

## Capacity Planning

# Midland Main Line: Congested Infrastructure Capacity Analysis Report

### Document Control

**Title:** Midland Main Line: Congested Infrastructure Capacity Analysis

**Version No:** 1.0  
**Status:** Final  
**Authors:** Peter Northfield  
**Version Date:** 24/03/2015  
**Security Level:** Unrestricted

### Authorisation Control

Peter Northfield	Signature	24 March 2015
<b>Project Manager</b>		Date

Matt Rice	Signature	24 March 2015
<b>Operational Planning Manager</b>		Date

Fiona Dolman	Signature	24 March 2015
<b>Head of Capacity Planning</b>		Date

## DOCUMENT CONTROL & ADMINISTRATION

### Change Record

Version	Date	Author(s)	Comments
0.1	19/02/2015	Peter Northfield	First skeleton draft
0.2	20/03/2015	Peter Northfield	Complete draft
1.0	24/03/2015	Peter Northfield	Final

### References

Ref.	Document Name	Doc. Ref. No.	Date	Rev.
1.				
2.				
3.				

### Stakeholders

Name of stakeholder	Company / Business
Graham Botham, Principal Strategic Planner LNE&EM	Network Rail
Keith Merritt, Train Service Planning & Access Manager	Rail Executive, Department for Transport

## Glossary

Term	Meaning
Class 4	Freight train, maximum speed 75mph
Class 6	Freight train, maximum speed 60mph
CP5	Control Period 5 (2014 – 2019)
ECML	East coast main line
EMT	East Midlands Trains
EWD	Every week day (i.e. Mondays to Saturdays)
FO	Fridays only
FSX	Fridays and Saturdays excepted (i.e. Mondays to Thursdays)
GBRf	GB Railfreight
GTR	GoVia Thameslink Railway
Jn	Junction
MML	Midland main line
MO	Mondays only
mph	Miles per hour
QJ	Designation code for path specified in the strategic capacity statement
MSX	Mondays and Saturdays excepted (i.e. Tuesdays to Fridays)
Regulation	One of the regulations within the Railways Infrastructure (Access and Management) Regulations 2005 as amended
SX	Saturdays excepted (i.e. Mondays to Fridays)
tph	Trains per hour
WCML	West coast main line

## CONTENTS

<b>EXECUTIVE SUMMARY .....</b>	<b>5</b>
<b>INTRODUCTION.....</b>	<b>6</b>
1.1 REASONS FOR THE ANALYSIS .....	6
1.2 SCOPE AND STRUCTURE OF THE REPORT .....	6
<b>2 REASONS FOR THE CONGESTION.....</b>	<b>7</b>
2.1 METHOD.....	7
2.2 CRICKLEWOOD TO BEDFORD.....	7
2.3 BEDFORD TO KETTERING .....	8
2.4 KETTERING TO LEICESTER .....	9
2.5 KETTERING TO MANTON.....	9
2.6 MANTON TO LEICESTER .....	10
2.7 EFFECT OF COMBINING THE CONSTRAINTS .....	10
2.8 CONCLUSIONS .....	12
<b>3 POTENTIAL MEASURES TO ALLEVIATE THE CONGESTION .....</b>	<b>13</b>
3.1 PRINCIPLES .....	13
3.2 RE-ROUTING OF SERVICES .....	13
3.3 RE-TIMING OF SERVICES.....	14
3.4 ALTERATIONS TO LINE-SPEED.....	15
3.5 INFRASTRUCTURE IMPROVEMENTS.....	16
3.6 CONCLUSIONS .....	17
<b>4 NEXT STEPS .....</b>	<b>18</b>
4.1 CAPACITY ENHANCEMENT PLAN .....	18
<b>APPENDIX A.....</b>	<b>19</b>
ROUTE DIAGRAMS .....	19
<b>APPENDIX B.....</b>	<b>21</b>
TRAIN GRAPHS.....	21
<b>APPENDIX C.....</b>	<b>25</b>
SOUTHBOUND FREIGHT PATHS AT BEDFORD.....	25
<b>APPENDIX D.....</b>	<b>27</b>
SLOW LINE SHARNBROOK - KETTERING .....	27
<b>APPENDIX E.....</b>	<b>30</b>
KETTERING - KILBY BRIDGE .....	30
<b>APPENDIX F .....</b>	<b>31</b>
SINGLE LINE KETTERING - CORBY .....	31
<b>APPENDIX G .....</b>	<b>32</b>
MANTON - SYSTON.....	32

