



West Coast Main Line Congested Infrastructure Report

Capacity Analysis – System Operator

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References				
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1.	West Coast Main Line and Trans-Pennine Capacity and Performance Assessment	Final ORR Stage 3 WCML TP Report	22/10/2013	1.1.1
2.	West Coast Main Line Capacity Assessment 2020	WCML Capacity Report 2020	20/02/2020	1.0

Abbreviations	
Acronym	Meaning
ESG	Event Steering Group
FL	Fast Line(s)
GC	Grand Central
HS2	High Speed 2
IPG	Industry Planning Group
Jn	Junction
MBR	Materials by Rail
ORR	Office for Rail and Road
TP	Trans-Pennine
SRT	Sectional Run Time
Mph	Miles Per Hour
NMT	New Measurement Train
SL	Slow Line(s)

Abbreviations	
Acronym	Meaning
TPR(s)	Timetable Planning Rule(s)
WCML	West Coast Mainline
WMT	West Midlands Trains

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Part A: Executive Summary

This report identifies the constraints and limitations on the West Coast Main Line (WCML) South which have contributed to the declaration of congested infrastructure for the fast lines (FL) between Camden South Junction and Ledburn Junction in May 2020.

In 2013 analysis was undertaken to determine whether additional paths could be accommodated on the West Coast Main Line, carried out by Network Rail upon the request of the Office for Rail and Road (ORR). It was determined that while capacity may exist for 3 additional paths in each direction, to utilise more than 1 of these paths for additional services would be of significant detriment to timetable performance in its current structure.

Further analysis was carried out in 2020, following a request from the ORR to review applications for additional services by 5 applicants. The analysis carried out identified which, if any, of the FL arrival and departure paths into and out of London Euston found in the 2013 report still existed in the May 2020 timetable, with a view to identifying whether any additional FL paths on the WCML could be found in the May 2020 timetable.

It was concluded that there is no available capacity without significantly impacting performance and causing a reduction in timetable resilience due to the resulting requirement for successive services to run on minimum headway.

As a result of this Network Rail declared the infrastructure on the West Coast Mainline South fast lines between Camden South Junction and Ledburn Junction as congested infrastructure with effect from the 11th May 2020.

Due to the above Network Rail rejected an access proposal from West Midlands Trains (WMT) for a new hourly FL path for both the May 20 and the December 20 Timetables.

In September 2020, after the publication of the congested infrastructure notification, Grand Central announced that they have withdrawn their plans to run a Blackpool North – London Euston service after Covid-19 rendered plans ‘unfeasible’¹. This would remove five weekday services on the fast lines in each direction (minus the contingent rights for one of these services in the down direction on a Wednesday due to the New Measurement Train).

¹ <https://www.grandcentralrail.com/news/2020/grand-centrals-planned-blackpool-london-route-falls-victim-covid-19/>

Network Rail undertook a high level view to see if these 110mph paths could be repurposed to provide any more capacity along the congested infrastructure section.

Although it was possible to compliantly timetable two paths at 125mph across the section of infrastructure in the Down direction, it wasn't possible to timetable an additional path from Rugby further north.

It also wasn't possible to accommodate two paths at 125mph in the Up direction because there was no additional capacity at Watford Junction.

Withdrawal of the Grand Central London Euston to Blackpool services would enable an alternative service to run in its place at either 110mph or 125mph but would not facilitate the running of two services in its place.

Congested infrastructure review	Report section
Constraints on infrastructure capacity which prevent requests for capacity from being adequately met	D.01
Proposed methods of enabling additional requests for access to be satisfied	D.02
Analysis considering the infrastructure, the operating procedures, the nature of the different services operating and the effect of all these factors on infrastructure capacity. Measures to be considered shall include in particular: <ol style="list-style-type: none"> 1. rerouting services, 2. retiming services, 3. speed alterations, 4. infrastructure improvements 	D.04 D.05 D.06 D.02

Table 1: Article 50 Criteria

A.01 Outcome

An increase of quantum of trains running on the fast lines between Camden South Junction and Ledburn Junction cannot be achieved to a point that would satisfy all of the outstanding fast line access proposals.

