

Technical Note

Implications of EWR Services Using Slow Lines North of Bedford



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1. Introduction

- 1.1 Bedford Borough Council (BBC) requested a technical review of whether future services on East West Rail between Bedford and Cambridge could use the existing slow lines between Bromham Road bridge, just to the north of Bedford station, and the junction where the Midland Main Line and the line to Cambridge would diverge.
- 1.2 The background to this request is that the East West Rail Company (EWR) is considering which route for the Central Section between Bedford and Cambridge should be recommended to ministers. As part of this EWR is assessing the extent of additional infrastructure needed for a route through Bedford Midland. BBC are concerned to ensure that extent of this additional infrastructure is minimised, in order to maximise the performance of the business case for this option.
- 1.3 There are two broad options for EWR infrastructure north of Bedford station. One that provides an additional two tracks from the EWR platforms at the station through to the point of bifurcation from the Midland Main Line; and another that brings the tracks from the EWR platforms to a junction with the Slow Lines just to the south of Bromham Road bridge. EWR services would use the Slow Lines, alongside other traffic, until the junction for Cambridge is reached, some 800m north of the station. The latter option is likely to be cheaper.
- 1.4 This technical note examines, at a high level, the feasibility of this second option from the point of view of line capacity and timetabling.

2. Constraints North of Bedford

- 2.1 The graphic below illustrates the current track and platform arrangements at Bedford. The interaction with the sidings south of the station has been simplified for this presentation.

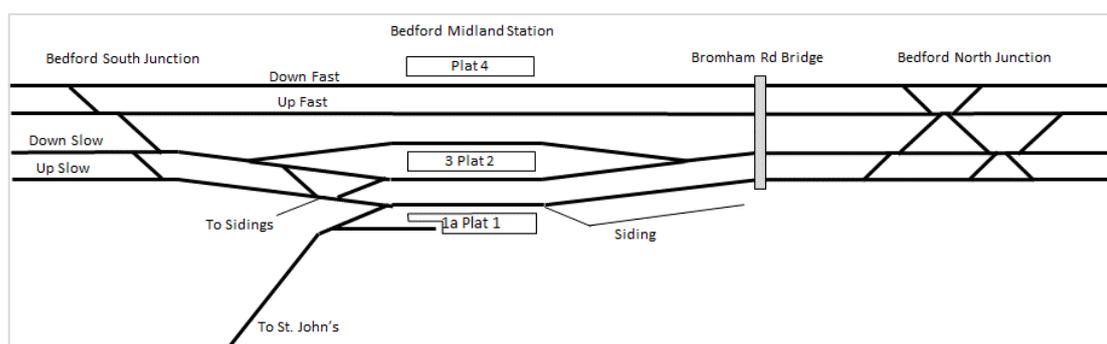


Figure 1 - Current track layout

- 2.2 Services are operated through the station area by East Midlands Railway, GTR (Thameslink), London Northwestern (from Bletchley to platform 1a only) and freight operators.

2.3 **East Midlands Railway (EMR)** operates 5 trains per hour (tph) in each direction between St.Pancras and the East Midlands. This will increase to 6 tph from December 2020 when an additional London-Corby service is introduced. In the Down direction (ie northbound¹) all these services use the Down Fast through platform 4. In the Up Direction (southbound) non-stop trains use the Up Fast. Stopping southbound services approach the Bedford area on the Up Fast, but must then use Bedford North Junction to access platform 1, 2 or 3, before using Bedford South Junction to regain the Up Fast. This move is shown in red on Figure 2. Two services per hour make this move (although this is temporarily suspended in the peak hours). We understand that from December 2020 EMR are still planning for there to be 2 tph stopping services (both from Corby).