## Executive Summary

The Railways Infrastructure (Access & Management) Regulations require that, when Network Rail is unable to adequately satisfy requests for access to the infrastructure, it must declare the relevant part of the infrastructure to be congested. Following such a declaration, Network Rail must complete a capacity analysis to identify the reasons for the congestion and potential short- or medium-term measures to address the congestion. This report contains the results of this analysis for the Midland Main Line between Cricklewood and Leicester via both Market Harborough and Corby, following the declaration made on 24 September 2014.

The congestion on this route is caused by a combination of factors. Limited capacity can be found on each section of the infrastructure, but given the current use and limitations of the infrastructure, these different elements of capacity cannot be joined up in a way that would produce a path that adequately satisfies the original request for access.

One theme to emerge from this analysis is the difficulty of accommodating significant speed differentials on this mixed traffic main line. Although there are fewer sections of this route available for operation at over 100 mph than on the West Coast or East Coast main lines, and there are fewer fast passenger services each hour than on those routes, this must be set against a majority of freight trains conveying heavier, slower Class 6 aggregates traffic rather than lighter, faster Class 4 intermodal traffic. As a consequence, there are limited opportunities to use the Fast lines for freight services, whether between Sharnbrook Jn and Kettering or between Kettering and Leicester.

A second theme is the significant capacity taken by the use of the reversible Slow line between Bedford and Kettering for traffic in both directions. Similarly, the relatively short Kettering – Corby single line loses half its capacity to the hourly out-and-back passenger service. These constraints on Slow line capacity mean that the short double-track section at Kettering station is used for passing services, so there are occasions when a path can be found on the reversible Slow line south of Kettering but it cannot be extended through Kettering station.

The potential solutions considered in sections 3.2 – 3.4 all involve disadvantaging some of the current users of the route. If services are diverted onto other routes then journey times will be increased. If the line-speed is reduced then journey times will be increased. If services are re-timed then operators will face additional costs and passengers will see a less regular service pattern, increasing their generalised journey time.

Only infrastructure improvements could provide capacity for additional services without adversely impacting demand in one or more of the markets currently served by this route. The infrastructure constraints identified as priorities for investment in this report will be taken forward in the capacity enhancement plan which Network Rail must now produce by 24 September 2015.

## INTRODUCTION

### 1.1 Reasons for the analysis

- 1.1.1 The Railways Infrastructure (Access & Management) Regulations require that, when Network Rail is unable adequately to satisfy requests for access to the infrastructure, it must declare the relevant part of the infrastructure to be congested. This should be done after “co-ordination” of requests for access, which Network Rail interprets to mean consideration within the bi-annual timetable planning cycle. Following such a declaration, Network Rail must complete a capacity analysis to identify the reasons for the congestion and potential short- or medium-term measures to address the congestion.
- 1.1.2 In May 2014, freight operator GB Railfreight submitted a train operator variation request to operate a train 6C99 on Mondays to Fridays from Leicester Humberstone Road to Cricklewood North End siding, departing between 0200 and 1800 with a journey time of up to approximately 6 hours. Network Rail was unable to accommodate this request, or to offer an acceptable alternative. After consideration of the likely result of the next timetable planning cycle (for May 2015), but without waiting for completion of that cycle, Network Rail decided to declare the infrastructure as congested, under Regulation 23(2) where it considers the infrastructure is likely to become congested during the next working timetable period. This declaration was made on 24 September 2014, and applies to infrastructure between Cricklewood and Leicester inclusive, via both Market Harborough and Corby.
- 1.1.3 Consequently, Network Rail was required to complete a capacity analysis of the congested infrastructure within 6 months, i.e. by 24 March 2015. This report contains the results of that analysis.