In the short term the withdrawal of the Grand Central London Euston to Blackpool services would enable an alternative service to run in its place at either 110mph or 125mph but would not facilitate the running of two services (at 125mph) in the capacity generated by the removal of the Grand Central Service.

No analysis has taken place to determine whether any of the live access proposals for additional services would be suitable to run in the place of the Grand Central services.

To evaluate the medium-term solutions the WCML Industry Planning Group (IPG) are looking at whether a timetable recast would have the potential to deliver further capacity and/or improved performance to offer enhancements to the timetable between now and the start of HS2 operating.

Long term the operation of the separate HS2 network will remove some current fast lines services from the existing WCML South network and allow for other services to use the existing infrastructure.

Part B: Introduction

B.01 Background

In 2013, Network Rail carried out an appraisal regarding capacity on the West Coast Main Line (WCML), at the request of the Office for Rail and Road (ORR), for the purpose of evaluating the impact of any additional services on performance. In February 2020, further analysis on WCML capacity was carried out as a result of a cross-industry group meeting in December 2019, in which it was agreed that the findings obtained in the 2013 report would be reviewed and subsequently updated. This was following a request from the ORR to review applications for additional services by 5 applicants. The applications received were as follows:

- The new franchisee First Trenitalia West Coast Rail Limited (FTWC, now operating as Avanti West Coast) for rights from December 2022 for additional 125mph capable (assumed class 390) London Euston – Liverpool Lime Street services to increase its service from 1 to 2 trains per hour;
- Prospective Open Access Operator Virgin Trains (VT) for rights from December 2022 for an hourly return service between London Euston and Liverpool Lime Street, running with 125mph capable class 221 rolling stock, calling at Nuneaton, Tamworth, Lichfield Trent Valley and Liverpool South Parkway;
- Prospective Open Access Operator Grand Union Trains (GUT) for rights from May 2021 for 4 return services per day between London Euston and Stirling, running with 110mph capable class 91 rolling stock, calling at Milton Keynes Central, Nuneaton, Crewe, Preston, Carlisle, Lockerbie, Motherwell, Whifflet, Greenfaulds and Larbert;
- Franchisee West Midlands Trains (WMT) for rights from December 2020 to run an additional return service in certain hours between Northampton and London Euston with an assumed 110mph capable class 350 rolling stock; and
- Existing Open Access Operator Grand Central North West (GCNW) to turn the contingent right that it holds to run a fifth service on Wednesday every 8 weeks between London and Blackpool into a firm right; this was assumed to be running with 110mph capable class 91 rolling stock.

With effect from 11th May 2020 Network Rail declared the infrastructure on the West Coast Mainline South fast lines between Camden South Junction and Ledburn Junction as congested infrastructure.

This declaration was made under regulation 26 (2) because, following consideration of access requests received; Network Rail considers that this element of the infrastructure would be likely to become congested during the December 2020 timetable period.

B.02 Aims and Objectives

The purpose of this report is to provide a review of both the 2013 and 2020 report, in order to determine whether the analysis meets the criteria outlined in Article 50 of Directive 12/34/EU of the European Parliament and of The Council: Establishing a Single European Railway Area. The criteria set out in Article 50 is as follows:

- The objective of capacity analysis is to determine the constraints on infrastructure capacity which prevent requests for capacity from being adequately met, and to propose methods of enabling additional requests to be satisfied. The capacity analysis shall identify the reasons for the congestion and what measures might be taken in the short and medium term to ease the congestion.
- The capacity analysis shall consider the infrastructure, the operating procedures, the nature of the different services operating and the effect of all these factors on infrastructure capacity. Measures to be considered shall include rerouting services, retiming services, speed alterations and infrastructure improvements.

This report draws heavily from the information found within the 2020 analysis and its findings and contains several direct quotes and extracts of information from it.

Part C: Assumptions

C.01 Timetable

The West Coast Mainline Capacity Assessment 2020 compared the May 2020 timetable (Subsidiary Change Timetable 2020) to the findings from the West Coast Main Line and Trans-Pennine Capacity and Performance Assessment published in 2013.

For ease of reading, from this point forward these reports will be referred to as the “2013 report” and “2020 report”.

