
- One Southport / Manchester Victoria – Leeds via Bradford Interchange.
- One Wigan Wallgate – Rochdale.
- One Blackpool North – York.
- One Kirkby – Rochdale.
- One Huddersfield – Leeds via Brighouse.
- One freight via Hebden Bridge and Brighouse (may be routed via Manchester Victoria or Copy Pit).
- One London Kings Cross – Bradford Interchange (not in all hours).

5.4.27 In hours when all of the above trains run, this equates to:

- Seven trains between Manchester Victoria and Rochdale (compared to 5 currently).
- Five trains between Hall Royd Junction and Milner Royd Junction (same quantum as current).
- Five trains between Dryclough Junction and Bradford Interchange (same quantum as current).

5.4.28 The route capacity between Hebden Bridge – Sowerby Bridge is about eight trains per hour, based on various traction types and stopping patterns. There is sufficient capacity to operate an Alliance Rail service over the Calder Valley to Bradford Interchange in December 2016.

Analysis of Alliance Rail & TPE Aspirations

5.4.29 For both the Chat Moss and Calder Valley routes, there is enough capacity to accommodate both the level of service specified in the Northern Hub ITSS (including a TPE fifth path) and Alliance's aspirational path. However, both

paths would not work as additional paths. One of the two paths sought would need to operate as a service specified in the ITSS.

5.4.30 Nominal journey times have been calculated for Alliance's proposed services to Leeds and Bradford Interchange which can be found in Appendix I. These are based on validated paths as far as Winwick Junction, using a Class 390 (with tilt) timing load.

5.5 Capacity Analysis - December 2018 Timetable

5.5.1 From December 2018 there are no plans to electrify Heaton Norris Junction to Guide Bridge. This results in aspired services from Euston having to attach a diesel locomotive at Crewe or Stockport to run through to Leeds.

Stockport – Leeds

5.5.2 The 'Service Map' (see Appendix F) shows the number of paths in the December 2018 ITSS on Trans-Pennine Routes. It includes all operators on the route.

5.5.3 Forming part of the second phase of the Northern Hub, electrification between Stalybridge – Leeds will be commissioned in time for the December 2018 timetable change. These interventions will allow further service enhancements to take place.

5.5.4 The December 2018 ITSS continues the basic structure introduced in the December 2016 ITSS, including the four fast and two semi-fast trains per hour. The introduction of EMUs, with faster acceleration than the equivalent DMUs, enables the reintroduction of an all-station stopping service between Manchester Piccadilly – Huddersfield, without impacting on the frequency or journey time of the four fast trains. This restores the connectivity between adjacent local stations which will be temporarily lost for the two year period from December 2016. It is currently assumed that the stopping service will be in addition to the semi-fast services making calls at local stations.

5.5.5 The December 2018 ITSS therefore shows three of the four quadrants to be occupied by passenger trains, leaving one remaining quadrant for the use of freight trains or ancillary movements. The ITSS specified service for the section of route between Stalybridge – Huddersfield effectively uses the capacity of the route, although there is scope for additional services on individual sections.

5.5.6 The theoretical route capacity between Stalybridge – Huddersfield is 10 trains per hour, calculated on the fastest running time (4 minutes) through Standedge Tunnel plus 2 minutes for route resetting under TPR. Trains not meeting this criteria (local stopping services and freight) will reduce this quantum as does the application of a strict 15 minute frequency fast service. However, as services will be operated by electric traction, stopping services will be quicker than in December 2016, with faster journey times.

5.5.7 The ITSS is made up of 8 paths (the route capacity), as follows:

- Four fast trains (Liverpool/Manchester Airport – the North East).
- Two Manchester Piccadilly – Leeds (semi-fast).
- One freight.
- One Manchester Piccadilly – Huddersfield (all station stopper).

5.5.8 The complex nature of the service specification between Huddersfield – Ravensthorpe, which includes services leaving and joining the route at different locations, and varying mixes of traffic, means that route capacity is difficult to calculate. The ITSS specifies:

- Four fast trains (Liverpool/Manchester Airport – the North East).
- Two Manchester Piccadilly – Leeds (semi-fast, calling at Dewsbury).
- One Huddersfield – Leeds (all station stopper).
- One Southport – Leeds via Brighouse and Dewsbury.
- One Huddersfield – Wakefield Westgate.
- One Huddersfield – Leeds via Brighouse and Bradford.
- One London Kings Cross – Bradford Interchange (not in all hours).
- Two freight (via Healey Mills and either Brighouse or Huddersfield).

5.5.9 The theoretical route capacity between Ravensthorpe – Leeds is 12 trains per hour. However, as there are various different headways, different traction types and stopping patterns – the actual route capacity somewhere closer to 8 or 9 trains per hour. The ITSS between Ravensthorpe – Leeds is made up of:

- Four fast trains (Liverpool/Manchester Airport – the North East).
- Two Manchester Piccadilly – Leeds (semi-fast, calling at Dewsbury).
- One Huddersfield – Leeds (all station stopper).
- One Southport – Leeds via Brighouse and Dewsbury.

Analysis of Alliance Rail and TPE Aspirations

5.5.10 In December 2018, the unused 'quadrant' in December 2016, contains a reinstated Manchester – Huddersfield (all station stopper) in the ITSS. Whilst it may be possible to path an additional service from Stalybridge – Huddersfield, it cannot reach Leeds without being overtaken at Huddersfield by the next fast service.

5.5.11 The layout of Huddersfield station is such that an overtaking move in either direction would most likely need to use platform 4. The availability of platform 4 for this purpose would depend very much on the detail of the timetable structure. Both the current timetable and the ITSS have three trains per hour to/from the east which start/terminate at Huddersfield (Wakefield, Leeds via Dewsbury and Leeds via Bradford Interchange). In the current timetable, all three of these trains are in Huddersfield station simultaneously, necessitating the use of platform 4 in addition to the two bay platforms (platforms 5 and 6). This means that an overtaking manoeuvre at Huddersfield may require re-timing of services to/from the east.

5.5.12 Both Alliance Rail and the TPE 5th path could be accommodated in one of the paths already identified in the Northern Hub ITSS, from Stalybridge. For Alliance Rail, a diesel locomotive would be required for the section between Heaton Norris Junction – Guide Bridge as it is not electrified. Further work

would be required to assess the impact on connectivity and calling patterns specified in the Northern Hub ITSS.

5.5.13 Based on current and projected traffic levels, the hourly freight path is unlikely to be used in every hour, especially given the limited trailing loads that can be accommodated in the window between fast passenger trains. This path may therefore, be usable by an additional passenger train in some hours for the between Stalybridge – Huddersfield. However, the freight path diverges from the main line at Mirfield East Junction/Thornhill LNW Junction and is routed via Healey Mills, so it does not offer a through path to Leeds. This could offer an option for Alliance Rail to terminate at Huddersfield and run empty to a suitable location for turnround purposes. It would also be important to understand what capacity is required to satisfy freight operators' established rights and reasonable aspirations for future growth.

5.5.14 As in 2016 Leeds station provides a capacity constraint for terminating services.

5.5.15 Nominal journey times have been calculated for Alliance's proposed services to Leeds which can be found in Appendix I. These are based on validated paths as far as Heaton Norris Junction, using a Class 390 (with tilt) timing load.

Earlestown – Bradford Interchange

5.5.16 The 'Service Map' (see Appendix F) shows the number of current paths expected to operate in the December 2018 Timetable on Trans-Pennine Routes. It includes all operators on the route.

5.5.17 The December 2018 ITSS includes the following services operating over the section of the Chat Moss route between Earlestown – Ordsall Lane Junction in each off-peak hour:

- Two Liverpool – Newcastle (Fast).
- Two Liverpool – Manchester Victoria – Stalybridge (Semi-fast).
- One Liverpool – Manchester Airport (Stopping).
- Two Chester – Leeds (via Manchester Victoria?) (1 x Fast, 1 x Semi-fast).
- One freight (Warrington Arpley – Yorkshire).
- One Barrow – Manchester Victoria (not every hour).

5.5.18 In addition, the following are shown to operate between Earlestown West – Earlestown South Junctions (these are included because they introduce crossing moves between Earlestown South Junction and Winwick Junction):

- One Liverpool – Warrington Bank Quay (Stopping).
- Two freight (Liverpool Docks – WCML).

5.5.19 Whilst the technical route capacity between Earlestown – Ordsall Lane Junction is 20 paths per hour on a 3 minute headway, it is also dependent on the number of crossing moves at Ordsall Lane Junction (from the Bolton Line – Castlefield Corridor) and by the number of services using the new Ordsall

Curve. A mix of fast, stopping and freight trains reduces this number closer to 10.

5.5.20 The service pattern specified in the ITSS for December 2018 consists of a mixture of fast, semi-fast and stopping trains, including the requirement for the two Liverpool – Newcastle trains to be 30 minutes apart. This limits the options for timetable structure.

5.5.21 The December 2018 ITSS shows the following trains operating per hour on the Calder Valley route between Miles Platting Junction [Manchester] and Mill Lane Junction [Bradford] (both exclusive): (trains marked * also run on the Chat Moss route):

- Two Chester – Leeds via Bradford (1 Fast, 1 Semi-fast)*
- One Manchester Airport – Leeds via Bradford.
- One Manchester Airport – Blackburn via Todmorden.
- One Southport – Leeds via Brighouse.
- One Blackpool North – Scarborough.
- One Manchester Victoria – Rochdale (these will extend west of Manchester Victoria, probably to/from Southport, Blackburn and Clitheroe)
- One Huddersfield – Leeds via Brighouse.
- One freight via Hebden Bridge and Brighouse (may be routed via Manchester Victoria * or Copy Pit).
- One London Kings Cross – Bradford Interchange (not in all hours).

5.5.22 In the hours when all of the above trains run, this equates to:

- Nine trains between Manchester Victoria and Rochdale (on a ruling headway of 4 minutes)
- Six trains between Hall Royd Junction and Milner Royd Junction (on a ruling headway of 6 minutes)
- Six trains between Dryclough Junction and Bradford (on a ruling headway of 6½ minutes)

5.5.23 The route capacity between Hebden Bridge – Sowerby Bridge is about 8 trains per hour, based on various traction types and stopping patterns.

5.5.24 At Manchester Victoria the December 2018 ITSS includes significantly more trains per hour than in December 2016. While this does not involve the platforms being occupied to 100% of their capacity, the proposed London Euston – Bradford Interchange service would need to cross between the Chat Moss and Rochdale lines, which uses more capacity than a movement between Salford Central and Rochdale or between the Chat Moss and Ashton lines.

Analysis of Alliance Rail & TPE Aspirations

5.5.25 For both the Chat Moss and Calder Valley lines, the planned quantum of train services suggests that there may be limited spare capacity *on individual sections of route*. However, the combination of fast and slow trains, the range of origins and destinations and the longer signalling sections at the eastern end of the Calder Valley route all pose limitations to joining together these individual pockets of capacity to facilitate the running of additional through services. Therefore, any additional train on these routes could be accommodated in one of the existing Chester – Leeds (via Bradford Interchange) paths identified in the Northern Hub ITSS. Further work would be required to assess the impact on connectivity and calling patterns described in the Northern Hub ITSS to understand the implications of this.

5.5.26 Based on current and projected traffic levels, the freight path is unlikely to be used in every hour, although it is important to maintain capacity for freight traffic on this section of route within the ITSS. While this path could be allocated to additional passenger trains in some hours, it will be important to maintain sufficient capacity to satisfy freight operators' established rights and reasonable aspirations for future growth.

5.5.27 The London Kings Cross – Bradford Interchange service does not currently operate in every hour. This indicates that there is spare capacity in some hours between Dryclough Junction and Bradford.

5.5.28 Nominal journey times have been calculated for Alliance's proposed services to Leeds and Bradford Interchange which can be found in Appendix I. These are based on validated paths as far as Winwick Junction, using a Class 390 (with tilt) timing load.

6. PERFORMANCE

6.1 Performance Analysis

6.1.1 A number of indicative performance assessments have been completed to build on previous analysis undertaken to understand the potential impact of introducing new services on the WCML.

6.1.2 These include

- Historic Data Analysis
- TRAIL modelling
- Headway Analysis

6.1.3 Examples have been used in the following section and further analysis can be found in Appendix H.

6.1.4 All performance analysis has demonstrated that increasing the number of services within the timetable structure degrades timetable robustness and impacts performance.

6.2 Historic Data Analysis

6.2.1 Euston to Rugby – Up Direction

6.2.2 Table 19 shows the standard off-peak hourly pattern on the WCML Up Fast line between Ledburn Jn and London Euston, also showing trains that call intermediately on the Up Fast Line at Milton Keynes Central (Platform 4) or Watford Junction (Platform 7):

Table 19					
Euston Arrival	**Train ID**	**Origin Depart**	**Origin**	**Milton Keynes Call?**	**Watford Call?**
xx01	1Axx	yy:55	Manchester Piccadilly		
xx09	1Mxx	yy:40	Glasgow Central		
xx14	1Bxx	yy:50	Birmingham New Street		
xx20	1Axx	yy:15	Manchester Piccadilly	Y	
xx27	1Yxx	yy:13	Birmingham New Street via Northampton		
xx32	1Bxx	yy:45	Wolverhampton		Y
xx36	1Axx	yy:35	Chester	Y	
xx39	1Axx	yy:35	Manchester Piccadilly		
xx45	1Wxx	yy:33	Birmingham New Street via Northampton		Y
xx49	1Uxx	yy:02	Crewe	Y	
xx53	1Bxx	yy:30	Birmingham New Street	Y	
xx56	1Axx	yy:48	Liverpool Lime Street		

6.2.3 Table 20 shows the percentage of trains arriving at Euston between 1100 and 1159 that are running within 5 minutes of their booked path on their route and how this changes as they progress along the route. This is based on actual data from periods 04-06 2013/14. The proposed additional paths (highlighted in red) have been inserted to represent where they would sit in the sequence of services. This demonstrates the impact of increasing the service level in the current timetable structure.

Table 20 – Time to 5 Up Fast Line Performance 1100-1159																				
Euston Arrival (WTT)	TOC	Headcode	Rugby Trent Valley Jn D	Rugby D	Hillmorton Jn D	Weedon D	Hanslope Jn D	Milton Keynes Central A	Milton Keynes Central D	Bletchley D	Ledburn Jn D	Tring D	Bourne End Jn (Herts) D	Watford Junction D	Harrow & Wealdstone D	Wembley Central D	Willesden West London Jn D	Camden Jn D	Camden South Jn D	London Euston A
11:01	VT	1A16	90%	90%	85%	86%	86%		81%	79%	81%	79%	74%	69%	64%	67%	78%	77%	77%	64%
11:02																				
11:09	VT	1M07	83%	83%	78%	83%	83%		81%	81%	80%	80%	81%	78%	78%	78%	81%	80%	80%	80%
11:14	VT	1B28	93%	89%	91%	89%	89%		89%	91%	83%	87%	87%	85%	83%	83%	87%	87%	87%	87%
11:20	VT	1A17	96%	96%	97%	96%	96%	95%	91%	91%	87%	95%	95%	95%	89%	95%	96%	96%	96%	89%
11:27	LM	1Y22	89%	93%	95%		96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	98%	98%	98%	98%
11:30																				
11:32	VT	1B30	84%	84%	87%	84%	84%		78%	78%	74%	76%	74%	72%	72%	72%	74%	76%	78%	72%
11:36	VT	1A18	88%	89%	89%	86%	88%	81%	74%	81%	79%	75%	72%	68%	61%	63%	79%	77%	74%	70%
11:39	VT	1A19	83%	80%	83%	84%	81%		73%	75%	71%	76%	75%	64%	59%	61%	69%	69%	69%	59%
11:43																				
11:45	LM	1W08	98%	98%	98%		95%	95%	95%	95%	95%	95%	93%	84%	80%	84%	88%	84%	82%	80%
11:49	LM	1U24	95%	93%	93%	95%	91%	91%	91%	79%	84%	89%	89%	82%	75%	79%	82%	82%	79%	79%
11:53	VT	1B32	84%	81%	80%	79%	73%	68%	68%	69%	69%	71%	71%	66%	59%	61%	71%	69%	69%	64%

11:56	**VT**	**1A20**	81%	83%	75%	82%	83%		72%	76%	81%	81%	79%	72%	64%	67%	79%	72%	76%	69%

6.2.4 It can be observed from the data in Table 20 that where a number of trains are timed to arrive consecutively on minimum headways in the timetable the later trains in each flight experience the highest lateness (xx32,xx36,xx39 arrivals; xx45,xx49,xx53,xx56 arrivals), thus showing a high level of reactionary delay passed through such sequences of trains

- By comparison the spread of four arrivals between xx09 and xx27 have better punctuality.
- This suggests that if additional trains are added on minimum headways to this pattern then lateness will increase and the opportunity for performance recovery that currently exists is reduced. This would be the case for all three possible additional Up direction paths.
- The xx43 arrival in particular would represent a high risk to performance, as this would remove the firebreak that currently exists between the xx32-39 and xx45-56 sequences of arrivals.
- An xx30 arrival into Euston would precede the xx32-39 flight, and thus would be also be of concern from a robustness perspective.