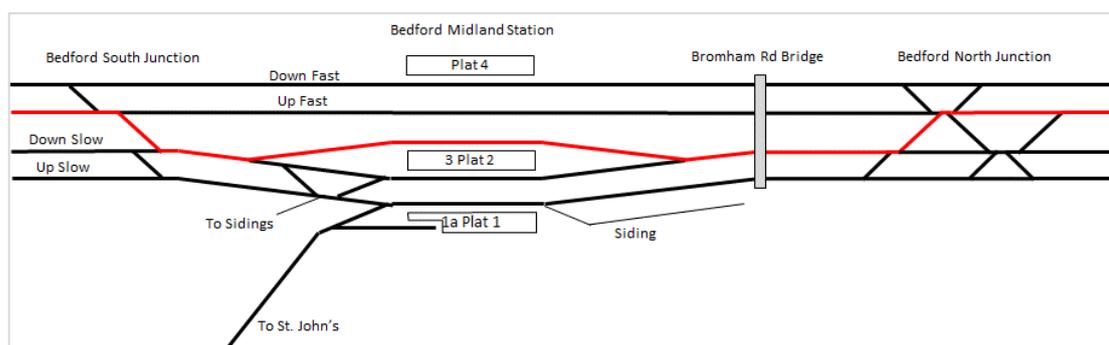


Figure 2 - Service calling at Bedford from the north

- 2.4 **GTR** operates 4 trains per hour in each direction off-peak and up to 8 tph in peak hours, all of which terminate or start from Bedford in platforms 1, 2 or 3.
- 2.5 **Freight** – Most, but not all, freight trains use the Slow Lines through the station. The routing of Up freight trains will depend on which platforms are occupied by Thameslink services. Although most use the Up Slow through platform 1, some use Bedford North Junction to access the Down Slow and pass through platform 2 or 3 before regaining the Up Slow at Bedford South Junction (the pointwork for this is off the left of the diagram at Figure 2. The number of freight trains in the timetable varies significantly throughout the day. In some hours there are no trains, and in others one or two each way, and exceptionally three. For the purpose of this technical note we have assumed that provision needs to be made for 2 freight trains per hour each way. This is shown as the long term requirement in Network Rail’s East Midlands Route Study².
- 2.6 The other key constraints are defined in the industry’s Timetable Planning Rules. These specify the rules that must be used in developing timetables, including the minimum headway (ie the minimum time distance that trains must be timetabled apart), and the time margins that need to be allowed between conflicting moves across junctions and for re-occupation of platforms. The headway through Bedford is 4 minutes, with the exception that two consecutive non-stop trains can have a 3 minute separation. The key rules for our purposes are those governing movements through Bedford North Junction, as shown in Figure 3.

¹ Up is towards London. Down is away from London.

² January 2015, p38

Bedford North Junction		
* Only applies if calling at Bedford		1 except 222
Junction Margins		
First Movement	Second Movement	Margin
All conflicting moves		5 before 3 after
Up Slow(Pfm 1) to Down Slow	Up Slow to Down Slow (Pfm 2) or Up & Down Platform Loop (Pfm 3)	5
Down Slow (Pfm 2) or Up & Down Platform Loop (Pfm 3) to Down Slow	Up Fast to Up Slow (Pfm 1)	5
Down Slow (Pfm 2) or Up & Down Platform Loop (Pfm 3) to Down Fast	Up Fast to Up Fast	6
Down Slow (Pfm 2) or Up & Down Platform Loop (Pfm 3) to Down Fast	Up Fast to Up Slow (Platform 1)	These are not conflicting movements
Converging Headway		
First Movement	Second Movement	Value
Up Slow – Up Fast	Up Fast – Up Fast	3½

Figure 3 - Extract from Timetable Planning Rules

- 2.7 Figure 3 shows that conflicting moves through the junction must be separated by 5 minutes. For example, 1) a train passes through Bedford North Junction on the Down Slow going north at xx00; and 2) a Corby-St.Pancras train making the move shown in Figure 2 cannot do so before xx05.

3. East West Rail Infrastructure Options

- 3.1 The presumption for EWR Central Section route options that go through Bedford Midland is that the line will approach from the south on the east side of the Midland Main Line (MML), and that two additional platforms will be needed on this side of the station. This will necessitate demolition and reconstruction of the station building.
- 3.2 North of Bedford, there are broadly two options. The first of these would involve the construction of two new lines on the east side of the MML from the station until the point where EWR diverges towards Cambridge. This option would ensure that EWR traffic flows are separated completely from flows on the MML. However, it would involve land/property acquisition and a new span for Bromham Road bridge.
- 3.3 The second option, developed by Kilborn Consulting Limited on behalf of BBC, is shown on Figure 4 (on which the layout is simplified at the south end of the station). The technical drawings are included at appendix A.