The conclusion from the 2020 report was that the timetable hadn’t fundamentally changed from the 2013 report, but the slots identified for additional train paths had either been sold or eroded through timetable change.

C.02 Geographic Scope

The geographic scope of the analysis was the West Coast Main Line from London Euston to Carnforth North Junction.

The declaration of congested infrastructure has been made on the fast lines between Camden South Junction and Ledburn Junction therefore this report will only refer to analysis covering this geographic area.

C.03 Rolling Stock

The rolling stock analysed in the 2020 report included four types of rolling stock currently in operation on the WCML, namely;

- Two types of 125 mph capable stock: classes 390 and tilt enabled 221 (221T)
- Two types of 110mph capable stock: class 91 locomotive with Mark 4 vehicles and class 350

C.04 Infrastructure

The 2020 report assumed infrastructure as of May 2020 (pre Covid-19 restrictions) with no further enhancements proposed.

Part D: Findings

D.01 Infrastructure Constraints

This section details the infrastructure constraints highlighted in the 2013 report and were still present in the 2020 report.

In the 2013 report, future considerations for the WCML ESG were identified and were included in the 2020 report. These are detailed in Appendix Part F:.

D.01.01 London Euston Station

London Euston station reduced to 16 platforms from 18 in 2019, limiting platform availability particularly in morning peak when there's a higher quantum of services.

Materials by Rail (MBR) services for the construction of HS2 are introduced from the 2019 timetable. Although these trains are planned on the slow lines the additional trains will put further strain on the infrastructure and network as they need to cross the fast lines at the throat of Euston station to access the HS2 work site (formerly platforms 17 and 18).

Stage B1 of the HS2 development at Euston will remove platforms 15 and 16 as well as the middle sidings by 2033 (Platform 15 is expected to be re-commissioned by 2038).

Timetable and diagram changes mean that there are more West Midlands Trains splitting and joining at Euston station. Both the 2013 and 2020 reports did not include platforming at London Euston.

D.02 Infrastructure Improvements

The 2013 and 2020 reports contain a list of capacity enhancement schemes, details of these can be found in the Appendix in Part F:.

D.02.01 WCML South Route Junction Strategy

The WCML South Route Junction Strategy is reviewing proposals to remove poor performing infrastructure at Bourne End crossovers and put in a new (reinstated) crossover to the north of Watford, with the aim of facilitating turnrounds there during times of disruption.

Analysis demonstrates that it's a more restrictive option for the timetable which reduces the level of flexibility provided by the current Bourne End junction arrangement. Not all of the limited number of existing services that are timetabled to cross running lines at Bourne End Junction can be accommodated by moving their crossing to either Watford North Junction or Ledburn Junction; a more fundamental recast of the timetable might provide a solution to this. The

junction strategy does not generate capacity which could be used for additional services.