6.2.5 It can also be observed from Table 20 that intermediate calls at Milton Keynes Central represent a minor risk to performance, since the trains that call at Milton Keynes Central when closely preceding another service on the Up Fast line (those arrivals at xx36, xx49 and xx53, in addition the to xx20 service that has a larger following gap) generally show a slight deterioration in performance through the Milton Keynes area.

6.2.6 However, calls at Watford Junction (in the xx32 and xx45 arrivals) represent a more significant risk to performance, with a significant reduction in performance observed through the Watford area in services following behind; in both cases (and through timetabling necessity) this is compounded by these calls being made as the first train in a sequence of trains arriving into Euston on a minimum headway.

6.2.7 Table 21 shows the percentage of trains arriving at Euston between 1700 and 1759 that are running within 5 minutes of their booked path on their route and how this changes as they progress along the route:

Table 21 - Time to 2 Up Fast Line Performance 1700-1759

Euston Arrival (WTT)	TOC	Headcode	Rugby Trent Valley Jn D	Rugby D	Hillmorton Jn D	Weedon D	Hanslope Jn D	Milton Keynes Central A	Milton Keynes Central D	Bletchley D	Ledburn Jn D	Tring D	Bourne End Jn (Herts) D	Watford Junction A	Watford Junction D	Harrow & Wealdstone D	Wembley Central D	Willesden West London Jn D	Camden Jn D	Camden South Jn D	London Euston A
17:01	VT	1A46	56%	64%	48%	53%	63%		37%	37%	27%	39%	39%		33%	25%	31%	47%	44%	44%	31%
17:02																					
17:08	VT	1M13	30%	28%	30%	30%	24%		24%	24%	39%	24%	28%		24%	22%	24%	41%	41%	37%	30%
17:13	VT	1B64	74%	62%	60%	55%	57%		55%	57%	43%	53%	55%		45%	38%	47%	59%	57%	59%	48%
17:20	VT	1A47	49%	58%	41%	37%	54%	41%	44%	47%	31%	51%	51%		46%	31%	41%	56%	56%	56%	44%
17:27	LM	1Y58	42%	53%	56%		71%	73%	71%	73%	63%	61%	53%		46%	46%	46%	63%	63%	63%	47%
17:30																					
17:32	VT	1M55	53%	56%	49%	48%	50%		46%	52%	40%	52%	48%	38%	27%	38%	42%	54%	56%	58%	40%
17:38	VT	1A48	37%	42%	27%	27%	32%	25%	15%	27%	14%	24%	24%		25%	31%	32%	44%	41%	37%	36%
17:41	VT	1A49	58%	54%	59%	58%	49%		24%	24%	24%	25%	24%		25%	25%	27%	44%	41%	34%	31%
17:43																					
17:45	LM	1W20	70%	70%	72%		95%	95%	93%	93%	70%	68%	54%	37%	35%	32%	30%	39%	39%	33%	28%
17:49	LM	1U36	85%	78%	75%	69%	64%	64%	56%	39%	47%	56%	63%		46%	29%	29%	49%	51%	38%	27%
17:53	VT	1B68	61%	64%	47%	44%	54%	29%	29%	32%	22%	34%	32%		44%	29%	36%	49%	47%	49%	34%


17:56
VT
1A50
54% 59% 48% 53% 58%
29% 39% 27% 46% 44%
44% 36% 38% 53% 49% 51% 41%

6.2.8 In addition to the conclusions previously described, it can also be seen from Table 21 that:

- In the late afternoon/evening, performance of the xx08 arrival (the Up Glasgow-Euston service) is very poor, due to primarily the length of journey this service has between Glasgow and Rugby.
- It is, on average, 10 minutes late passing Rugby, causing reactionary delay to be passed onto xx20 arrival (rather than preceding xx13 arrival (an Up Birmingham-Euston service, which instead gets priority over the Glasgow service at Rugby.
- This contributes to the poor performance of the sequence of arrivals between xx08 and xx27, with the vacant xx30 path in theory providing a useful firebreak to facilitate recovery from this poor performance. However, even without this path in the timetable, poor performance continues for the rest of the hour, with the xx27 arrival knocking on to the xx32 arrival and subsequent trains.
- As such, adding the xx30 path into the timetable is likely to compound this situation.

6.3 Euston to Rugby – Down Direction

6.3.1 Table 22 shows the percentage of trains arriving at Euston between 0800 and 0859 that are running within 5 minutes of their booked path on their route and how this changes as they progress along the route:

Table 22 - Time to 2 Down Fast Line Performance 0800-0859

Euston Dep. (WTT)	TOC	Headcode	London Euston D	Camden South Jn D	Camden Jn D	Willesden West London Jn D	Wembley Central D	Harrow & Wealdstone D	Watford Junction A	Watford Junction D	Bourne End Jn (Herts) D	Tring D	Ledburn Jn D	Bletchley D	Milton Keynes Central A	Milton Keynes Central D	Hanslope Jn D	Weedon D	Hillmorton Jn D	Rugby D	Rugby Trent Valley Jn D
08:00	VT	1H11	96%	98%	91%	89%	91%	95%		84%	79%	79%	79%	71%		64%	70%	57%	64%	59%	
08:03	VT	1G07	95%	96%	93%	89%	91%	91%		84%	71%	68%	70%	68%		48%	57%	55%	60%	57%	57%
08:07	VT	1F12	90%	90%	89%	86%	86%	88%		81%	76%	76%	79%	66%		66%	74%	60%	60%	59%	
08:10	VT	1D82	89%	93%	88%	82%	84%	86%		81%	77%	68%	75%	65%	54%	47%	70%	63%	75%	67%	72%
08:13	LM	1N09	93%	97%	90%	90%	90%	90%		79%	78%	79%	57%	52%	69%	69%	57%				
08:20	VT	1H12	93%	95%	89%	91%	93%	93%		88%	86%	82%	80%	55%	57%	55%	59%	66%	75%	68%	75%
08:23	VT	1G98	93%	93%	89%	88%	89%	89%	89%	81%	88%	86%	86%	79%		68%	68%	68%	79%	68%	75%
08:30	VT	1S45	92%	90%	77%	77%	87%	87%		83%	77%	77%	79%	62%		62%	58%	67%	75%	65%	73%
08:40	VT	1H63	96%	100%	95%	95%	95%	98%		98%	95%	95%	95%	88%		88%	93%	91%	93%	93%	
08:43	VT	1S54	93%	93%	88%	88%	93%	93%		90%	90%	90%	90%	86%	88%	83%	86%	88%	93%	86%	90%
08:46	LM	1U27	84%	86%	82%	79%	80%	75%		71%	66%	70%	68%	59%	64%	46%	64%	63%	63%	52%	70%
08:49	LM	1W05	77%	84%	77%	72%	72%	70%	70%	67%	58%	35%	28%	46%	61%	51%	54%		88%	86%	84%

6.3.2 It can be observed from Table 22 that:

- There is gradually declining performance in the sequence of departures between xx00 and xx10 due to limited opportunity to recover lateness in the timetable as trains depart at or close to minimum planning headway.
- Additionally, the xx13 receives reactionary delay as it passes Camden Jn an joins behind the xx10 (it has a greater opportunity to use a different running line between Euston and Camden Jn before it merges behind the xx10, offering greater scope for a right time departure from Euston, before becoming delayed at Camden Jn)
- Therefore, if both xx33 and xx36 departures from Euston are additionally operated, this creates a very similar sequence of departures between xx30 and xx49, so a similar result could be expected
- There is typically a drop in performance as trains pass through the Watford area. This is attributed to the generally lower line speed (110mph) and increased technical headway compared to other sections of the WCML, causing trains to 'bunch' and receive restrictive aspects through the area. It is anticipated that these issues will be resolved once the Watford area is re-signalled in 2014/2015.
- There is a noticeable performance drop as trains cross from the Down Fast to Slow at Ledburn Jn:
    - The xx13 departure has a drop in performance as it waits on the Down Fast line to cross the Up Fast line in between other services.
    - Because of that, the xx20 departure from Euston has a significant deterioration in performance as it passes Ledburn Jn.
    - Therefore introduction of an additional xx57 path (which would follow the xx49 crossing at Ledburn) is likely to have significant negative performance implications, particularly as it precedes the flight of trains between xx00 and xx13.
- Currently, the xx49 crosses from the Down Fast to the Down Slow at Milton Keynes Central via Platform 5. Although it receives reactionary delay while this move takes place, this does not significantly affect any other trains on the Down Fast line, as it is clear of the Down Fast whilst standing awaiting a path in Platform 5.

Table 23 - Time to 2 Down Fast Line Performance 1700-1759

WTT Through Section	TOC	Headcode	London Euston D	Camden South Jn D	Camden Jn D	Willesden West London Jn D	Wembley Central D	Harrow & Wealdstone D	Watford Junction A	Watford Junction D	Bourne End Jn (Herts) D	Tring D	Ledburn Jn D	Bletchley D	Milton Keynes Central A	Milton Keynes Central D	Hanslope Jn D	Weedon D	Hillmorton Jn D	Rugby D	Rugby Trent Valley Jn D
17:00	VT	1H38	90%	90%	86%	83%	81%	85%		81%	78%	75%	68%	42%		51%	59%	49%	49%	51%	
17:03	VT	1G34	84%	88%	79%	76%	83%	84%		83%	81%	79%	76%	48%		50%	52%	43%	47%	43%	50%
17:07	VT	1F22	90%	93%	80%	69%	76%	81%		78%	76%	71%	73%	51%		58%	59%	53%	46%	42%	
17:10	VT	1D91	85%	88%	78%	64%	71%	76%		69%	63%	58%	59%	47%	32%	41%	66%	47%	64%	56%	63%
17:13	LM	1Y63	75%	80%	55%	50%	54%	50%		39%	41%	41%	38%	29%	23%	36%	23%		82%	80%	80%
17:20	VT	1H39	93%	93%	88%	83%	86%	88%		78%	75%	73%	68%	46%	51%	56%	59%	64%	76%	68%	73%
17:23	VT	1G35	86%	86%	84%	82%	81%	81%	74%	67%	74%	74%	72%	63%		56%	56%	61%	70%	61%	67%
17:30	VT	1S90	92%	92%	92%	92%	92%	92%		81%	74%	74%	74%	68%		64%	72%	75%	79%	72%	77%
17:33	VT	1F23	86%	91%	81%	77%	86%	88%		86%	74%	74%	75%	61%		65%	65%	63%	70%	60%	58%
17:40	VT	1H72	88%	88%	85%	83%	85%	83%		80%	80%	80%	80%	75%		69%	71%	68%	68%	63%	60%
17:43	VT	1G36	81%	82%	75%	72%	77%	76%		72%	71%	69%	69%	64%	62%	66%	66%	69%	74%	72%	76%
17:46	LM	1Y67	93%	93%	77%	66%	71%	70%		57%	57%	57%	68%	80%	86%	80%	73%		82%	82%	80%
17:57	VT	1C94	96%	98%	94%	94%	96%	96%		94%	92%	92%	84%	61%		69%	75%	69%	76%	78%	

6.3.3 It can be seen through comparison of Tables and 23 that performance of the xx40 departure from Euston is worse between the 0800 and the 1100 hour and the 1700 hour through addition of the xx33 departure in the evening peak. This then cascades through the xx43 and xx46 departures as they progress northwards.

6.3.4 Additionally, and further to the point made previously, the deterioration in performance in the xx57 departure from Euston can be observed as it receives reactionary delay behind the xx46 departure, which is waiting for a path across Ledburn Jn. This lateness can then be observed cascading through the xx00 departure in the following hour, right through to the xx20 departure, highlighting the risk of this sequence of moves.

6.4 Norton Bridge

6.4.1 Infrastructure enhancements at Norton Bridge in 2016 will remove conflicts between services travelling from/to Bushbury Jn to/from Stone and those travelling to/from Crewe to/from Stafford. The following analysis shows the current level of delay experienced by services on the Stafford / Crewe corridor which are expected to be eliminated by the grade separated junction; currently two CrossCountry services per hour between Manchester Piccadilly and Birmingham New Street (and beyond) must cross both Fast Lines in the Stafford/Norton Bridge area in order to travel between the Stone lines at Norton Bridge and the Birmingham lines at Stafford.

6.4.2 Table 24 shows how these CrossCountry services crossing moves fit into the current timetable:

6.4.3 Grade separation at Norton Bridge provides the following results[3]:

- Average lateness for passenger services running on the Fast Lines between Stafford – Norton Bridge in both directions is significantly lower since there is less conflict with services crossing between the Slow Lines and Stone Lines, and there are less services running on the Fast Lines.
- Average lateness for passenger services running from Bushbury Junction towards Stoke Junction is significantly lower since services no longer use conflicting moves at Norton Bridge.
- No impact on average lateness for services operating from Stoke to Bushbury Junction (Up Line).

[3] See Stafford Area Improvements Project final report published by Network Rail on 19/01/11 and Stafford Area Improvement Project: GRIP 4 report published by Network Rail on 01/02/13. The second report confirmed that 'there is no significant performance difference between the previously analysed GRIP 3 option and the refined version being taken forward'.

Table 24 - CrossCountry Crossing Moves around Stafford					
Direction	**Path**	**TID**	**Crosses WCML Fast Lines At**	**Following Down WCML Service**	**Following Up WCML Service**
Southbound	Bristol	1Vxx	Stafford North Jn No 4 Jn	1Fxx xx36 Birmingham New Street-Liverpool Lime Street	1Lxx xx04 Liverpool Lime Street-Birmingham New Street
Southbound	Bournemouth	1Oxx	Stafford No 4	1Dxx xx10 London Euston-Chester	1Axx xx48 Liverpool Lime Street-London Euston
Northbound	Bristol	1Mxx	Norton Bridge	1Fxx xx36 Birmingham New Street-Liverpool Lime Street	1Axx xx35 Chester-London Euston
Northbound	Bournemouth	1Mxx	Norton Bridge	1Fxx xx01 Birmingham New Street-Liverpool Lime Street	1Axx xx55 Manchester Piccadilly-London Euston

6.4.3 It can be seen from Table 24 the WCML services whose performance could potentially be improved by removing the conflict with a CrossCountry service crossing the WCML Fast Lines in front of each path.

6.4.4 Examining the historic performance data, it can be seen that the trains shown above have performance deterioration in the Stafford/Norton Bridge area that could be attributed to the crossing moves:

- Almost all xx48 Liverpool Lime Street to Euston services increase lateness between Madeley and Stafford by on average 30 seconds (0.5 minutes)
- On average each xx36 Birmingham New St to Liverpool Lime St services increases in lateness by almost one minute (0.8 minutes) between Stafford Trent Valley Jn and Madeley.
- Almost all of the Chester/North Wales to Euston services increase in lateness by just less than 30 seconds (0.4 minutes) between Madeley and Stafford.
- On average each xx01 Birmingham New St to Liverpool Lime St services increase in lateness by 30 seconds (0.5 minutes) between Stafford Trent Valley Jn and Madeley.
- On average each xx55 Manchester Piccadilly to Euston service increases in lateness by 30 seconds (0.5 minutes) between Madeley and Stafford.

6.4.5 There is likely to be minimal benefit arising from grade separation of Norton Bridge on the performance of the xx36 Birmingham New Street-Liverpool Lime Street and xx04 Liverpool Lime Street-Birmingham New Street services. This is because the grade separation at Norton Bridge would not resolve the key interaction between these services, which is on the Slow Lines and Birmingham Lines southwards from Stafford station.