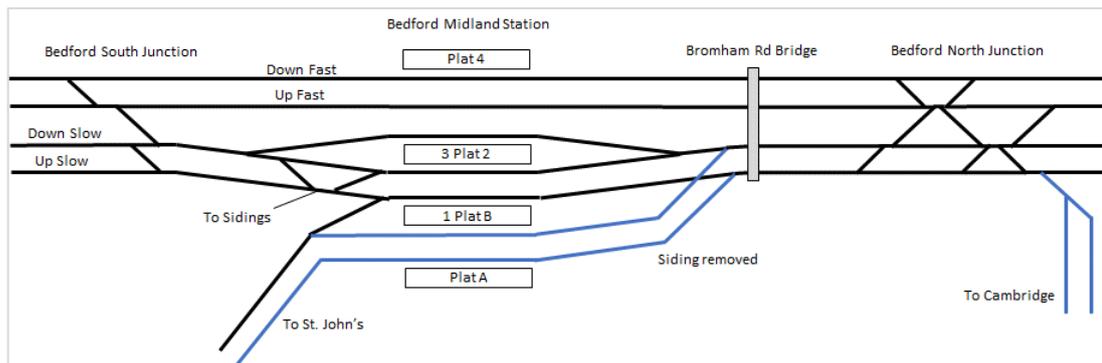


Figure 4 - Option developed for BBC

3.4 This option has a junction between the EWR lines and the MML Slow Lines just to the south of Bromham Road bridge. EWR trains would then use the Slow Lines through Bedford North Junction before diverging as shown toward Cambridge. This option could be significantly cheaper than the first option described above, but is dependent for its feasibility on EWR services being able to fit in with existing and prospective traffic using the MML Slow Lines for a distance of c.800m.

4. Conflicting Moves

4.1 The layout shown in Figure 4 would give rise to the types of conflicting movements shown in Figure 5.

EWR Service	MML Service	Type of Conflict
Eastbound	Up fast line passenger train calling at Bedford	Conflicting – opposite direction move
Eastbound	Up train using Up Slow	Conflicting – opposite direction move
Westbound	Up train using Up Slow	Same direction
Eastbound	Down train using Down Slow	Same direction

Figure 5 - Conflicting movements with BBC option

4.2 Same direction conflicts mean that the two services would need to be timed to be separated by at least the minimum headway of 4 minutes. The movements shown as “conflicting” are shown diagrammatically on Figure 6.

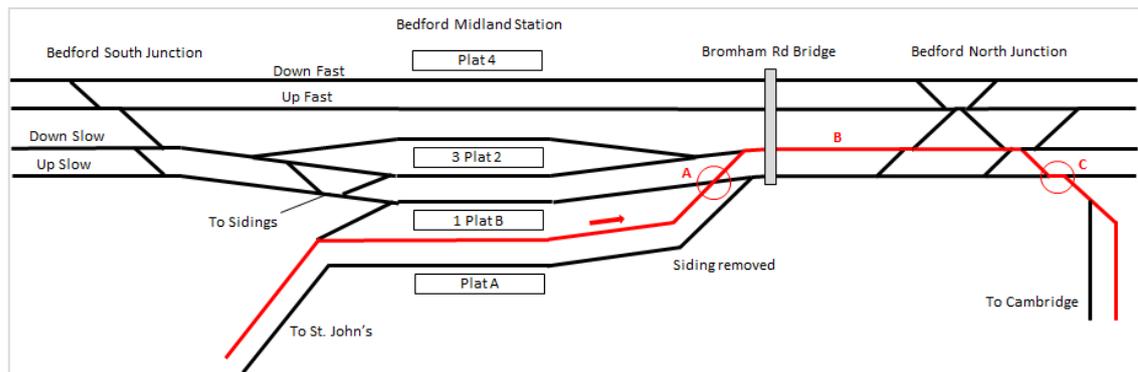


Figure 6 - Representation of conflicting moves with eastbound EWR train

- 4.3 An Up passenger train calling at Bedford (eg Corby-London) would use the same section of track – B – as an eastbound EWR train departing from the station.
- 4.4 An Up train (passenger or freight) approaching Bedford on the Up Slow would conflict at points C and A with an eastbound EWR train departing from the station.
- 4.5 A single-lead junction for Cambridge as shown would create conflicts between eastbound and westbound EWR services on the junction.