### 1.2 Scope and structure of the report

- 1.2.1 Regulation 24 sets out the requirements for the capacity analysis.
- 1.2.2 The analysis must first identify the reasons for the congestion, considering the characteristics of the infrastructure, the operating practices used, and the characteristics of the different train services that have been allocated capacity to operate on the infrastructure. The results of this analysis are presented in section 2 of this report.
- 1.2.3 Secondly, the analysis must identify measures to alleviate congestion in the short and medium term, particularly considering re-routing of services, re-timing of services, alterations to the line-speed, and infrastructure improvements. The results of this analysis are presented in section 3 of this report.

## 2 Reasons for the congestion

### 2.1 Method

- 2.1.1 The affected infrastructure has been divided into five geographical sections for the purposes of this analysis. The sections were defined according to the capacity and operating characteristics of the infrastructure and train services. Appendix A contains a simple diagram of this infrastructure for reference.
- 2.1.2 Each section is analysed in turn, identifying reasons for the congestion with reference to the three elements required by the regulations, i.e. the characteristics of the infrastructure, the operating practices used on the infrastructure, and the characteristics of the train services allocated capacity to operate on the infrastructure.
- 2.1.3 Section 2.7 identifies how the different constraints interact to limit capacity on the route as a whole. Conclusions are then drawn in section 2.8.
- 2.1.4 It should be emphasised that for the purposes of this analysis, “the congestion” is taken to mean Network Rail’s inability to accommodate the access requested by GBRf as described in section 1.1.
- 2.1.5 The analysis considers only Mondays to Fridays (SX) because the access request that could not be accommodated was for those days.

### 2.2 Cricklewood to Bedford

- 2.2.1 This section of the Midland Main Line has four tracks throughout, arranged in pairs as Fast lines and Slow lines. The planning headway is 4 minutes on all lines, although this may be reduced to 3 minutes for no more than two successive non-stop services.
- 2.2.2 The off-peak service pattern is based on a repeating hourly cycle with East Midlands Trains services on the Fast Lines and GoVia Thameslink Railway services on all lines. The timetable is structured around where and when GTR services weave between Fast and Slow lines: in general the longer distance GTR services occupy the Fast Lines as they overtake shorter distance stopping services; but to access the low level platforms at St Pancras they have to be on the Slow Lines at Kentish Town.
- 2.2.3 This structure produces two paths an hour in each direction for freight trains, suitable for Class 4 or 6 subject to a maximum load. During the morning commuter peak (in the Up direction only) no freight paths are available because of the enhanced passenger service and restrictions in the timetable planning rules.
- 2.2.4 The use of these standard freight paths in the Up direction is set out in appendix C, based on times passing Bedford. The first available path after the morning peak period is at 0858 passing Bedford. From this time until 2300 there are 28 paths available of which only 13 are used (counting 6O41

as unused because it is a 'QJ' strategic path) – these are set out in appendix C.

- 2.2.5 Engineering access patterns mean that overnight services are timed to use the Slow lines only, as either the Slow or the Fast lines may be under possession. During this period between 2300 and 0600, 11 Up direction freight paths are used.
- 2.2.6 On the basis of this analysis, this section of the route is not a significant reason for the congestion.

## **2.3 Bedford to Kettering**

- 2.3.1 The Fast lines remain double track throughout this section, with 4½ minute planning headways. The Slow lines are double track between Bedford and Sharnbrook Jn, then single track reversible to Kettering South Jn but with access via a Down direction Fast to Slow ladder at Wellingborough North Jn, an Up direction Fast to Slow ladder at Harrowden Jn and a Down direction Fast to Slow ladder at Kettering South Jn. Planning headways are 5 minutes on the Slow lines south of Sharnbrook Jn and 13 minutes on the reversible section, although this may be reduced to 8 minutes between successive Up direction services only.
- 2.3.2 On the Fast lines, the standard off-peak pattern has 5 EMT services in each direction. These are necessarily spaced more widely than south of Bedford (because of calling patterns) but there is sufficient interval to accommodate some lightweight freight services. This is generally only used in the Down direction, because the majority of freight services are aggregates traffic which is loaded southbound and empty northbound. Up freight services and heavier Down services have to use the Slow lines except when there are fewer passenger services at the beginning and end of the day.
- 2.3.3 Engineering access patterns mean that overnight services are timed to use the Slow lines only, as either the Slow or the Fast lines may be under possession.
- 2.3.4 South of Sharnbrook there is surplus capacity on the double track section of the Slow lines. However, most of this traffic has to use the reversible single line, so its utilisation is high. This is worsened by the crossing moves north of Wellingborough station for EMT services to/from Corby, which use the Slow lines through Kettering, and for freight traffic to/from Wellingborough Up Sidings. Appendix D shows occupation of the reversible Slow line between Sharnbrook Jn and Kettering South Jn.
- 2.3.5 It can be seen that there is some capacity remaining available over this section of the route, particularly when unused paths are excluded, but it is heavily constrained by (i) the bidirectional use of the reversible Slow line, and (ii) crossing movements at the junctions between Wellingborough and Kettering. On this evidence, this section of the route can be identified as a significant contributory cause of the congestion.