6.4.6 In all of these cases, introduction of additional paths into the Stafford area before full completion of the grade separation of Norton Bridge potentially adds significant performance risk into the Stafford/Norton Bridge area beyond the levels of reactionary delay already seen above.

6.4.7 However, once these capacity improvements have been implemented:

- Performance benefits will be made possible to some WCML Long Distance services to provide between presentation (and associated performance benefits) at the south end of the route, primarily:
  - The hourly xx48 Liverpool Lime Street-Euston services
  - The hourly Chester/North Wales-Euston services, and
  - The hourly xx55 Manchester Piccadilly-Euston services
- This will, in turn, potentially provide performance benefits at the south end of the route to enable additional paths to be introduced
- Additionally, the improvements at Norton Bridge will in theory support additional WCML Fast Line paths to be provided through the Stafford area without significant impact on other services caused by flat crossing moves in the area.

6.4.8 As a further benefit, line speed increases of the Slow Lines between Stafford and Crewe will enable services between Birmingham New Street and Liverpool Lime Street (currently operated by 100mph Class 350 units) to

operate on the Slow Lines between Stafford and Crewe in both directions without journey time penalty, rather than the Fast Lines as today. This has the effect of freeing up two 100mph paths per hour on the Fast Lines between Stafford and Crewe, which could equate to more flexible 125mph paths, and further reduce the level of interaction between services (and associated performance implications) in the Stafford area.

6.5 Conclusions from Historic Performance Analysis

6.5.1 Addition of Up Fast line paths into Euston represent a risk to performance, particularly in the case of the xx43 arrival and, to some extent, the xx30 arrival as these paths would extend a sequence of services operating on minimum headway on the Fast Lines through the Watford area

6.5.2 Calls on the Up Fast Line at Watford Junction represent a significant risk to performance, particularly since these calls must, by timetabling necessity, be done so as the first train in a sequence of trains arriving into Euston on a minimum planning headway.

6.5.3 Therefore, reducing or removing such calls would likely yield a significant benefit to overall WCML performance.

6.5.4 Addition of an xx30 arrival, particularly in evening peak hours, is highly likely to further compound the effects of the generally poor presentation of Up Glasgow-Euston services, which causes significant reactionary delay to other Up trains

6.5.5 Extending any sequence of down trains on minimum headway (such as by adding both xx.33 and xx.36 departures from Euston) is likely to create deteriorating performance towards the end of the sequences of trains on minimum headway that they create. Only adding one of these paths is likely to limit the effects of this to some extent (although not mitigate it entirely)

6.5.6 A drop in performance is generally observed through the Watford area, although this is anticipated to be at least partially resolved as part of re-signalling of the Watford area in 2014/2015.

6.5.7 Crossing moves at Ledburn Jn mean that introduction of an xx57 departure path is likely to yield significant performance risk, as this follows the xx49 departure, which is required to cross at Ledburn Jn (instead of Milton Keynes Central as today) in order to create the xx57 path in the off-peak standard hour.

6.5.8 Timetable performance could be improved by having all Down Fast trains via Northampton cross at Milton Keynes Central rather than at Ledburn Jn, to prevent reactionary delay to following services, as trains can await a crossing move in Platform 5 clear of the Down Fast line

6.5.9 There is currently some reactionary delay in the Stafford/Norton Bridge area attributable to flat crossing moves by CrossCountry services. Once these flat crossing moves are removed as a result of grade separation of Norton Bridge, this yields performance benefits to Long Distance WCML services, potentially cascading to provide improve performance of trains at the south end of the WCML.

6.5.10 In addition, line speed increases on the Slow Lines between Stafford and Crewe will enable the level of passenger service required on the Fast Lines

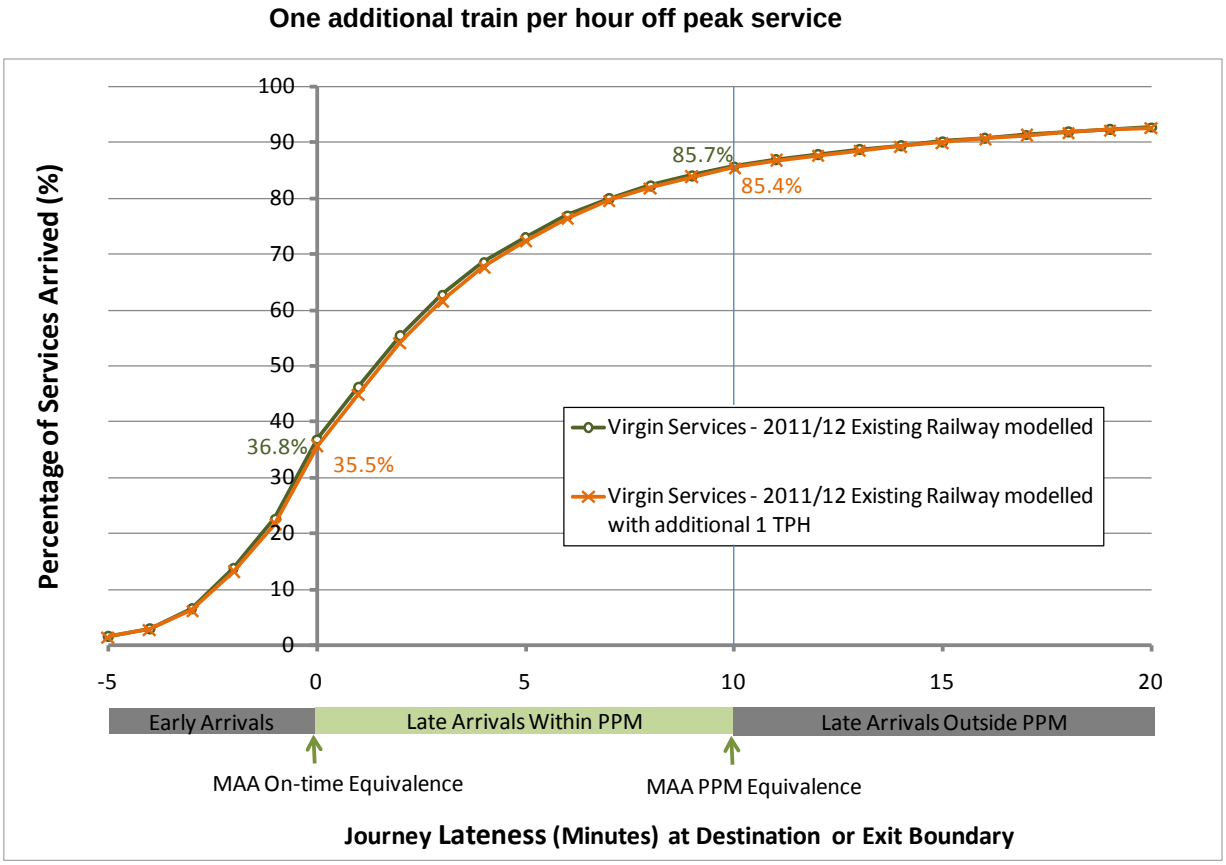
between these locations to be reduced, with associated capacity and performance benefits.

6.6 TRAIL Modelling

6.6.1 TRAIL is a discrete event simulator used to represent the life-cycle operation of railway infrastructure systems. It is used to assess the system performance based on industry aligned inputs including infrastructure layout, timetabled services and system reliability (infrastructure, operations and rolling stock). The model accounts for the frequency of incidents and the associated impact upon services. The impacts are provided by route representatives as stoppages or delays which are applied by the model to services for the duration of the incident.

6.6.2 Performance analysis has focused on the southern part of the WCML to assess the impact of the proposed services on the most intensely utilised portion of the route. The model has assessed the impact of increasing incrementally the number of additional services running over the WCML to build up a view of performance.

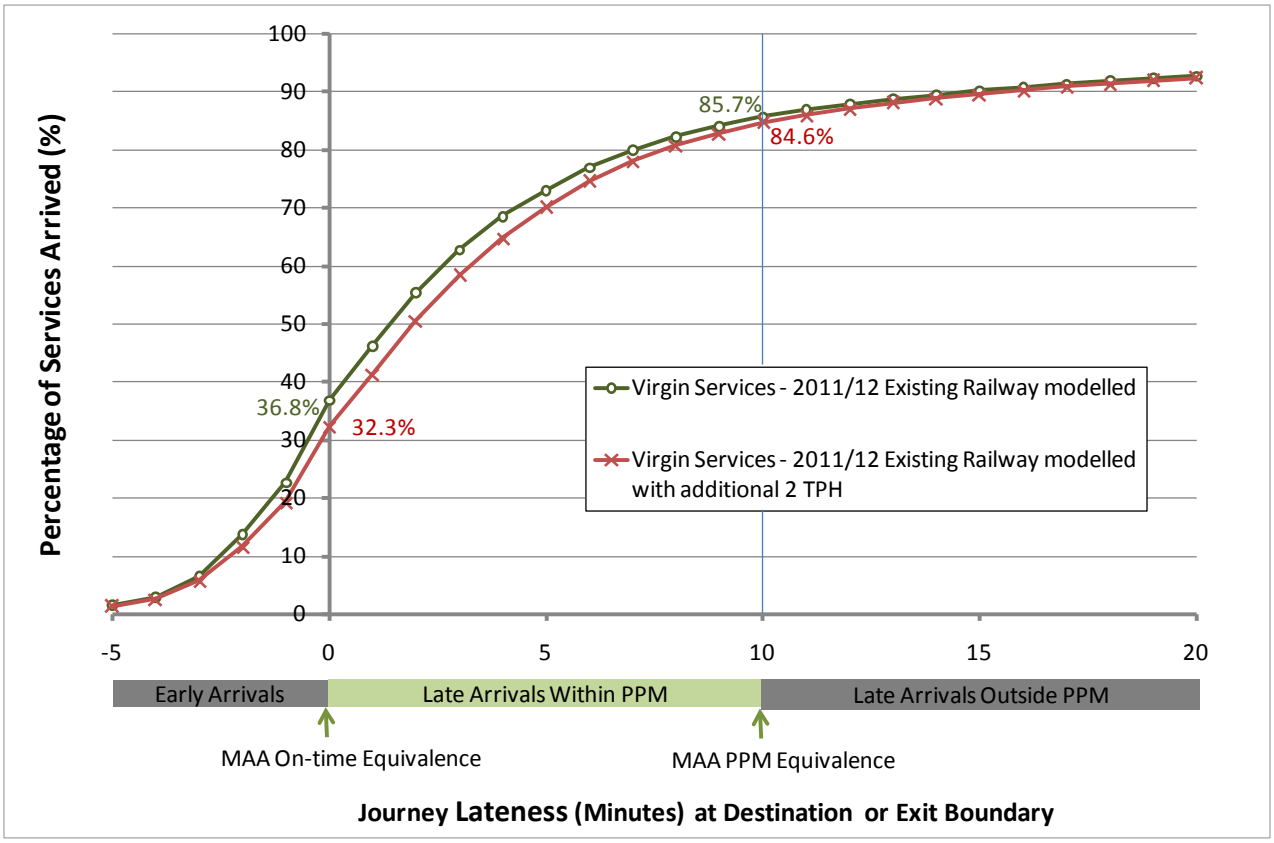
6.6.3 Additional trains have been modelled to run in both directions every hour between 1000 and 1600 using a December 2008 timetable base (the latest available timetable in TRAIL), with performance data from 2011/12.



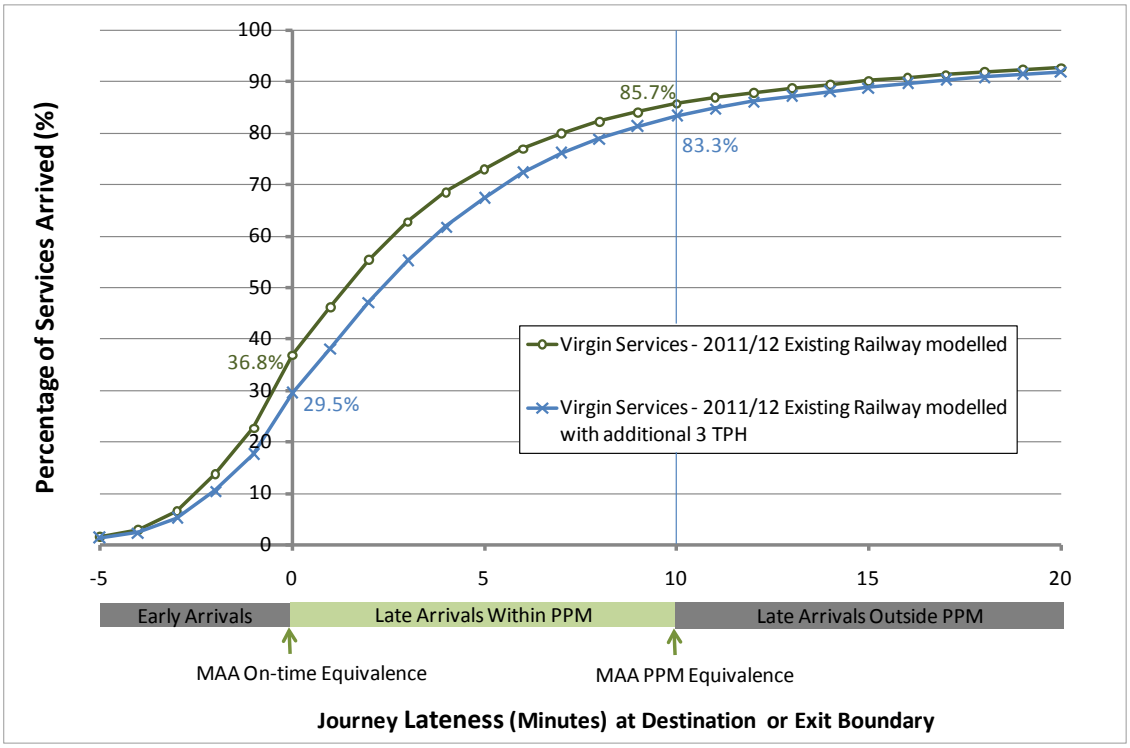
6.6.4 This graph shows the percentage of trains that have arrived at their destination on-time up to 10 minutes late (PPM for long distance services). This shows that the timetable containing the additional service (the orange line) performed 0.3% worse than the current timetable when looking at trains that arrived within 10 minutes of their booked time.

6.6.5 It should be noted that this figure is lower than the 0.5% calculated detriment to running 8 additional services between Euston and Blackpool/Shrewsbury from the same model. This discrepancy can be explained by the differences in the times of operation – all additional services here have been modelled to run off-peak whereas the additional services between Euston and Blackpool/Shrewsbury included a number of services running during peak hours. When one additional train per hour is modelled to run between 0600 and 2200 the degradation in PPM equivalence rises to 1.1%

Two additional trains per hour off peak service



Three additional trains per hour off peak service



6.6.6 In both the two and three additional service scenarios the performance impact is higher. 1.1% worse for the two additional services (the red line) and 2.4% for three additional services (the blue line). This demonstrates the level of impact each additional path has on performance.

Service Group Description	Right Time	0-10 minutes
Virgin Trains Current	36.8%	85.7%
Virgin Trains Current + xx33 (and return)	35.5%	85.4%
Virgin Trains Current + xx33 + xx36 (and returns)	32.3%	84.6%
Virgin Trains Current + xx33 + xx36 + xx57 (and returns)	29.5%	83.3%

(Note: The additional trains from Euston were paired with additional return workings – hence xx33 departure & xx30 arrival, xx36 departure & xx02 arrival and xx57 departure & xx43 arrival).

6.6.7 In summary performance is significantly affected by increasing the number of services on the WCML within the current timetable structure.

6.7 Headway Analysis

6.7.1 Headway analysis has been undertaken to understand the change in timetable robustness of the potential options compared to the May 2014 timetable. The number of services planned on minimum planning margins provides an indication to the risk of reactionary delay spreading across services through any perturbation event.