5. Analysis

- 5.1 The prospective full EWR timetable (Western and Central sections) has to be made to work at number of capacity “pinch-points” where EWR services will join the existing network. These are:
 - on the southern approaches to Cambridge
 - between Bletchley and Milton Keynes on the West Coast Main Line
 - over the single line between Claydon Junction and Aylesbury
 - on the northern approaches to Oxford
- 5.2 It is therefore important that there is enough flexibility in the timetabling of trains on the rest of the EWR network to allow for limited path availability on these sections. The key question, therefore, is whether the BBC-developed solution will provide sufficient flexibility on the timing of EWR services through Bedford to ensure that this is the case.
- 5.3 In order to assess this, the following process was used:
 - a full weekday timetable for the section between Bedford North Junction and Flitwick was extracted from the Working Timetable³ – this is shown at Appendix B
 - all trains using the Slow Lines north of Bedford Midland station were highlighted

³ The Working Timetable is the industry’s internal, detailed timetable, showing passing times, platforms and lines used. Times are shown to the ½ minute.

- a number of minutes was assigned to each service to represent the time when the line would not be available to be used by EWR
- a percentage of “unavailable” time was then calculated by timeband

5.4 Figure 7 shows minutes assigned for each conflicting move⁴.

EWR Service	MML Service	Minutes	Assumption
Eastbound	Up fast line passenger train calling at Bedford	6	Margin at Bedford North Junction is 5 minutes. However, occupation of track “B” will add another minute.
Eastbound	Up train using Up Slow	6	Margin at Bedford North Junction is 5 minutes. However, another minute added as there are two conflicting points – A and C.
Westbound	Up train using Up Slow	4	Timetable Planning Rules specified headway.
Eastbound	Down train using Down Slow	4	Timetable Planning Rules specified headway.

Figure 7 - Minutes allowed for conflicting moves

5.5 Using these figures, the results in Figure 8 show the number of minutes in the timetable at Appendix B when the line is unavailable for EWR traffic.

Hour of Day	WESTBOUND EWR		EASTBOUND EWR	
	Minutes	%	Minutes	%
0600 to 0700	0	0.0	0	0.0
0700 to 0800	4	6.7	6	10.0
0800 to 0900	8	13.4	12	20.0
0900 to 1000	4	6.7	6	10.0
1000 to 1100	4	6.7	22	36.7
1100 to 1200	4	6.7	26	43.3
1200 to 1300	8	13.4	24	40.0
1300 to 1400	0	0.0	24	40.0
1400 to 1500	0	0.0	20	33.3
1500 to 1600	0	0.0	16	26.7
1600 to 1700	4	6.7	26	43.3
1700 to 1800	4	6.7	22	36.7
1800 to 1900	0	0.0	12	20.0
1900 to 2000	4	6.7	18	30.0
2000 to 2100	0	0.0	16	26.7
2100 to 2200	0	0.0	16	26.7
AVERAGE	3	4.6	17	27.7

Figure 8 - Line unavailability for EWR traffic (2019 weekday timetable)

⁴ Each train carries its own margin only. So, for example, in Figure 3 it shows “5 before, 3 after”, but each margin is attributed to only one train.