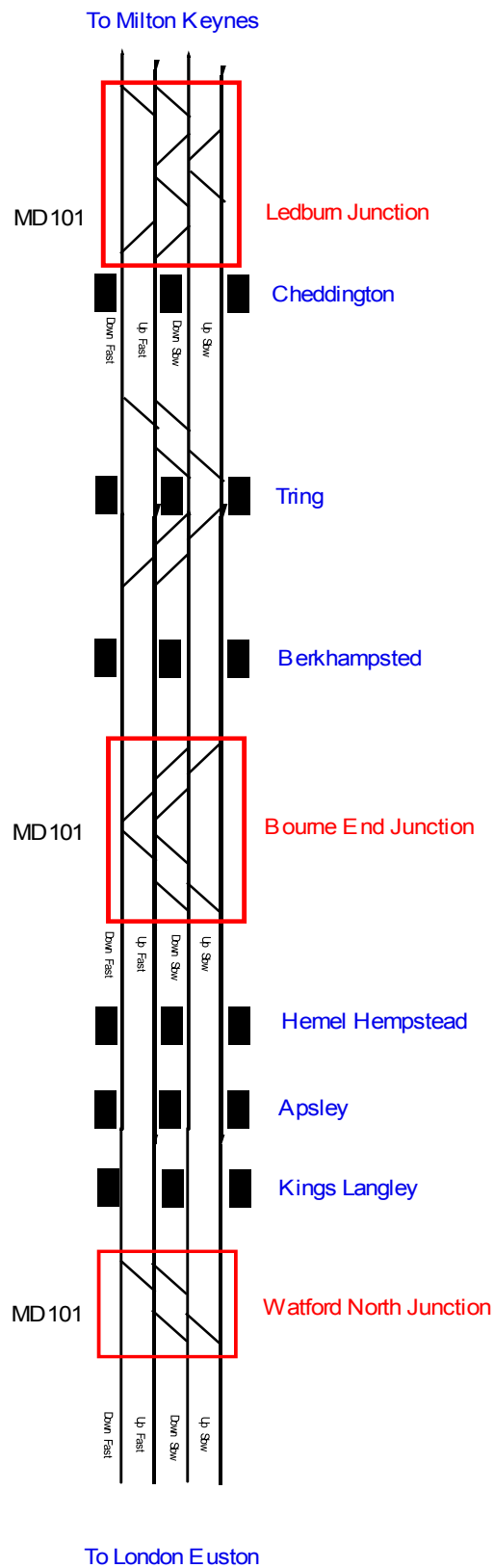


Figure 1: Junctions tested as part of the WCML South Route Junction Strategy

D.02.02 High Speed 2

The building of the new High Speed 2 railway will take trains off the existing railway and place them on to dedicated high speed tracks. The main aims of this are to improve journey times for long-distance high-speed services running on these new lines and to ‘free up’ capacity which could be used effectively by both long-distance and suburban passenger services, and freight services on the conventional network. However, it is anticipated that some existing WCML services will continue in similar form to today, though potentially with adjusted stopping patterns and timings. These are expected to include long distance services to Birmingham New Street and extensions from there to Shrewsbury and Scotland, and services to Chester and North Wales.



Figure 2: Extract of the HS2 phase 1 route proposal

D.03 Operating Procedures

Timetable and diagram changes mean that there are more West Midlands Trains splitting and joining at Euston station.

Network Rail is working with Avanti West Coast regarding the multiple unit speed differential for non-tilt multiple unit stock, to enable existing 110mph services to run at 125mph on sections of the WCML. Although advantageous, this would not be an improvement in terms of 2020 report because that assumed use of 125mph capable tilt enabled stock.

D.04 Rerouting services

In the 2020 report rerouting of services was not given consideration as a means of providing additional capacity on the fast lines.

In the 2013 Report, however, there is a section on retiming services, which also provides information on the possibility of extra capacity on the Slow Line, including a potential timetable recast. This extract can be found in Section F.03 of this report.

The current WCML timetable structure tries to limit crossing movements where possible keeping the fast services on the fast lines where they have a limited stopping pattern and frequently stopping services and freight services, which are limited to lower speeds, to the slow lines.

Rerouting fast line services onto the slow lines offers no capacity advantage as it would require the services to slow down to cross the junction thereby utilising more fast line capacity. It also increases the interaction with other, currently separated, services and decreases timetable stability.

D.04.01 Industry Planning Group

Network Rail has set up an Industry Planning Group to explore whether a timetable recast would have the potential to deliver further capacity and/or improved performance to offer enhancements to the timetable between now and the start of HS2 operating. This group is formed of representatives from timetable participants and service specifiers.

This group will be exploring whether restructuring the timetable including changing locations for crossing moves and potentially better utilising the slow lines may release capacity on fast lines.

The outputs of this exploratory analysis are not yet known and are due to be reported in early 2021.

D.05 Retiming services

The 2013 report considered a high level recast of the WCML timetable to look at whether this would release additional capacity on the fast lines. It concluded that route capacity on the fast lines would remain at 15 trains per hour. This was based on the theoretical maximum of 20 paths per hour², with two services calling at Watford and three service running at 110mph which reduced this. This is detailed in Section 4.6.5 of the 2013 report, the extract of this is in Figure 4. Note that this is a theoretical quantum which doesn't account for the time taken for a train calling at Watford to decelerate to stop at the station or accelerate after stopping at the station.

In the May 2020 timetable, there are 13 services in both the Down direction and Up direction. These take up 14 paths in each direction, due to speed differences.