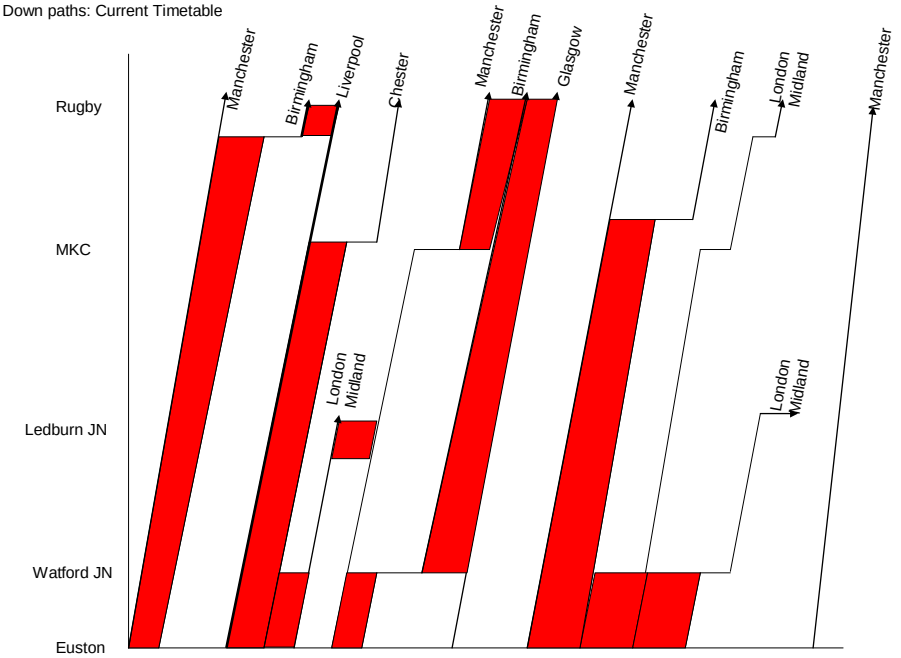
6.7.2 The two sets of three graphs overleaf show the graphical timetable and the areas where trains are on or close to minimum planning headway. The x-axis represents time for an off-peak hour and the y-axis, the line of route between London Euston – Rugby on the WCML. Each of the 2 sets of three graphs show the May 2014 timetable, Option 1 and Option 2.

Down Direction

6.7.3 When comparing the current timetable with Option 1 (current timetable with additional services) it is possible to see that the number of services running on minimum headway immediately ahead or behind another service is higher. This means in times of disruption there is a greater probability of a reactionary delay passing to other services.

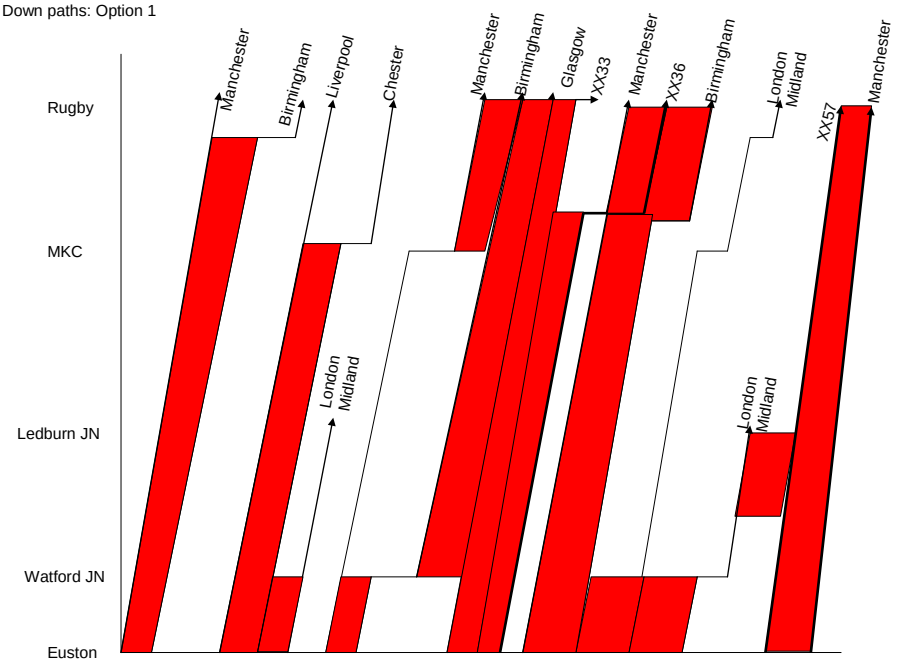
6.7.4 The third graph shows the Option 2 timetable which has a different structure (ie. the 4 trains per hour to Birmingham and Manchester). This has a greater margin for recovery in the second half of the hour and has fewer trains overall running on minimum headways than Option 1.

Down paths: Current Timetable

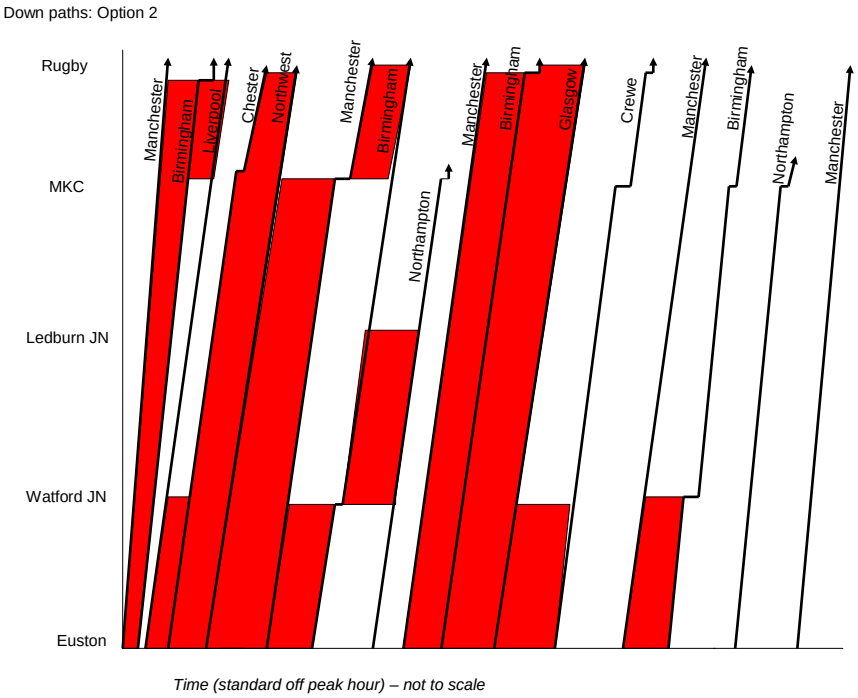


Time (standard off peak hour) – not to scale

Down paths: Option 1



Time (standard off peak hour) – not to scale



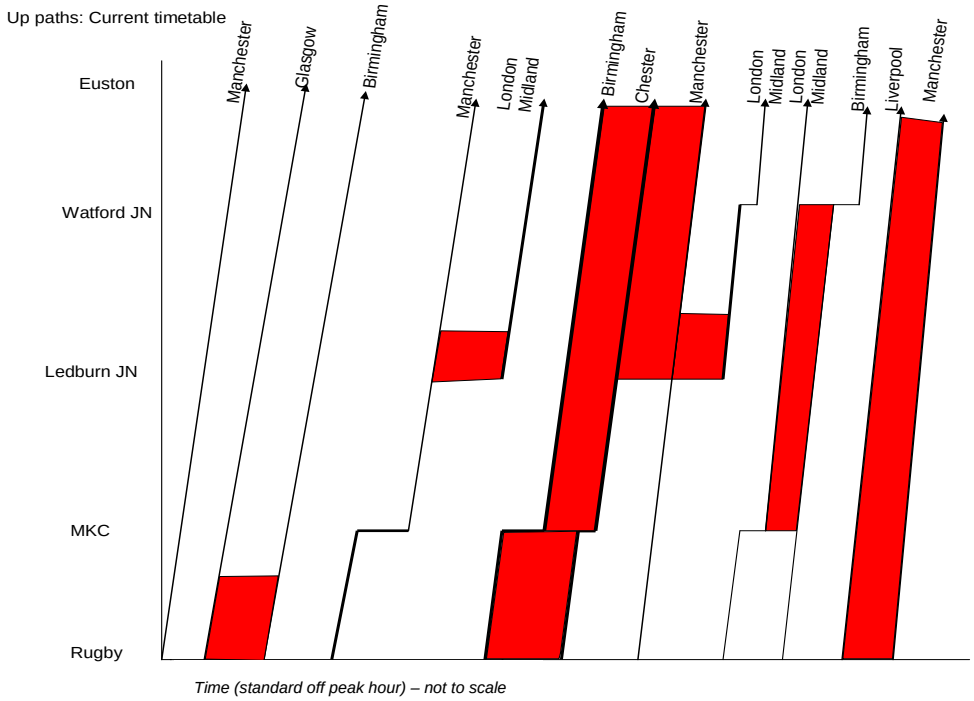
6.7.5 The table below show the differences in number of services that are running at minimum headway on the West Coast Main Line in the timetable options considered in this report in the Down direction.

Down Direction	Current	Option 1	Option 2
London Euston	7	10	9
Watford Junction	7	10	7
Ledburn Junction	5	8	5
Milton Keynes	5	8	10
Rugby	4	7	5

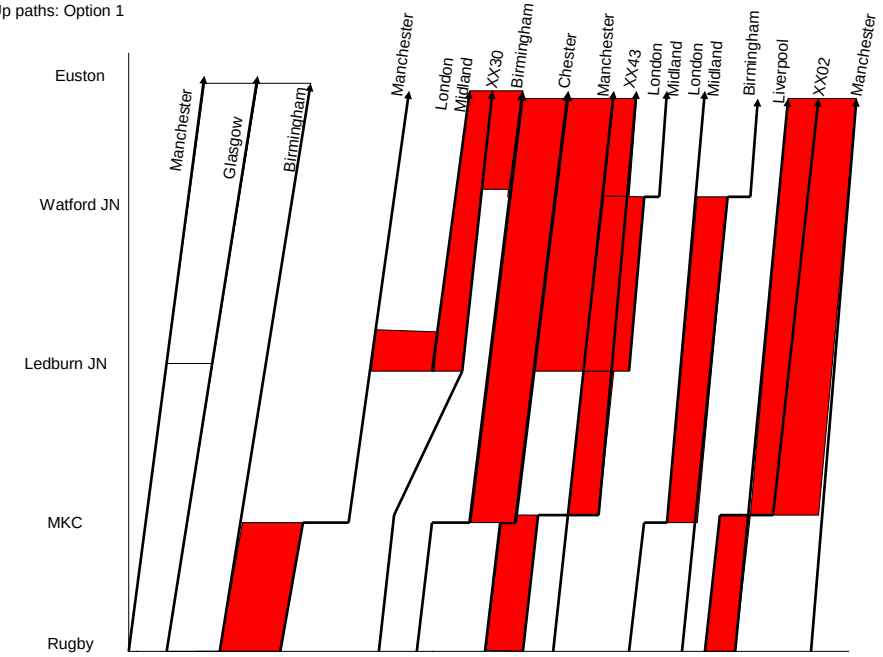
Up Direction

6.7.5.1 When comparing the current timetable with Option 1 (current timetable with additional services) it is possible to see that the number of services running on minimum headway immediately ahead of or behind another service is higher. This means in times of disruption there is a greater probability of a primary delay passing to other services.

6.7.5.2 The third graph shows the Option 2 timetable which has a different structure (ie. the 4 trains per hour to Birmingham and Manchester). This has a greater margin for recovery in the second half of the hour and has fewer trains overall running on minimum headways than Option 1.

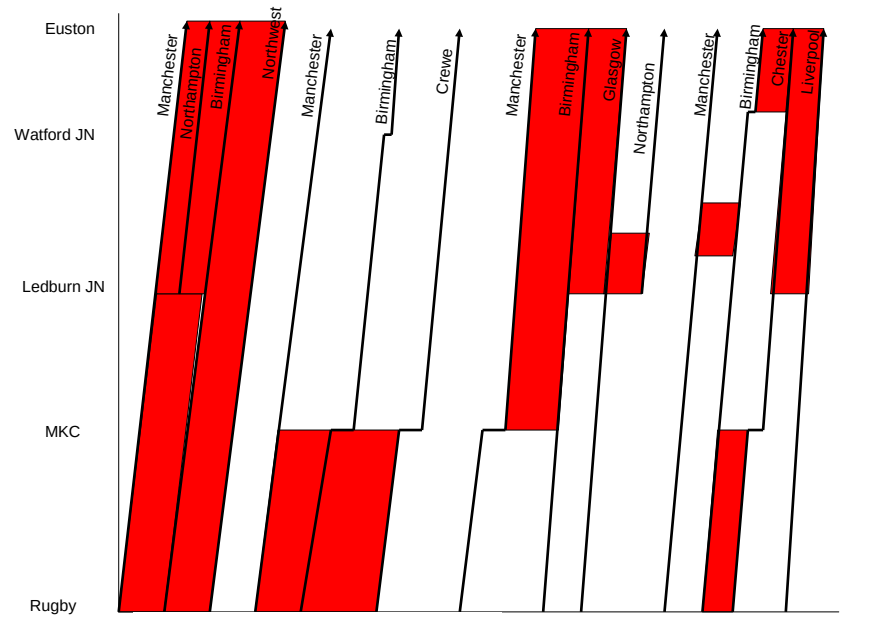


Up paths: Option 1



Time (standard off peak hour) – not to scale

Up paths: Option 2



Time (standard off peak hour) – not to scale

6.7.6 The table below show the differences in number of services that are running at minimum headway on the West Coast Main Line in the timetable options considered in this report in the Up direction.

Up Direction	Current	Option 1	Option 2
Rugby	3	3	5
Milton Keynes	3	8	4
Ledburn Junction	6	8	6
Watford Junction	4	7	8
London Euston	3	7	8

7. CONCLUSIONS

7.1 WCML – May 2014 Timetable Structure

7.1.1 The timetable analysis has shown that up to three additional paths per hour in each direction could be accommodated within the existing WCML timetable structure once the power supply upgrade work is completed for December 2015.

7.1.2 Headway analysis has been undertaken to understand the change in timetable robustness through the introduction of additional services compared to the May 2014 timetable. The results show an increase of between three and five more trains on minimum planning headway between London Euston – Rugby per off-peak hour. The number of services planned on minimum planning headway provides an indication to the risk of reactionary delay spreading across services through any perturbation event. The introduction of between one and three additional services results in increased risk of reactionary delay spreading due to an increase in services planned on minimum headway.

7.1.3 TRAIL modelling has been undertaken to assess the impact of an additional one, two and three trains in each direction in the WCML timetable between London Euston and Coventry / Nuneaton in off-peak hours between 1000 and 1600. This has concluded that performance will deteriorate if more services are operated on the route.

7.1.4 WCML PPM equivalence would fall by 0.3% with the addition of one off-peak path in each direction, by 1.1% with the addition of two off-peak paths in each direction and by 2.4% with the addition of three off-peak paths in each direction, over and above the existing May 2014 timetable. This has been modelled off-peak between London Euston and Coventry / Nuneaton.

7.1.5 Whilst overall PPM on the WCML continues to fall below the regulatory targets, the Reliability Programme for West Coast South is expected to deliver improved reliability, asset resilience and PPM performance by December 2014.

7.1.6 Network Rail does not believe it can operate two or more additional Fast Line services in the current timetable structure without an unacceptable risk to performance on the planned infrastructure. Network Rail would be happy to work with the industry to investigate performance mitigations which would support delivery of this output.

7.1.7 With the completion of the West Coast South Reliability Programme and Stafford Area Improvement Scheme (2016), Network Rail has high confidence that one additional Fast Line path can be operated on the WCML every off peak hour without a significant impact to performance. To achieve this Network Rail will have to work closely with operators to agree and implement a robust timetable in 2016.

7.1.8 Network Rail is happy to work with any operator in the use of this path.

7.2 WCML - A Recast WCML Fast Line

7.2.1 Potential options to recast the WCML have been considered and minor alterations to the current structure could be developed. The service structure in May 2014 is based around a 20 minute frequency service to Birmingham and Manchester and without any change in this requirement; there is very little change that can be made to the overall timetable without changing journey opportunities and connectivity.

7.2.2 One example considered is to remove a Watford Junction call in the fast line timetable. This has the advantage of removing performance risk to the timetable but results in reduced connectivity from Watford Junction.