- 5.6 Figure 8 illustrates that for westbound EWR traffic the maximum number of minutes in an hour when the line is unavailable is 8 minutes (13%). This reflects 2 freight trains using the Up Slow line.
- 5.7 For Eastbound EWR traffic line availability is less good, but still over 50% in all hours. The 1100 to 1200 and 1600 to 1700 hours have the maximum number of unavailable minutes, at 26. In these particular hour there were 2 Up passenger trains calling at Bedford, 1 freight train using the Up Slow and 2 freight trains using the Down Slow.
- 5.8 If we assume a “standard hour” specification that allows paths for 2 freight trains each way and 2 EMR passenger trains calling at the station, the line unavailability for eastbound EWR traffic would be 32 minutes - ie **53%** (2 x 6 minutes for Up passenger services calling, plus 2 x 6 minutes for Up freight trains, plus 2 x 4 minutes for Down freight trains).
- 5.9 We understand that the EWR service specification is for 4 tph each way between Bedford and Cambridge (2 from Oxford and 2 from Bletchley/Milton Keynes). These would use 16 minutes of a standard hour (4 x 4 minutes headway) out of the 28 minutes available in the standard hour specification.

6. Improving Line Availability

- 6.1 The most important issue with the BBC-developed design, therefore, is line availability for eastbound EWR services. This is because there are 3 points of conflict with MML traffic as shown in Figure 6 (points A, B and C). There are several ways in which the layout could be adjusted to improve line availability without needing to build a 6-track railway through and beyond Bromham Road bridge. Some of these are illustrated on Figure 9.