D.05.01 Industry Planning Group

The primary aim of the Industry Planning Group study is to determine if re-structuring the timetable shows there is an opportunity to deliver a combination of additional capacity and improved performance on the WCML.

The outputs of this exploratory analysis are not yet known and are due to be reported in early 2021.

² 60 minutes divided by a 3 minute headway gives a theoretical maximum of 20 services per hour.

D.06 Speed alterations

The Fast Lines comprise of a mixture of 125mph paths, 110mph paths and 100mph paths. This heterogeneity of paths constrains capacity south of Rugby. This is expected to be a constraint in future timetables, which may be resolved with the addition of new rolling stock, but it remains a constraint for at least the short term.

Figure 3 demonstrates the difference in journey time from London Euston to Milton Keynes Central between a 125mph capable service and a 110mph capable service. Both pairs of orange and blue bands represent 125mph paths and their 3 minute headway behind them; they are departing London Euston 9 minutes apart in each case.

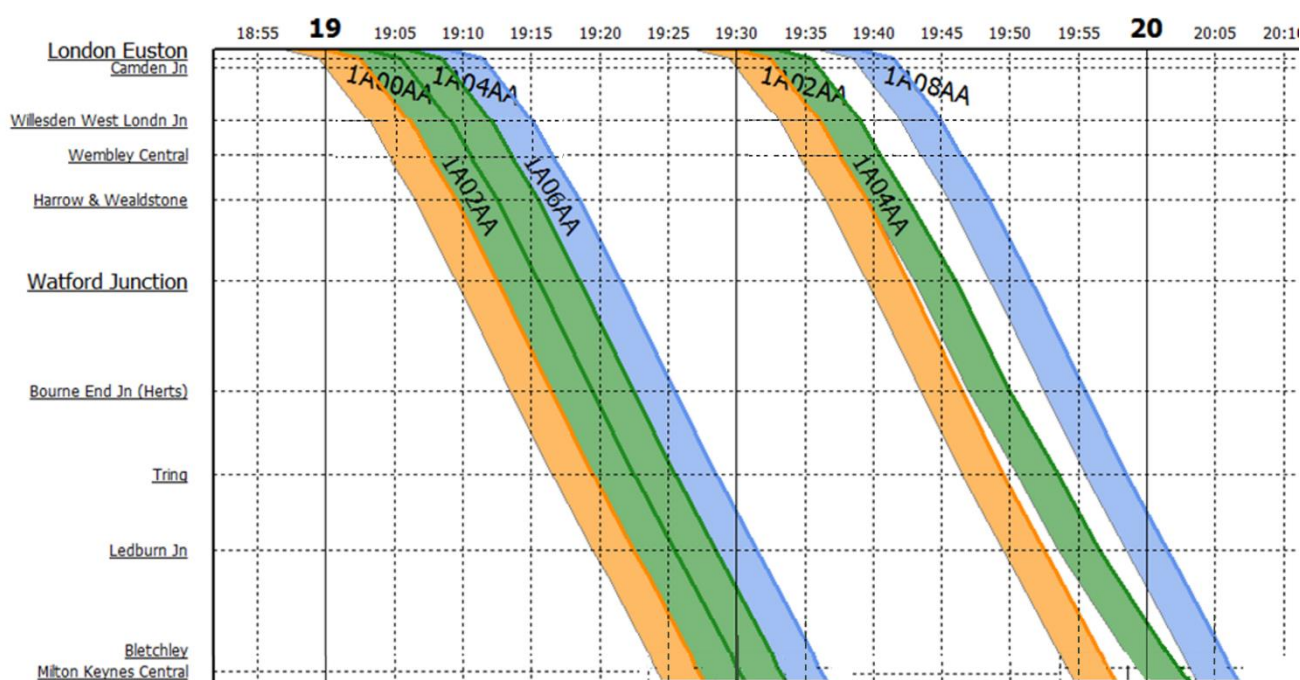


Figure 3: Graph showing the difference in journey time and path utilisation of a 110mph capable rolling stock compared to that of a 125mph capable rolling stock, between London Euston and Milton Keynes Central

The pair of green bands on the left-hand graph show two 125mph paths departing on and travelling at the three minute minimum headway between the orange and blue services. Since all four services on the left-hand graph have the same maximum speed, they arrive at Milton Keynes Central in the same time.