7.2.3 To understand what a completely different timetable structure could be on the WCML, a notional WCML timetable has been developed based on a 15 minute interval to Birmingham and Manchester compared to the 20 minute interval provided by the May 2014 timetable. This timetable could deliver a maximum of 15 off-peak paths per hour on the Fast Lines. This would provide up to 3 additional paths above the May 2014 Fast Line timetable. The recast has allowed the timetable structure to be modified and therefore the capacity and performance impact assessed.

7.2.4 The notional timetable has been used to understand the impact of a change in service structure and has not been tested for rolling stock, train crew or commercial implications. All operators and the DfT would need to be involved in defining the optimum structure and calling patterns of a revised timetable structure on the WCML.

7.2.5 The notional timetable assumes the power supply upgrade and Stafford Area Improvement Scheme are complete.

7.2.6 Headway analysis of the notional timetable has been undertaken to understand the change in timetable robustness compared to the May 2014 structure. The number of services planned on minimum margins provides an indication to the likely risk of reactionary delay spreading across services through any perturbation event. The revised structure allows for more trains (up to 15 per off peak hour) to be accommodated with shorter sequences of services on minimum planning headways compared to the timetable based on the May 2014 structure. The primary reason for this is that the timetable has been structured from first principles to allow for the increase in service and restructured the nested calling pattern.

7.2.7 Network Rail believes that a full review of the WCML timetable from December 2016 may be appropriate, based on the potential opportunities described in this report. However, there are potential issues to resolve, such as calls at Leighton Buzzard and Bletchley, which would need more consideration. Further work will be required to assess the capacity and performance impact once more certainty on outputs is understood.

7.2.8 Network Rail would support working with the industry to understand the benefits (not only in terms of capacity) that a revised timetable structure could realise and to develop an implementation plan.

7.3 Trans-Pennine

7.3.1 In 2016 with Northern Hub Phase 1, there is capacity to accommodate an additional train between Stalybridge and Huddersfield above the Northern Hub ITSS. However, the construction of the timetable and the pattern of ITSS mean that it is difficult to match the capacity to the west of Huddersfield with a clear path to Leeds. Network Rail has medium confidence that a solution could be found.

7.3.2 Alternatively, an additional service could occupy a fast or semi-fast path identified in the Northern Hub ITSS. Given that an Alliance Rail path will be diesel hauled, it will require further work to understand the impact on connectivity and calling pattern assumptions specified in the Northern Hub ITSS between Manchester – Leeds, and to accommodate a long train (which requires a full platform) at Leeds

7.3.3 In 2016, for both the Chat Moss and Calder Valley routes, there is enough capacity to accommodate both the level of service specified in the Northern Hub ITSS (including TPE's 5th path) and Alliance's aspirational path.

7.3.4 In 2018 with Northern Hub Phase 2, there is no capacity for an additional through path between Stalybridge and Leeds above what has been specified in the Northern Hub ITSS. Therefore if additional services are required on this route it would need to occupy a fast or semi-fast path identified in the Northern Hub ITSS. Given that an Alliance Rail path will be diesel hauled, it will require further work to understand the impact on connectivity and calling pattern assumptions specified in the Northern Hub ITSS between Manchester – Leeds, and to accommodate a long train (which requires a full platform) at Leeds Station.

7.3.5 In December 2018, there is no capacity for an additional through path between Earlestown and Bradford Interchange. On both the Chat Moss and Calder Valley routes, the planned quantum of train services suggests that there may be limited spare capacity on individual sections of route. However, a through service could be accommodated in one of the Chester – Leeds (via Bradford Interchange) paths currently specified in the Northern Hub ITSS.

7.4 Future Considerations

7.4.1 The development of the biomass market may require additional freight capacity which has not been considered within this study. The use of biomass for electricity generation may result in different requirements for power station paths.

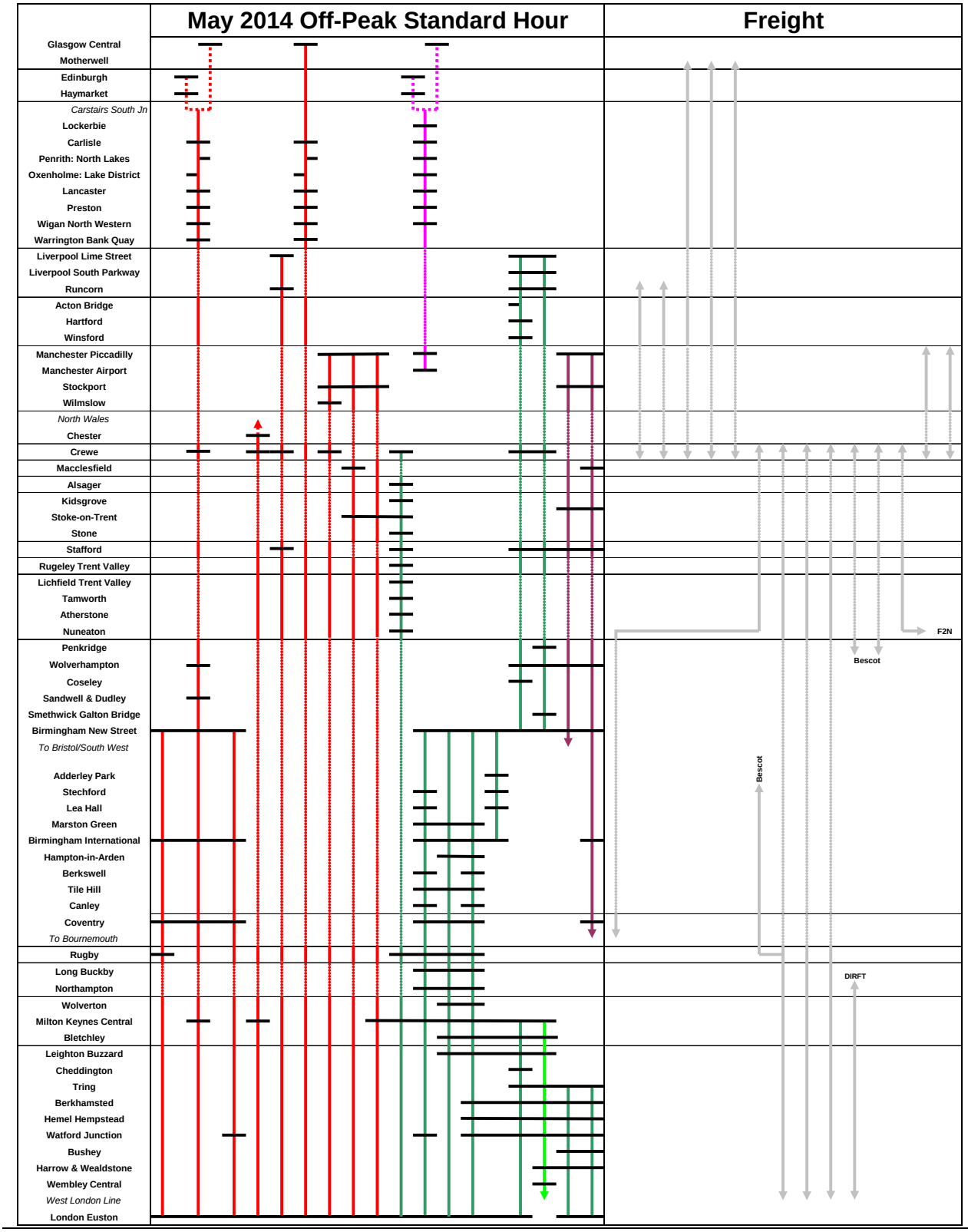
7.4.2 High Speed 2 (HS2) has not been taken into account in the capacity and performance analysis within this report. However, construction work is planned to start in 2015 at Euston and will have an impact on network capacity. Our understanding of HS2 Ltd's proposals is that this will reduce the number of running lines on the approaches to London Euston from six to four and reduce the number of platforms for the WCML from 18 to 13 (all 11-car Class 390 in length). HS2 Ltd have undertaken a capacity and performance assessment which assumes that no additional services will be operating on the WCML to and from London Euston. Having reviewed the HS2 Ltd plans for their required enabling works at Euston

station and the HS2 Ltd produced TRAIL modelling of the impact of these works, Network Rail has low confidence that any additional services can be delivered robustly on the proposed phasing layouts.

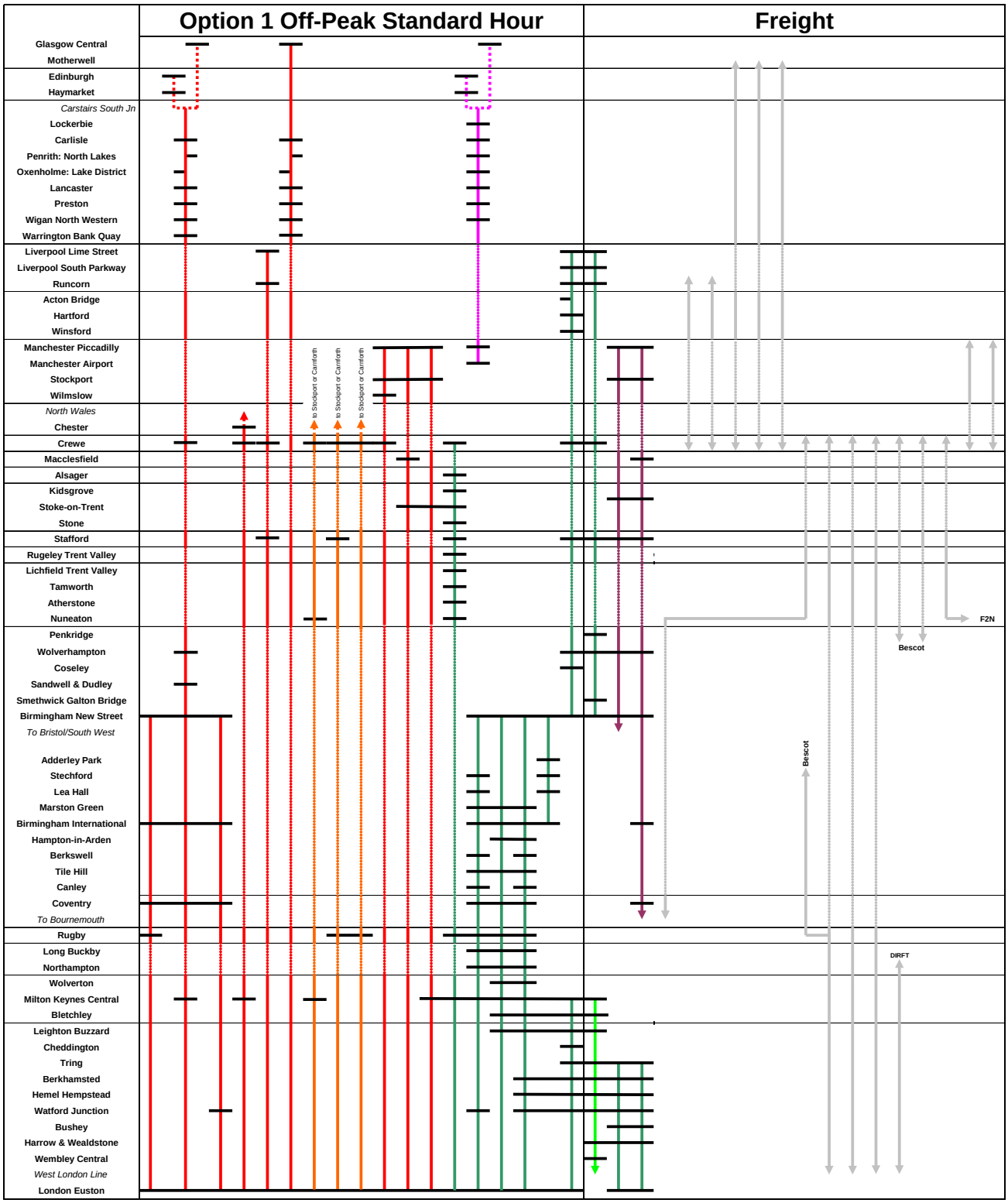
7.5 Event Steering Groups (ESGs)

7.5.1 Once an access rights decision has been made, it is the intention of Network Rail to include it within the work already being undertaken in the WCML ESG and in the soon to commence, North of England ESG.