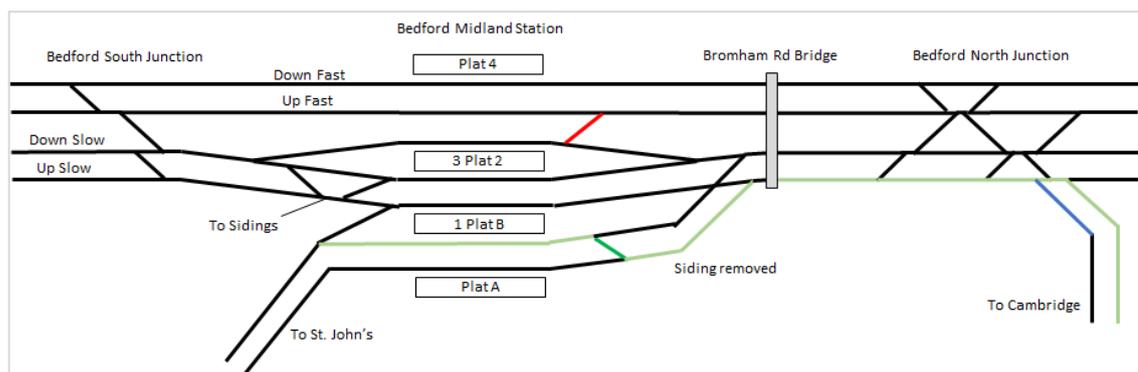


Figure 9 - Possible options for improving line availability

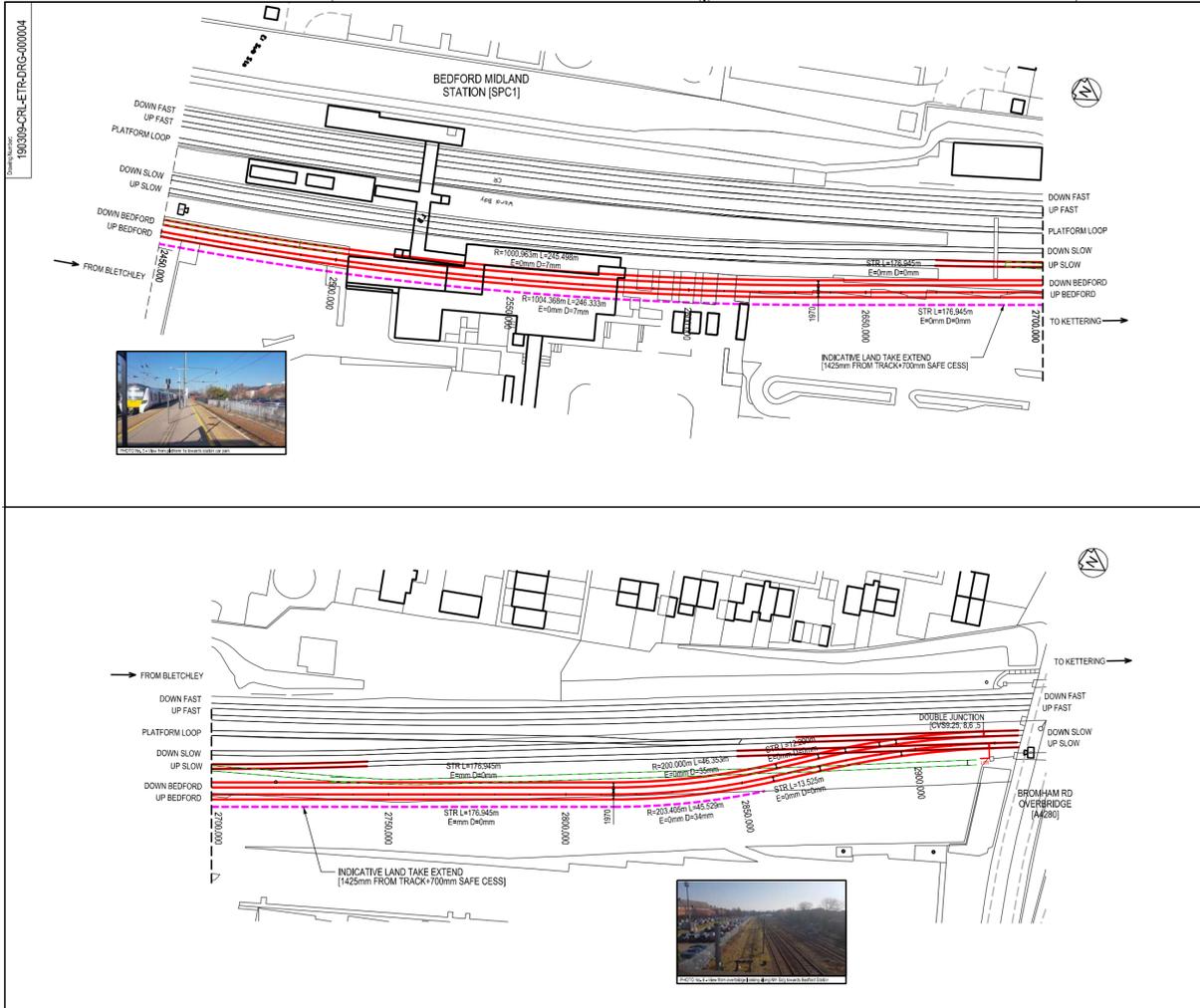
- 6.2 An additional crossover, shown in red on Figure 9, would remove conflicts between eastbound EWR trains and Up passenger trains calling at the station. This would reduce the standard hour 32 minute unavailability for eastbound EWR services described in 5.8 above to just 20 minutes.

- 6.3 An additional crossover, shown in **dark green**, would facilitate an alternative route (shown in **light green**) for eastbound EWR services which would avoid conflicts with services using the Down Slow line.
- 6.4 It would be prudent to consider a double junction rather than a single-lead where the Cambridge line diverges in order to ensure there are no conflicts between westbound and eastbound EWR services. This is shown in **blue**.

7. Conclusions

- 7.1 This note has shown that in the BBC-developed design:
- There are no conflicting moves between westbound EWR services and existing MML services, other than a need to comply with the standard 4 minute headway on the Up Slow line.
 - There are three physical points of conflict between eastbound EWR services and services on MML. In a standard hour (ie assuming 2 x EMR services calling at the station and 2 x freight trains in each direction) these would still provide availability for EWR traffic for 28 minutes in the hour (47%).
- 7.2 Line availability for eastbound EWR services could be improved through the provision of an alternative route for Up passenger trains approaching the station on the Fast Lines before making a station call. This would improve line availability to 40 minutes in the hour (67%).
- 7.3 Additional modifications to the pointwork - shown in Figure 9 - would reduce conflicts further and improve operational resilience. There may be further adjustments which would have the same affect that are not identified in this note. These could be considered further in an optioneering workshop.
- 7.4 Given the interaction between EWR and MML services in the BBC-developed option, we would strongly recommend a double junction where the two lines diverge in order to eliminate any conflicts between eastbound and westbound EWR services.

Appendix A – Technical Drawings for BBC-Developed Option



Appendix B – Working Timetable Extract

See separate Excel file.