The single green band on the right-hand graph shows a 110mph path departing London Euston 3 minutes (the minimum headway of three minutes) after the 125mph orange train and shows that by the time it has reached Milton Keynes Central the 125mph blue train has caught up with

it. In effect, the 110mph path requires the capacity of two 125mph paths for the journey from London Euston to Milton Keynes Central.

- The greater the distance travelled, the more likely a 125mph capable rolling stock would be required for a TPR compliant path. This is due to the 110mph paths utilising more capacity – in effect, the greater the distance covered, multiple 125mph paths are required to run one 110mph path.
- Capacity is most efficiently utilised either with all paths comprising rolling stock of the same capabilities or by flighting services to increase capacity in the event that paths are using differing rolling stock with differing capabilities.

In the case of the departures to Milton Keynes Central from London Euston that were identified, either 125mph or 110mph capable rolling stock was found to have a TPR compliant path. Running at 110mph would require a train service to depart approximately 3 minutes earlier than a 125mph service from London Euston but the paths would merge to pass Ledburn Junction at the same time.

For this reason, the overall difference between 125mph or 110mph rolling stock was very small in terms of specific paths identified in the WCML Congested Infrastructure 2020 report. However, a 125mph path increases overall train capacity, and offers greater timetable robustness and better performance as it would be better able to recover from delay.

D.06.01 Grand Central Sensitivity

Since the publication of the congested infrastructure notification, Grand Central announced in September 2020 that they have withdrawn their plans to run a Blackpool North – London Euston service after Covid-19 rendered plans ‘unfeasible’³. This would remove five weekday services on the fast lines in each direction (minus the contingent rights for one of these services in the down direction on a Wednesday due to the New Measurement Train).

Network Rail undertook a high level evaluation to see if these 110mph paths could be repurposed to provide any more capacity along the section of congested infrastructure.

As expected, the results match the findings in Figure 3 in that it is possible to compliantly timetable two paths at 125mph in the Grand Central 110mph path between Camden Junction and Ledburn Junction in the Down direction. This does increase the number of trains which are consecutively running on minimum headway margins which would therefore impact on the timetable resilience.

This additional Down direction path could be timetabled compliantly to Milton Keynes Central, but it then wasn’t possible to timetable an additional path from Rugby further north.

³ <https://www.grandcentralrail.com/news/2020/grand-centrals-planned-blackpool-london-route-falls-victim-covid-19/>

It also wasn't possible to accommodate two paths at 125mph in the Up direction as there was no additional capacity at Watford Junction to accommodate the second path.

Therefore, the removal of the Grand Central London Euston to Blackpool services would enable a service to replace it like-for-like but does not generate any additional capacity.

No analysis has taken place to determine whether any of the live access proposals for additional services would be suitable to run in the place of the Grand Central services.

Part E: Conclusion

An increase in the quantum of trains running on the fast lines between Camden South Junction and Ledburn Junction cannot be achieved to a point that would satisfy all the fast line access proposals for additional services.

In the short term the withdrawal of the Grand Central London Euston to Blackpool services would enable an alternative service to run in its place at either 110mph or 125mph but would not facilitate the running of two services (at 125mph) in the capacity generated by the removal of the Grand Central Service.

No analysis has taken place to determine whether any of the live access proposals for additional services would be suitable to run in the place of the Grand Central services.

To evaluate the medium-term solutions the WCML IPG are looking at whether a timetable recast would have the potential to deliver further capacity and/or improved performance to offer enhancements to the timetable between now and the start of HS2 operating.

Long term the operation of the separate HS2 network will remove some current fast lines services from the existing WCML South network and allow for other services to use the existing infrastructure.