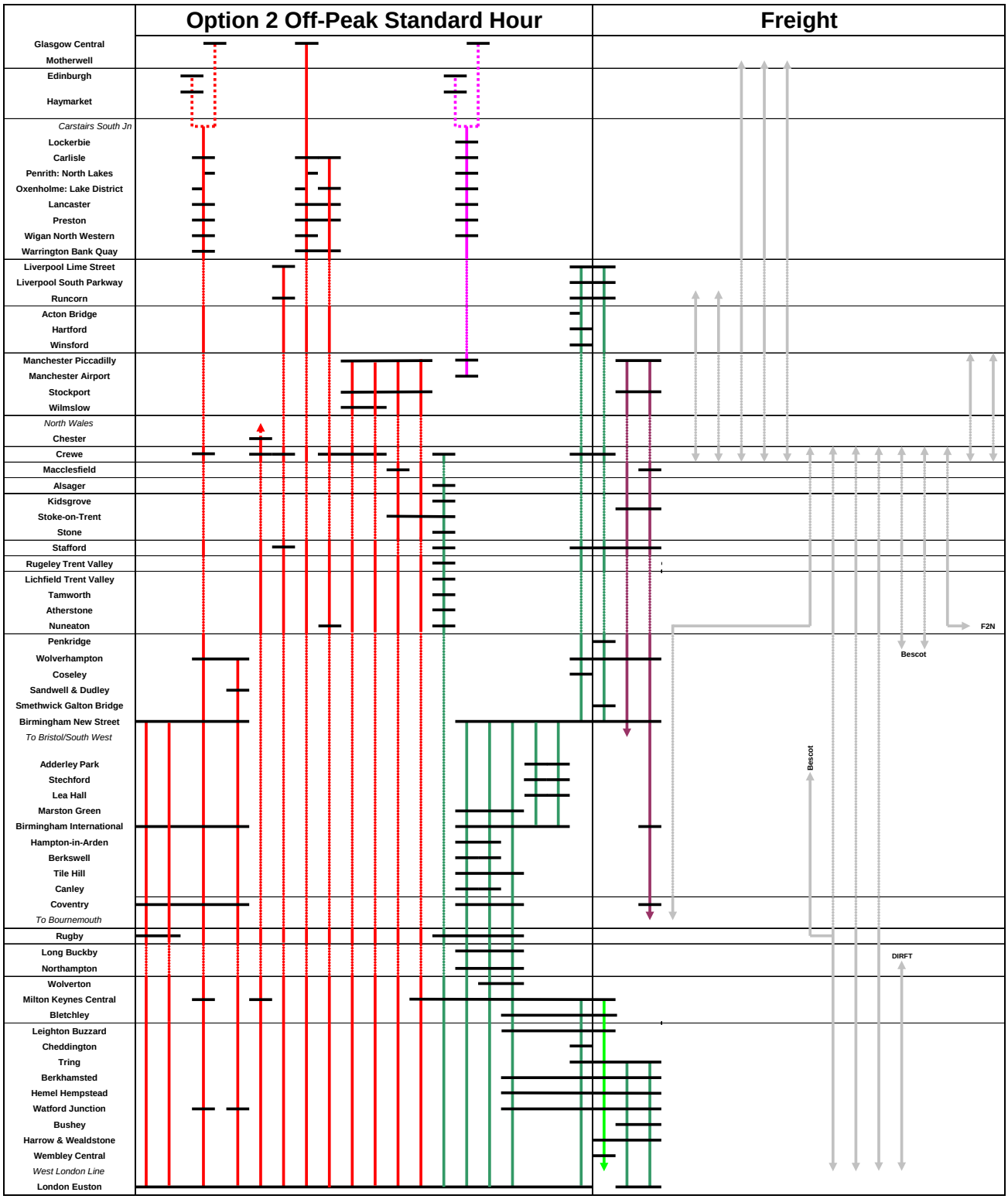
APPENDIX A – SERVICE MAP WCML MAY 2014 TIMETABLE



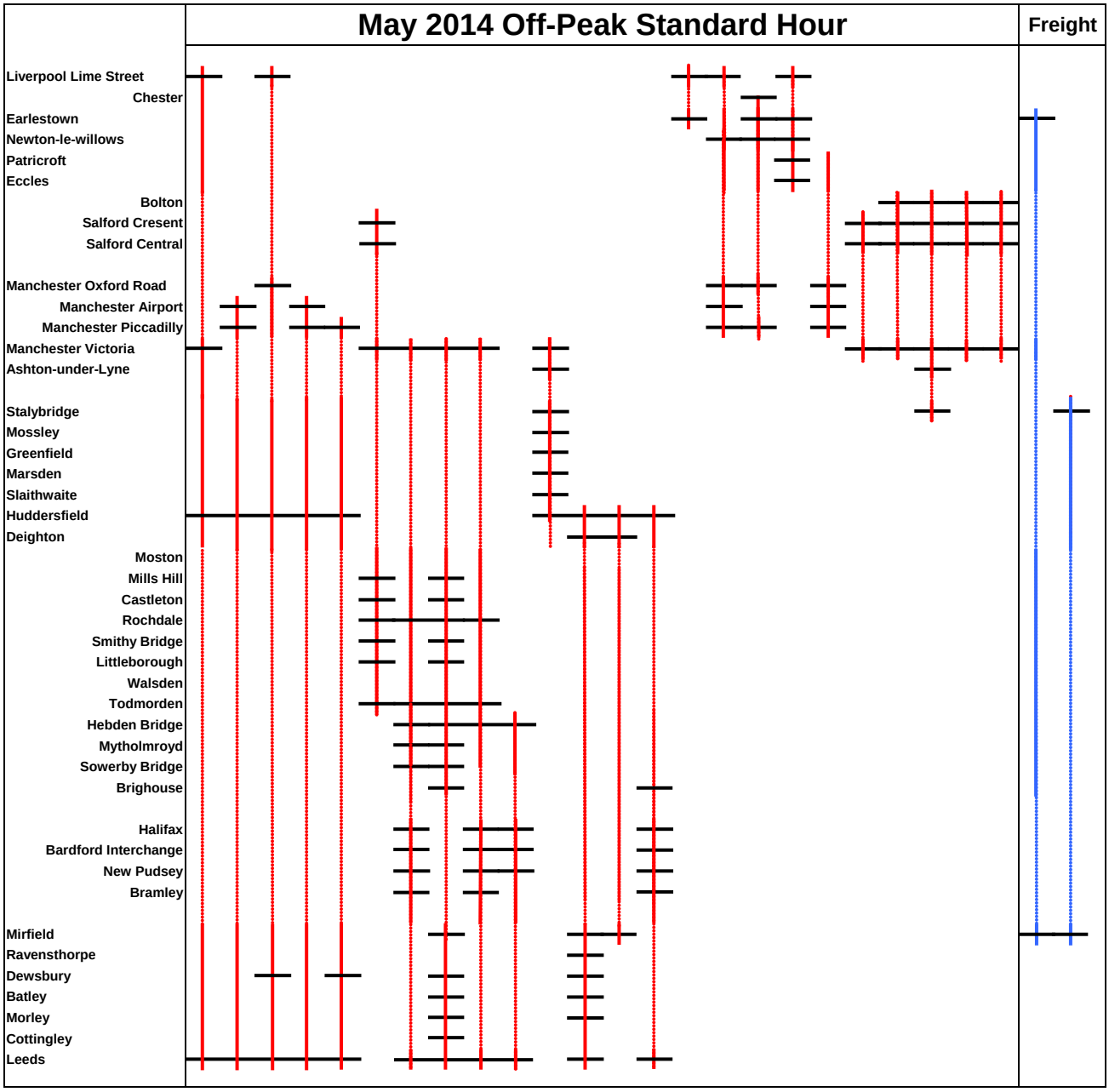
APPENDIX B – SERVICE MAP WCML OPTION 1



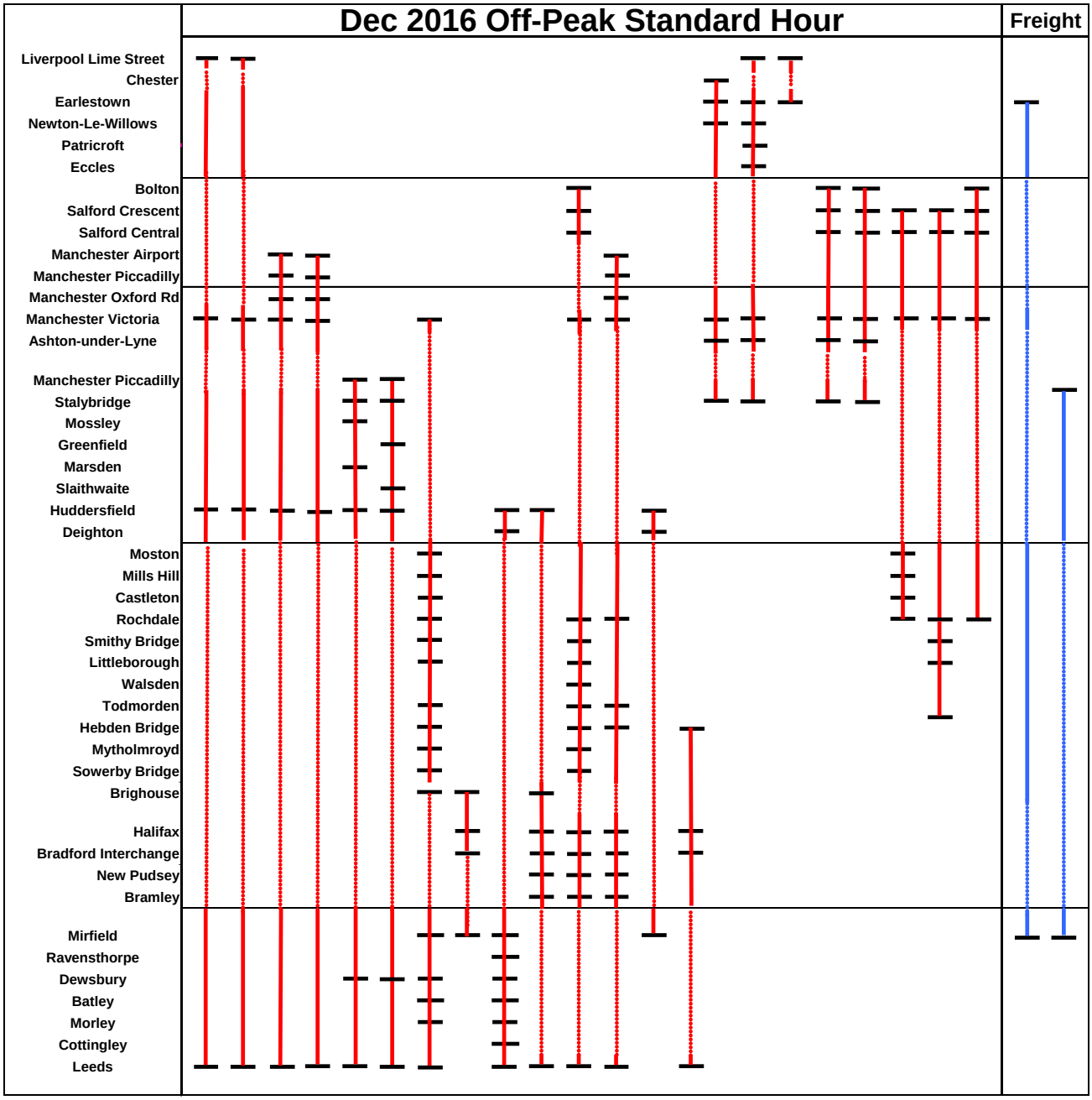
APPENDIX C – SERVICE MAP WCML OPTION 2



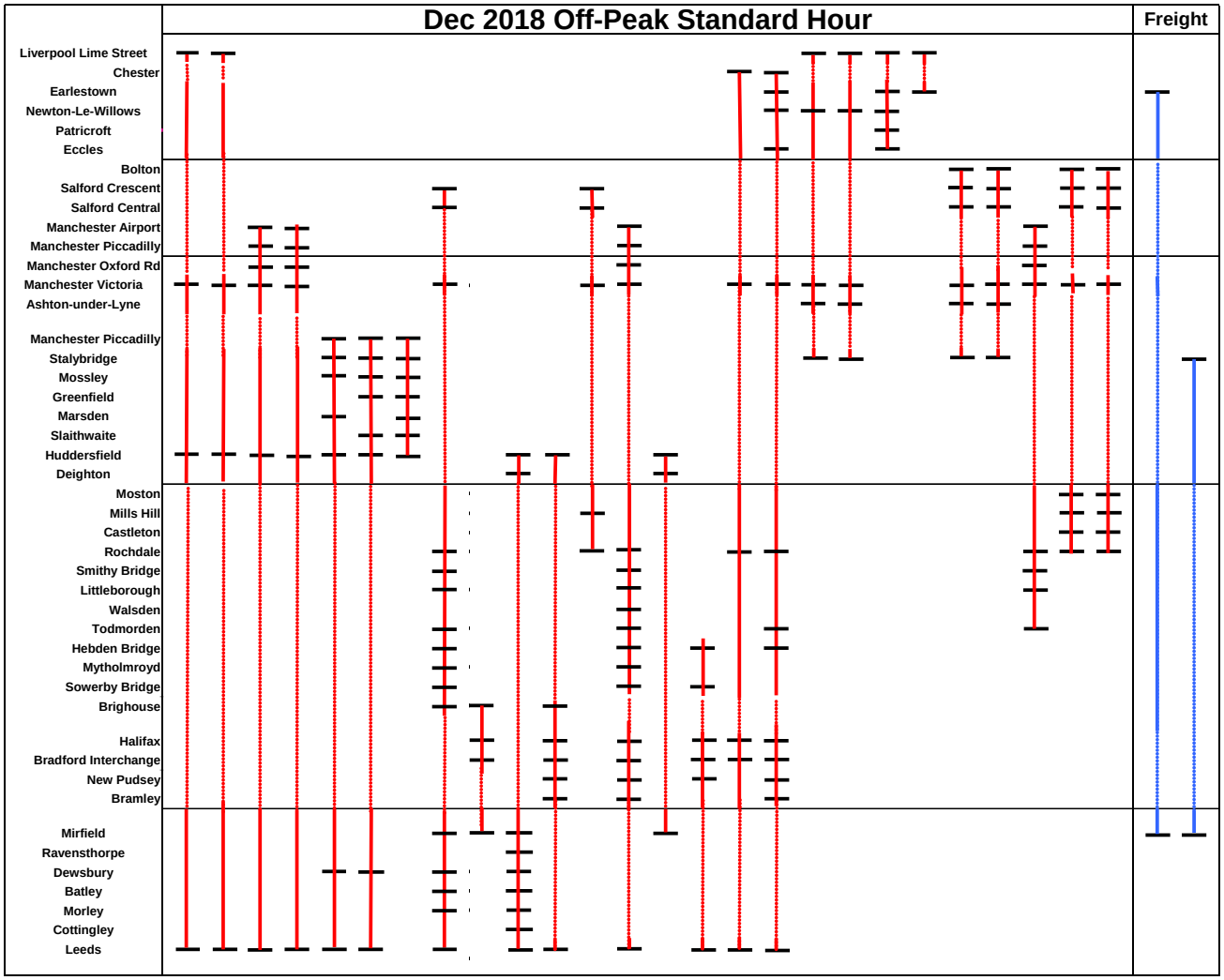
APPENDIX D – SERVICE MAP TRANS-PENNINE MAY 2014 TIMETABLE



APPENDIX E – SERVICE MAP TRANS-PENNINE DECEMBER 2016 TIMETABLE



APPENDIX F – SERVICE MAP TRANS-PENNINE DECEMBER 2018 TIMETABLE



APPENDIX G – OPTION 2 TIMETABLE

		EUS-Class 390			EUS-Class 390			EUS-Class 390			EUS-Class 221			EUS-Class 390			EUS-MAN Class 390			EUS-Class 390			EUS-Class 390			EUS-NMF Class 350/	
	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.
Euston			10.00			10.03			10.07			10.10			10.13			10.16						10.19			10.23
Harrow &		10/09			10/12			10/16			10/19			10/22			10/25						10/28			10/32	
																	(½)									(1)	
Watford Jn		10/12			10/15			10/19			10/23			10/26			10/29					10.32		10.34		10/37	
Bourne End Jn		10/16			10/19			10/23			10/27			10/30			10/33						10/39			10/42	
Ledburn Jn		10/22			10/25			10/29			10/33			10/36			10/39						10/45			10/49	
		(1)			(1)									(2½)			(1½)						(1)				
Milton Keynes		10/29			10/32			10/35		10.40		10.41		10/44		10.47		10.49					10/52		10.57	Pl.5	11.00
		[1]			[1]			[1]			[1]			[1] (2)			[1]						[1] (1)			SL [1]	
Hanslope Jn		10/33			10/36			10/39			10/47			10/50			10/55						10/58			11/05	
																									11.16		
		[1]			[1]			[1]			[1]			[1]			[1]						[1]				
Hillmorton Jn		10/47			10/50			10/53			11/01			11/04			11/08						11/11				
								(1)																			
Rugby		10/47		10.51		10.53		10/54			11/02			11/05			11/09						11/12				
					[1]																		[1]				
				11.02		11.04																11.20		11.22			
Birmingham Int.				11.14		11.16																11.31		11.33			
Birmingham New				11.27																		11.44					
Brinklow		10/50						10/57			11/05			11/08			11/12										
		(½)									(2)			(1½)			(1½)										
Attleborough Jn		10/54						11/01			11/11			11/14			11/17										
Nuneaton		10/55						11/01			11/11		11.17		11.19		11/17				<<<						
														>>>													
Atherstone																											
Tamworth																											
Lichfield																											
Rugeley																											
Colwich Jn		11/11						11/18			11/28						11/36			11/39							
Stafford		11/16					11.23		11.25		11/34									11/43							
Norton Bridge		11/19						11/29			11/37									11/46							
Stoke-on-Trent																11.48		11.50									
Macclesfield																											
Crewe	11.31		11.33				11.42		11.44	11.50		11.53							11.59		12.01						
Chester										12.12																	
Wilmslow	11.47		11.49																								
Stockport	11.57		11.58													12.16		12.18									
Manchester Picc.	12.07															12.26											
Weaver Jn								11/56													12/12						
Runcorn							12.00		12.02																		
Liverpool Lime St							12.19																				
Warrington B.O.																			12.16		12.18						
Wigan N.W.																											
Preston																			12.37		12.40						
Lancaster																			12.53		12.55						
Oxenholme																			13.01	Arrive	C'forth						
Carlisle																											

Glasgow Central																												

		EUS-			EUS-			EUS-			EUS-			EUS-			EUS-			EUS-			EUS-	
		Class 390			Class 390			Class 390			Class 350/1			Class 390			Class 350/1			Class 390			Class 350/1	
	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.
Euston			10.30			10.33			10.36			10.39			10.45						10.48			10.53
Harrow &		10/39½			10/42½			10/45½			10/48½			10/54½						10/57½			11/02½	
Watford Jn		10/42½			10/45½			10/48½			10/52			10/57½					11.01½		11.03		11/06	
																							(1½)	
Bourne End Jn		10/46½			10/49½			10/52½			10/56			11/01½						11/08½			11/11½	
Ledburn Jn		10/52½			10/55½			10/58½			11/02½			11/07½						11/14½			11/18	
		(2)			(2)			(2)						(½)										
Milton Keynes		11/00½			11/03½			11/06½		11.11	Pl.5	11.16		11/14			<<<		11.21½		11.23½	11.26½	Pl.5	11.27½
		[1]			[1]			[1]			>>>			[1]			[1]						SL [1]	
Hanslope Jn		11/04½			11/07½			11/10½						11/18			11/21½			11/29			11/34	
																						11.44		
		[1]			[1]			[1]						[1]			[1]			[1]				
Hillmorton Jn		11/18			11/21			11/24						11/31½			11/38			11/42½				
								(1)																
Rugby		11/18½		11.22½		11.24½		11/25½						11/32		11.40½		11/41½		11/43				
					[1]															[1]				
				11.33½		11.35½													11.51		11.53			
Birmingham Int.				11.45		11.47													12.03½		12.05½			
Birmingham New				11.58															12.16					
Brinklow		11/21½						11/28½						11/35			11/45½							
		(2½)																						
Attleborough Jn		11/27½						11/32						11/38½			11/50							
Nuneaton		11/28						11/32½						11/39		11.52		11.54						
Atherstone																11.59		12.00						
Tamworth																12.07		12.08						
Lichfield																12.13		12.14						
Rugeley																12.20		12.21						
Colwich Jn		11/43½						11/49						11/55½										
Stafford		11/48						11/53½								12.31		12.35						
Norton Bridge		11/51						11/56½																
Stoke-on-Trent													12.08		12.10	12.56		12.58						
Macclesfield													12.24½		12.26									
Crewe	12.03½		12.05½					12/07½								13.20								
Wilmslow	12.19½		12.21																					
Stockport	12.28½		12.30										12.38½		12.40									
Manchester Picc.	12.38												12.48											
Weaver Jn								12/18																
Runcorn																								
Liverpool Lime St																								
Warrington B.O.							12.22		12.24															
Wigan N.W.							12.33		12.35															
Preston							12.46½		12.49½															
Lancaster							13.02½		13.04½															
Oxenholme							13.16		13.18															
Carlisle							13.54½		13.56½															
Glasgow Central							15.05																	

Southbound

		MAN-			BHM-			CAR-			NMP-			CRE-			MAN-			BHM-			CRE-	
		Class 390			Class 390			Class 390			Class			Class 350/			Class 390			Class 390			Class 350/	
	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.
Glasgow																								
Carlisle																								
Oxenholme							C'forth	Depart	08.21															
Lancaster							08.30½		08.32½															
Preston							08.49		08.52															
Wigan N.W.																								
Warrington							09.10		09.12															
Liverpool																								
Runcorn																								
Weaver Jn								09/16½																
Manchester			08.59															09.11						
Stockport	09.06		09.08													09.18		09.19½						
Wilmslow																09.25½		09.27						
Chester																								
Crewe							09.28½		09.30½						08.48	09.42½		09.44½						
Macclesfield	09.19		09.20½																					
Stoke-on-	09.35		09.37										09.09		09.14									
Norton								09/44½									09/56½							
Stafford								09/47½					09.31		09.32		10/00½							
Colwich Jn		09/50						09/52						09/37½			10/05							
Rugeley													09.42½		09.43½									
Lichfield													09.49½		09.50½									
Tamworth													09.56½		09.57½									
Atherstone													10.06		10.07									
Nuneaton		10/06					10.08		10.09½				10.12½	Pl.5	10.14½		10/20½							
Birmingham						09.43															09.59			
Birmingham				09.51½		09.53½													10.09		10.11			
				10.03		10.05								SL					10.20½		10.22½			
		[1] (½)			[1]			[1]						[1]			[1]			[1]			<<<	
Rugby		10/14½		10.14		10.16		10/20½					10.29½	Pl.5	10.33½		10/28½			10/31½		10.29½	Pl.5	10.33½
														>>>										
Hillmorton		10/15			10/18			10/21									10/29			10/32			10.35	
												10.21												
Hanslope Jn		10/27½			10/30½			10/33½			10/29½						10/41½			10/44½			10/49½	
											SL													
Milton		10/30½			10/33½			10/36½		10.35	Pl.1	10.36					10/44½		10.48½		10.50½	10.54		10.55
											SL>FL													
Ledburn Jn		10/37			10/40			10/43			10/46						10/51			10/58			11/03½	
		[1]			[1]			[1]			[1]						[1]			[1]			[1]	
Bourne End		10/43½			10/46½			10/49½			10/54						10/57½			11.04½			11/11	
Watford Jn		10.47½			10/50½			10/53½			10/58½						11.01½		11.09½		11.11		11/15½	
								(½)															(½)	
Harrow &		10/51			10/54			10/57			11/02						11/05			11/15½			11/19	
		{1} [1]			{1} [1]			{1} [1]			[1]						{1} [1]			{1} [1]			[1]	
Euston	11.03			11.06			11.09			11.13						11.17			11.27			11.31		

Note: NOT VALIDATED AGAINST OTHER SERVICES NORTH OF ATTLEBOROUGH JUNCTION

		MAN-			BHM-			GLC-			NMP-			MAN-			BHM-			CTR-			LIV-EUS	
		Class 390			Class 390			Class 390			Class 350/1			Class 390			Class 390			Class 221			Class 390	
	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.
Glasgow Central									07.10															
Carlisle							08.17		08.20															
Oxenholme							08.53		08.55															
Lancaster							09.08		09.10															
Preston							09.26½		09.28½															
Wigan N.W.							09.39½		09.41½															
Warrington B.O.							09.50½		09.52½															
Liverpool Lime St																								09.46
Runcorn																						10.00½		10.02
Weaver Jn								09/58															10/07	
Manchester Picc.			09.29												09.40									
Stockport	09.36		09.37½										09.47		09.48½									
Wilmslow													09.54½		09.56									
Chester																					09.55			
Crewe								10/08½					10.11½		10.13½				10.14		10.17	10.19		10.21
Macclesfield		09/48																						
Stoke-on-Trent	10.02		10.04																					
Norton Bridge								10/19½						10/25½						10/31½			10/34	
Stafford								10/23½						10/29½						10/34½		10.38		10.40
Colwich Jn		10/17						10/28						10/34						10/39			10/45½	
Rugeley																								
Lichfield																								
Tamworth																								
Atherstone																								
Nuneaton		10/33						10/43½						10/49½						10/54½			11/03½	
Birmingham New						10.13												10:.30						
Birmingham Int.				10.22		10.24										10.39		10.41						
				10.33½		10.35½										10.50½		10.52½						
		[1]			[1]			[1]						[1]			[1]			[1] (1½)			[1]	
Rugby		10/41		10.45		10.47		10/51½						10/57½			11/01			11/04			11/11½	
Hillmorton Jn		10/41½			10/49			10/52						10/58			11/01½			11/04½			11/12	
												10.52												
Hanslope Jn		10/54			11/00½			11/04½			11/00½			11/10½			11/14			11/17			11/24½	
					(1)						SL													
Milton Keynes	10.58		11.00		11/04½			11/07½		11.06	Pl.1	11.05		11/13½			11/17		11.21		11.22½		11/27½	
					(1)						SL>FL													
Ledburn Jn		11/07½			11/11			11/14			11/17			11/20			11/23½			11/30½			11/34	
		[1]			[1]			[1]			[1]			[1] (1)			[1] (1)			[1]			[1]	
Bourne End Jn		11/14			11/17½			11/20½			11/25			11/28			11.31			11/37½			11/40½	
		(½)												(½)										
Watford Jn		11/18½			11/21½			11/24½			11/29½			11.32½		11.36		11.37½		11/41½			11.44½	
		(½)			(½)			(½)						(½)										
Harrow &		11/22			11/25			11/28			11/33			11/36			11/42			11/45			11/47½	
		{1} [1]			{1} [1]			{1} [1]			[1]			{1} [1]			{1} [1]			{1} [1]			{1} [1]	
Euston	11.34			11.37			11.40			11.44			11.48			11.54			11.57			12.00		

Note: NOT VALIDATED AGAINST OTHER SERVICES NORTH OF ATTLEBOROUGH JUNCTION

NOTIONAL 'STANDARD HOUR' – COVENTRY CORRIDOR (DOWN)

		EUS-BHM			BHI-BHM			NMP-BHM			EUS-BHM			BMH-MAN			NMP-BHM	
		Class 390			Class 323			Class			Class 390			Class 22x			Class	
	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.
Euston			10.03									10.19						
Harrow & Wealdstone		10/12½									10/28½							
Watford Jn		10/15½								10.32½		10.34						
Bourne End Jn		10/19½									10/39½							
Ledburn Jn		10/25½									10/45½							
		(1)									(1)							
Milton Keynes		10/32½									10/52½							
		[1]									[1] (½)							
Hanslope Jn		10/36½									10/58							
		[1]									[1]							
Hillmorton Jn		10/50						10/54			11/11½						11/15½	
Rugby	10.51½		10.53½				10.56		10.57		11/12					11/17½		11.18½
		[1]						[1]			[1]						[1]	
Coventry	11.02½		11.04½				11.07½		11.08½	11.20		11.22	11.23		11.26	11.29		11.30
Canley							11.11		11.11½									
Tile Hill							11.14½		11.15½							11.33½		11.34
Berkswell							11.18		11.18½									
Hampton-in-Arden							11.22		11.23					{½}				
Birmingham Int.	11.14		11.16			11.20	11.25½		11.26½	11.31		11.33	11.36		11.37½	11.40½		11.41½
Marston Green							11.29		11.29½							11.44		11.44½
Lea Hall		<1>		11.23½		11.24												
Stechford		11/20½		11.26		11.26½		11/32			11/36½			11/41½			11/47	
Adderley Park				11.29		11.29½												
		[1]						[1]			[1] <1>			[1]			[1]	
Proof House Jn		11/24			11/31½			11/35½			11/41			11/45			11/50½	
Birmingham New St	11.27			11.34			11.38			11.44			11.47		11.57	11.53		

		EUS-Class 390			BHI-BHM Class 323			Freight Class 4			NMP-BHM Class			EUS-BHM Class 390			BHI-ABY Class 158	
	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.
Euston			10.33												10.48			
Harrow & Wealdstone		10/42½												10/57½				
Watford Jn		10/45½											11.01½		11.03			
Bourne End Jn		10/49½												11/08½				
Ledburn Jn		10/55½												11/14½				
		(2)																
Milton Keynes		11/03½											11.21½		11.23½			
		[1]												[1]				
Hanslope Jn		11/07½												11/29				
		[1]												[1]				
Hillmorton Jn		11/21						11/25			11/28			11/42½				
Rugby	11.22½		11.24½					11/27		11.30		11.31		11/43				
		[1]						[1]			[1]			[1]				
Coventry	11.33½		11.35½					11/38½		11.41½		11.42½	11.51		11.53			
Canley										11.45		11.45½						
Tile Hill										11.48½		11.49½						
Berkswell										11.52		11.52½						
Hampton-in-Arden								(4)		11.56		11.57						
Birmingham Int.	11.45		11.47			11.50		11/54		11.59½		12.00½	12.03½		12.05½			12.09
Marston Green										12.03		12.03½						
Lea Hall		<1>		11.53½		11.54		{1} (½)						<1>				
Stechford		11/51½		11.56		11.56½		12/00			12/06			12/10			12/14	
Adderley Park				11.59		11.59½												
		[1]									[1]			[1]				
Proof House Jn		11/55			12/01½						12/09½			12/13½			12/17½	
Birmingham New St	11.58			12.04						12.12			12.16			12.20		12.23

NOTIONAL 'STANDARD HOUR' – COVENTRY CORRIDOR (UP)

		BHM-EUS			BHM-NMP			BHM-BHI			BHM-			MAN-BMH			BHM-NMP	
		Class 390			Class			Class 323			Class 390			Class 22x			Class	
	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.
Birmingham New			09.43			09.46			09.49			09.59			10.02			10.05
Proof House Jn		09/45			09/48			09/51			10/01			10/05			10/08	
Adderley Park							09.54		09.54									
Stechford		09/48			09/52		09.57		09.57		10/04			10/08			10/12	
Lea Hall							09.59		10.00									
Marston Green				09.54		09.55					(½)			(½) {1}		10.14		10.15
Birmingham Int.	09.51		09.53	09.57		09.58	10.04			10.08		10.10	10.13		10.15	10.17		10.18
Hampton-in-Arden				10.01		10.01												
Berkswell				10.05		10.06												
Tile Hill				10.09		10.09										10.24		10.24
Canley				10.12		10.13												
		[1]									[1] {½}			[1]				
	10.03		10.05	10.16		10.17				10.20		10.22	10.24		10.25	10.28		10.29
		[1]			[1]						[1]						[1]	
Rugby	10.14		10.16	10.27		10.28					10/31					10.39		10.40
Hillmorton Jn		10/18			10/30						10/32						10/42	
Hanslope Jn		10/30									10/44							
Milton Keynes		10/33								10.48		10.50						
Ledburn Jn		10/40									10/58							
		[1]									[1]							
Bourne End Jn		10/46									11.04							
Watford Jn		10/50								11.09		11.11						
Harrow &		10/54									11/15							
		{1} [1]									{1} [1]							
Euston	11.06									11.27								

		BHM-			BHM-NMP			BHM-			BHM-			Freight			ABY-BHI	
		Class 390			Class			Class 323			Class 390			Class 4			Class 158	
	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.	Arr.	Pass	Dep.
Birmingham New			10.13			10.16			10.19			10.30						10.37
Proof House Jn		10/15			10/18			10/21			10/32						10/39	
Adderley Park							10.24		10.24									
Stechford		10/18			10/22		10.27		10.27		10/35			10/39			10/43	
Lea Hall							10.29		10.30									
Marston Green				10.24		10.24								(½)				
Birmingham Int.	10.21		10.23	10.28		10.29	10.34			10.39		10.41		10/44		10.48		
Hampton-in-Arden				10.31		10.32												
Berkswell				10.36		10.37												
Tile Hill				10.39		10.40												
Canley				10.42		10.43												
		[1] (1)									[1] (½)							
	10.34		10.36	10.46		10.47				10.50		10.52		10/55				
		[1]			[1]						[1]							
Rugby	10.45		10.47	10.57		10.58					11/01			11/08				
Hillmorton Jn		10/49			11/00						11/01			11/10				
Hanslope Jn		11/01									11/14							
Milton Keynes		11/04									11/17							
		(1)																
Ledburn Jn		11/11									11/23							
		[1]									[1] (1)							
Bourne End Jn		11/17									11.31							
Watford Jn		11/21								11.36		11.37						
		(½)																
Harrow &		11/25									11/42							
		{1} [1]									{1} [1]							
Euston	11.37									11.54								

APPENDIX H – NORTON BRIDGE PERFORMANCE DATA (1 OF 3)

Euston Dep. (WTT)	TOC	Headcode	Rugby Trent Valley Jn D	Brinklow D	Attleborough South Junction D	Nuneaton D	Amington Junction D	Lichfield North Jn D	Rugeley North Jn D	Colwich D	Stafford D	Norton Bridge D	Madeley (Staffs) D	Crewe Basford Hall Jn D	Crewe A	Crewe D	Crewe Steel Works D	Chester A
09:10	VT	1D81	1.0	1.1	1.1	1.3	1.6	1.6	1.6	1.6	1.6	1.7	1.8	1.8	2.2	2.3	2.4	2.2
10:09	VT	1D82	2.9	3.0	3.0	3.4	3.7	3.7	3.7	3.1	3.8	4.0	4.1	3.7	4.5	4.1	4.4	4.2
11:09	VT	1D83	4.3	4.2	4.2	4.6	4.9	4.9	4.8	4.1	4.7	4.7	4.8	4.6	5.4	5.8	6.2	6.3
12:10	VT	1D84	3.0	3.0	3.0	3.5	3.8	3.8	3.8	3.1	3.9	4.0	4.3	4.0	4.6	4.2	4.4	3.9
13:10	VT	1D85	2.1	2.1	2.1	2.4	3.2	3.2	3.2	2.7	3.3	3.5	3.8	3.4	4.1	3.6	3.8	3.5
14:10	VT	1D86	2.0	2.1	2.0	2.2	2.5	2.5	2.5	2.0	2.4	2.6	2.7	2.5	3.1	2.6	2.8	3.0
15:10	VT	1D87	1.7	1.7	1.8	2.1	2.5	2.5	2.5	2.0	2.8	2.9	3.1	2.9	4.1	3.5	3.8	3.6
16:10	VT	1D88	1.8	1.9	2.1	2.5	2.9	3.0	3.1	2.6	3.5	4.0	4.2	3.9	4.7	4.1	4.4	4.2
17:10	VT	1D89	1.9	1.9	1.9	2.3	2.7	2.7	2.8	2.1	3.0	3.2	3.3	3.0	3.6	3.1	3.3	3.0
18:08	VT	1D90	2.4	2.5	3.3	3.8	4.2	4.2	4.1	3.5	4.4	4.7	4.9	4.6	5.4	4.8	5.1	5.6
19:14	VT	1D91	4.4	4.5	4.7	5.5	6.8	6.5	6.5	5.6	6.3	5.1	5.3	5.2	5.9	5.1	5.5	6.4
20:14	VT	1D92	4.1	4.2	4.6	5.7	6.7	6.7	6.6	5.6	5.9	4.4	4.6	4.7	5.3	4.9	5.1	6.2
21:10	VT	1D93	5.3	5.4	5.4	5.9	6.6	6.5	6.5	5.4	6.3	6.3	6.6	6.4	7.2	7.0	7.4	7.9
22:13	VT	1D94	1.8	1.7	1.8	2.4	3.0	3.0	3.1	2.4	3.0	3.4	3.5	3.3	4.4	4.0	2.9	3.2
			2.8	**2.8**	**2.9**	**3.4**	**3.9**	**3.9**	**3.9**	**3.3**	**3.9**	**3.9**	**4.1**	**3.9**	**4.6**	**4.2**	**4.4**	**4.5**