Part F: Appendix

F.01 Infrastructure Improvements

Enhancement Scheme	Completion Date	Delivered?	Capacity Impact
Power upgrade between North Wembley – Whitmore (between Norton Bridge – Crewe) and between Whitmore – Great Strickland (between Tebay – Penrith)	Phase 3A in July 14. Phase 3B in Dec 15.	No	Supports an increase from 12 electric FL paths per hour to 15 between North Wembley and Whitmore.
Procurement of additional 10 x class 350 by WMT capable of 110mph operation	By Dec/14 Timetable	Yes	Delivered during 2014. Enables additional 110mph services and strengthening of existing services.
East West Rail	2024	No	Additional services running between Bletchley and Milton Keynes on the SL. Any additional WCML services planned on the SL at Milton Keynes but join the FL further south (e.g. Ledburn Junction) could conflict with the paths that have been identified for East West Rail services.
Reduction in number of platforms at Euston from 18 to 16	2019	Yes	Limits platform availability, particularly in morning peak.

F.02 2013 Report WCML ESG Considerations:

2013 identified future consideration	Still valid from May 2020?
An increase in the number of strategic slots for freight.	Yes
Postal Services.	Yes
Cross Country services to/from the South Coast routed via Coventry.	Valid – unlikely to occur until post-HS2
Accelerated Anglo-Scottish services.	Valid, but uncertain level of acceleration
Potential for issues with WMT units needing to go to Northampton to have their tanks emptied. Unknown start date.	Yes
Potential impact of revised WMT resource plan from May 20 Timetable.	Yes

F.03 Extract from 2013 report looking at retiming services

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.

Figure 4: Extract from the 131022 Final ORR Stage 3 WCML TP Report 1_1_1 sections 4.6.1 to 4.6.6

F.04 Down Fast Line Paths

Time	Euston to	Stops south of Rugby	Notes	FL path number	Max speed
xx:00	Manchester	None		1	125
xx:03	Birmingham	Rugby		2	125
xx:07	Liverpool	None		3	125
xx:10	Chester/North Wales	Milton Keynes Central		4	125
xx:15	Liverpool	Leighton Buzzard (SL), Bletchley (SL), Milton Keynes Central (SL), Wolverton (SL), Northampton, Rugby	FL to Ledburn Jn then SL via Northampton This path terminated at Birmingham in the timetable used by the 2013 report	5	110
xx:20	Manchester	Milton Keynes Central		6	125
xx:23	Birmingham	Watford Junction	This path terminated at Wolverhampton in the timetable used by the 2013 report	7	125
xx:30	Glasgow	None		8	125
xx:33/ xx:36	Blackpool	Milton Keynes Central (GC services only)	Run in different hours by Avanti West Coast and GC trains Does not operate in all hours from 10:00 to 16:00	9	110/ 125
xx:40	Manchester	None	via Crewe	10	125
xx:43	Edinburgh/Glasgow via Birmingham	Milton Keynes Central	Terminates at Edinburgh and Glasgow in alternate hours	11	125
xx:46	Crewe	Milton Keynes Central, Rugby		12	110

Time	Euston to	Stops south of Rugby	Notes	FL path number	Max speed
xx:49	Liverpool	Watford Junction, Milton Keynes Central	SL via Northampton north of Milton Keynes Central Terminated at Birmingham in the timetable used by the 2013 report	13	110

F.05 Up Fast Line Paths

Time	Arrive Euston From	Stops south of Rugby	Notes	FL path number	Max Speed
xx:02	Manchester	None		1	125
xx:10	Glasgow	None		2	125
xx:14	Birmingham	None		3	125
xx:21	Manchester	Milton Keynes Central		4	125
xx:24	Birmingham	Milton Keynes Central, Bletchley (SL), Leighton Buzzard (SL)	SL to Leighton Buzzard then non-stop FL	5	110
xx:31	Liverpool	Long Buckby, Northampton, Milton Keynes central and Watford Junction		6	110
xx:34	Scotland (via Birmingham)	Milton Keynes Central	Terminates at Edinburgh and Glasgow in alternate hours	7	125
xx:37	Chester	Milton Keynes Central		8	125
xx:42	Manchester	None		9	125
xx:49	Blackpool	Milton Keynes Central (GC services only)	Run in different hours by Avanti West Coast and GC trains Does not operate in all	10	110/125

			hours from 10:00 to 16:00		
xx:52	Crewe	Milton Keynes Central		11	110
xx:55	Birmingham	Watford Junction		12	125
xx:59	Liverpool	None		13	125