APPENDIX H – NORTON BRIDGE PERFORMANCE DATA (2 OF 3)

Origin WTT	TOC	Headcode	Crewe Basford Hall Jn D	Crewe A	Crewe D	Crewe Coal Yard D	Winsford D	Hartford Jn D	Acton Bridge D	Weaver Jn D	Runcorn A	Runcorn D	Ditton East Junction D	L'Pool Sth Pw Hl (Allertn) A	L'Pool Sth Pw Hl (Allertn) D	Wavertree Jn D	Edge Hill D	Liverpool Lime Street A
08:36	LM	1F35	2.5	3.3	3.1	3.7	3.1	3.0	3.0	2.6	3.0	3.0	3.0	2.6	2.5	2.2	2.8	2.6
09:36	LM	1F37	3.5	4.6	4.9	5.5	5.0	4.8	4.8	4.4	5.0	4.9	4.8	4.7	4.5	4.1	4.9	4.7
10:36	LM	1F39	2.5	3.6	3.4	3.9	3.5	3.3	3.4	3.0	3.7	3.7	3.7	3.3	3.2	2.7	3.6	3.2
11:36	LM	1F41	2.9	4.0	4.1	4.4	4.2	3.8	3.8	3.7	4.2	4.2	4.1	3.7	3.7	3.4	4.2	4.0
12:36	LM	1F43	2.7	3.7	3.4	3.8	3.5	3.3	3.4	3.1	3.5	3.4	3.3	3.0	2.9	2.5	3.2	2.8
13:36	LM	1F45	2.8	3.9	3.6	4.0	3.7	3.5	3.6	3.3	3.8	3.7	3.7	3.3	3.2	2.8	3.6	3.2
14:36	LM	1F47	2.7	3.8	3.5	3.8	3.6	3.4	3.4	3.2	3.7	3.9	3.9	3.4	3.3	3.1	3.8	3.4
15:36	LM	1F49	2.4	3.4	3.4	3.9	3.5	3.4	3.4	3.2	3.7	3.7	3.5	3.2	3.2	2.7	3.5	3.1
16:36	LM	1F51	3.0	3.8	3.4	3.7	3.3	3.0	3.0	2.8	3.3	3.4	3.3	3.1	3.0	2.6	3.2	2.9
17:36	LM	1F53	2.5	3.1	2.7	2.7	3.2	3.4	3.9	3.0	3.2	3.1	3.2	2.9	2.7	2.4	3.1	3.0
18:36	LM	1F55	3.2	4.0	4.1	4.1	4.7	4.3	4.9	4.5	4.8	4.7	4.7	4.5	4.3	3.5	4.4	4.7
19:36	LM	1F57	4.0	5.2	4.9	4.8	5.1	4.8	5.3	4.6	4.9	4.8	4.7	4.5	4.4	4.1	4.9	5.7
20:36	LM	1F59	2.8	4.1	4.1	4.6	5.8	5.1	5.4	4.6	5.0	4.8	4.9	4.4	4.3	3.9	4.7	3.7
21:36	LM	1F61	1.6	2.0	1.8	1.9	3.1	2.8	3.5	2.6	2.9	3.0	3.1	1.8	2.0	1.4	1.6	1.5
			2.8	**3.7**	**3.6**	**3.9**	**3.9**	**3.7**	**3.9**	**3.5**	**3.9**	**3.9**	**3.8**	**3.5**	**3.4**	**3.0**	**3.7**	**3.4**

APPENDIX H – NORTON BRIDGE PERFORMANCE DATA (3 OF 3)

Origin WTT	TOC	Headcode	Crewe D	Crewe Coal Yard D	Winsford D	Hartford Jn D	Acton Bridge D	Weaver Jn D	Runcorn A	Runcorn D	Ditton East Junction D	L'Pool Sth Pw Hl (Allertn) A	L'Pool Sth Pw Hl (Allertn) D	Wavertree Jn D	Edge Hill D	Liverpool Lime Street A
06:01	LM	1F30	1.5	1.9	2.6	2.1	2.4	1.4	1.8	1.7	1.7	1.3	1.3	1.0	1.8	1.0
07:01	LM	1F32	2.1	2.2	3.4	2.8	3.0	2.3	2.5	2.5	2.7	2.5	2.4	2.0	2.3	2.1
09:01	LM	1F36	2.6	2.5	3.9	3.4	3.7	2.7	3.0	3.1	3.0	2.3	2.3	2.0	2.6	1.9
10:01	LM	1F38	2.2	2.3	3.0	2.5	2.8	2.5	2.9	2.9	3.0	2.7	2.7	2.4	3.2	2.3
11:01	LM	1F40	2.6	2.6	2.9	2.7	3.0	2.3	2.5	2.5	2.5	2.1	2.4	2.1	2.7	3.3
12:01	LM	1F42	1.6	1.5	1.9	1.6	1.8	1.5	1.7	1.6	1.7	1.2	1.1	0.9	1.4	0.9
13:01	LM	1F44	1.9	1.9	2.4	2.1	2.3	2.0	2.3	2.3	2.3	2.0	1.9	1.6	2.3	1.2
14:01	LM	1F46	1.4	1.5	2.2	1.8	2.0	1.8	1.9	1.9	2.0	1.5	1.5	1.2	1.7	0.8
15:01	LM	1F48	3.0	3.0	2.7	2.5	2.6	2.0	2.2	2.2	2.3	2.0	1.9	1.7	2.0	2.1
16:01	LM	1F50	3.1	3.1	4.1	3.8	3.9	3.1	3.2	3.3	3.4	3.0	2.9	2.6	3.1	2.4
17:01	LM	1F52	3.7	3.6	4.5	3.9	4.6	3.7	4.1	4.0	4.1	3.7	3.6	3.4	4.3	3.0
18:01	LM	1F54	3.7	3.9	4.6	4.1	4.4	4.1	4.4	4.4	4.5	4.5	4.4	4.0	4.8	3.9
			2.4	**2.5**	**3.2**	**2.8**	**3.0**	**2.4**	**2.7**	**2.7**	**2.8**	**2.4**	**2.4**	**2.1**	**2.7**	**2.1**

APPENDIX I – NOTIONAL JOURNEY TIMES

Nominal journey times have been calculated for Alliance's proposed services to Leeds, Bradford Interchange, Blackpool and Carlisle (via Barrow). These are based on validated paths as far as Heaton Norris Junction, Winwick Junction, Preston and Carnforth respectively, using a Class 390 (with tilt) timing load. Beyond those locations, they area based on the accumulation of:

- Estimated running times for a diesel-hauled 6-car Class 390.
- 7 minutes allowance for attaching / detaching an assisting diesel locomotive.
- 1½ minutes dwell at each scheduled call (or the minimum applicable Timetable Planning Rules value, if greater)
- Required Engineering Allowance as per Timetable Planning Rules.

As there are no agreed timetables in place for December 2016 and beyond, around which to validate these trains, the running times away from the WCML take no account of any pathing time or extended station dwells which may be required.

Leeds Trains

Station	Elapsed notional time from Departing Origin to Arrival			
	Option 1 xx:33 Departure	**Option 1 xx:36 Departure**	**Option 1 xx:57 Departure**	**Option 2**
Euston	0h 00m	0h 00m	0h 00m	0h 00m
Milton Keynes	N/A	0h 29m	N/A	N/A
Rugby	0h 48m	N/A	0h 47m	N/A
Nuneaton	N/A	1h 02m	N/A	1h 04m
Stafford	1h 20m	N/A	N/A	N/A
Crewe	1h 41m	1h 41m	1h 37m	1h 46m
Wilmslow	N/A	N/A	N/A	2h 03m
Stockport	2h 11m	2h 10m	2h 14m	2h 14m
Stalybridge	2h 47m	2h 44m	2h 45m	2h 37m
Huddersfield	3h 09m	3h 06m	3h 07m	2h 59m
Dewsbury	3h 18m	3h 15m	3h 16m	3h 08m
Leeds	3h 30m	3h 27m	3h 28m	3h 20m

Station	Elapsed notional time from Departing Origin to Arrival			
	Option 1 xx:02 Arrival	**Option 1 xx:30 Arrival**	**Option 1 xx:43 Arrival**	**Option 2**
Leeds	0h 00m	0h 00m	0h 00m	0h 00m
Dewsbury	0h 10m	0h 10m	0h 10m	0h 10m
Huddersfield	0h 20m	0h 20m	0h 20m	0h 20m
Stalybridge	0h 42m	0h 42m	0h 42m	0h 42m
Stockport	1h 09m	1h 09m	1h 09m	1h 09m
Wilmslow	N/A	N/A	N/A	1h 19m
Crewe	1h 41m	1h 45m	N/A	1h 36m
Stafford	N/A	2h 06m	N/A	N/A
Nuneaton	2h 21m	N/A	N/A	2h 15m
Rugby	N/A	2h 38m	2h 48m	N/A
Milton Keynes	2h 51m	N/A	N/A	N/A
Euston	3h 29m	3h 34m	3h 42m	3h 16m

Bradford Interchange Trains

Station	Elapsed notional time from Departing Origin to Arrival			
	Option 1 xx:33 Departure	Option 1 xx:36 Departure	Option 1 xx:57 Departure	Option 2
Euston	0h 00m	0h 00m	0h 00m	0h 00m
Milton Keynes	N/A	0h 29m	N/A	N/A
Rugby	0h 48m	N/A	0h 47m	N/A
Nuneaton	N/A	1h 02m	N/A	1h 04m
Stafford	1h 20m	N/A	N/A	N/A
Crewe	1h 41m	1h 41m	1h 37m	1h 46m
Warrington Bank Quay	2h 01m	2h 02m	1h 57m	2h 03m
Newton-le-Willows	2h 18m	2h 19m	2h 13m	2h 20m
Eccles	2h 31m	2h 32m	2h 26m	2h 33m
Manchester Victoria	2h 40m	2h 41m	2h 35m	2h 42m
Rochdale	2h 54m	2h 55m	2h 49m	2h 56m
Hebden Bridge	3h 09m	3h 10m	3h 04m	3h 11m
Halifax	3h 21m	3h 22m	3h 16m	3h 23m
Bradford Interchange	3h 34m	3h 35m	3h 29m	3h 36m

Station	Elapsed notional time from Departing Origin to Arrival			
	Option 1 xx:02 Arrival	**Option 1 xx:30 Arrival**	**Option 1 xx:43 Arrival**	**Option 2**
Bradford Interchange	0h 00m	0h 00m	0h 00m	0h 00m
Halifax	0h 10m	0h 10m	0h 10m	0h 10m
Hebden Bridge	0h 23m	0h 23m	0h 23m	0h 23m
Rochdale	0h 37m	0h 37m	0h 37m	0h 37m
Manchester Victoria	0h 53m	0h 53m	0h 53m	0h 53m
Eccles	1h 01m	1h 01m	1h 01m	1h 01m
Newton-le-Willows	1h 13m	1h 13m	1h 13m	1h 13m
Warrington Bank Quay	1h 22m	1h 22m	1h 22m	1h 22m
Crewe	1h 54m	1h 47m	N/A	1h 41m
Stafford	N/A	2h 07m	N/A	N/A
Nuneaton	2h 25m	N/A	N/A	2h 20m
Rugby	N/A	2h 41m	2h 32m	N/A
Milton Keynes	2h 58m	N/A	N/A	N/A
Euston	3h 38m	3h 39m	3h 34m	3h 21m

Blackpool North Trains

Station	Elapsed notional time from Departing Origin to Arrival			
	Option 1 xx:33 Departure	Option 1 xx:36 Departure	Option 1 xx:57 Departure	Option 2
Euston	0h 00m	0h 00m	0h 00m	0h 00m
Milton Keynes	N/A	0h 29m	N/A	N/A
Rugby	0h 48m	N/A	0h 47m	N/A
Nuneaton	N/A	1h 02m	N/A	1h 04m
Stafford	1h 20m	N/A	N/A	N/A
Crewe	1h 41m	1h 41m	1h 37m	1h 46m
Warrington Bank Quay	2h 01m	2h 02m	1h 57m	2h 03m
Wigan North Western	2h 12m	2h 13m	2h 08m	2h 14m
Preston	2h 25m	2h 26m	2h 21m	2h 29m
Poulton-le-Fylde	2h 46m	2h 47m	2h 42m	2h 50m
Blackpool North	2h 54m	2h 55m	2h 50m	2h 58m

Station	Elapsed notional time from Departing Origin to Arrival			
	Option 1 xx:02 Arrival	**Option 1 xx:30 Arrival**	**Option 1 xx:43 Arrival**	**Option 2**
Blackpool North	0h 00m	0h 00m	0h 00m	0h 00m
Poulton-le-Fylde	0h 07m	0h 07m	0h 07m	0h 07m
Preston	0h 27m	0h 27m	0h 27m	0h 27m
Wigan North Western	0h 40m	0h 40m	0h 40m	0h 37m
Warrington Bank Quay	0h 52m	0h 52m	0h 52m	0h 48m
Crewe	1h 12m	1h 12m	N/A	1h 07m
Stafford	N/A	1h 34m	N/A	N/A
Nuneaton	1h 53m	N/A	N/A	1h 46m
Rugby	N/A	2h 08m	2h 04m	N/A
Milton Keynes	2h 26m	N/A	N/A	N/A
Euston	3h 06m	3h 05m	3h 05m	2h 47m

Carlisle Trains

Station	Elapsed notional time from Departing Origin to Arrival			
	Option 1 xx:33 Departure	Option 1 xx:36 Departure	Option 1 xx:57 Departure	Option 2
Euston	0h 00m	0h 00m	0h 00m	0h 00m
Milton Keynes	N/A	0h 29m	N/A	N/A
Rugby	0h 48m	N/A	0h 47m	N/A
Nuneaton	N/A	1h 02m	N/A	1h 04m
Stafford	1h 20m	N/A	N/A	N/A
Crewe	1h 41m	1h 41m	1h 37m	1h 46m
Warrington Bank Quay	2h 01m	2h 02m	1h 57m	2h 03m
Wigan North Western	2h 12m	2h 13m	2h 08m	2h 14m
Preston	2h 25m	2h 26m	2h 21m	2h 29m
Carnforth	2h 51m	2h 52m	2h 47m	2h 55m
Barrow	3h 34m	3h 35m	3h 30m	3h 38m
Carlisle	5h 46m	5h 47m	5h 42m	5h 50m

Station	Elapsed notional time from Departing Origin to Arrival			
	Option 1 xx:02 Arrival	Option 1 xx:30 Arrival	Option 1 xx:43 Arrival	Option 2
Carlisle	0h 00m	0h 00m	0h 00m	0h 00m
Barrow	2h 15m	2h 15m	2h 15m	2h 15m
Carnforth	2h 57m	2h 57m	2h 57m	2h 57m
Preston	3h 24m	3h 24m	3h 24m	3h 24m
Wigan North Western	3h 37m	3h 37m	3h 37m	3h 34m
Warrington Bank Quay	3h 49m	3h 49m	3h 49m	3h 45m
Crewe	4h 09m	4h 09m	N/A	4h 04m
Stafford	N/A	4h 31m	N/A	N/A
Nuneaton	4h 50m	N/A	N/A	4h 43m
Rugby	N/A	5h 05m	4h 59m	N/A
Milton Keynes	5h 23m	N/A	N/A	N/A
Euston	6h 03m	6h 03m	6h 02m	5h 44m