## 2.4 Kettering to Leicester

- 2.4.1 This section of the route is predominantly double track. The Slow lines at Kettering revert to a reversible single line north of the station then diverge towards Corby at Kettering North Jn: this section of the route is considered in section 2.5. South of Leicester, there is a reversible Slow line between Kilby Bridge Jn and Wigston North Jn, then the route reverts to double track until Leicester South Jn. Use of the Wigston – Leicester section is particularly heavy because EMT and freight services heading north or south share the route with CrossCountry and other freight services heading east or west.
- 2.4.2 The primary constraint on freight capacity on this section of route is the spacing of EMT passenger services (4 in each direction in a standard hour), and the speed differential between them and the slower freight trains. A typical Up direction Class 6 freight train takes 38 minutes non-stop between Leicester South Jn and Kettering North Jn. Adding the planning headway of 4½ minutes, this margin is not available in the standard hour pattern, although it is occasionally available at either end of the day.
- 2.4.3 Southbound freight trains therefore must use the reversible Slow line between Wigston North Jn and Kilby Bridge Jn, which is also used by northbound freight services. This is a further constraint on the availability of southbound freight paths on this part of the route, as indicated in appendix E.
- 2.4.4 On the basis of this evidence, the combination of the passenger service pattern, speed differentials between passenger and freight services, and the long double-track section with no passing facility between Kettering North Jn and Kilby Bridge Jn, taken together are a contributory cause of the congestion.

## 2.5 Kettering to Manton

- 2.5.1 There is a reversible single Slow line between Kettering station and Kettering North Jn, accessed there by an Up direction Fast to Slow ladder. The line to Corby is also reversible single, which returns to double track at Corby North Jn, so Corby station is sited on the single line. The line between Corby North Jn and Manton Jn is double track, signalled by Absolute Block.
- 2.5.2 There are only occasional passenger trains north of Corby, but the standard hourly EMT London – Corby service turns round in the platform at Corby and so occupies the single line for a minimum of 25 minutes every hour. Occupation of the single line is shown in appendix F.
- 2.5.3 On the basis of this evidence, the intensive use of the single line section between Kettering and Corby North Jn is a contributory cause of the congestion.

## 2.6 Manton to Leicester

- 2.6.1 Between Manton Jn and Syston Jn the route is double track with passing loops at Oakham (Up), Langham (Down) and Melton Mowbray (both directions). From Syston to Leicester there is a reversible Slow line as well as the Up and Down Fast lines. The junction at Syston is a triangle: the north side is double track but the south chord (from the Manton direction towards Leicester) is single. The signalling between Manton Jn and Syston Jn is Absolute Block.
- 2.6.2 Between 0600 and 2200 there is an hourly CrossCountry service in each direction. There are between 2 and 4 freight services in each direction each hour, which are a mix of Class 4 and Class 6, and occasionally an additional passenger service of CrossCountry or EMT.
- 2.6.3 Appendix G shows the quantum of passenger and freight paths each hour. It can be seen that the combined maximum is 5 tph, but this is only used in five hours out of 24.
- 2.6.4 On the basis of this analysis, this section of the route is not a significant reason for the congestion.

## 2.7 Effect of combining the constraints

- 2.7.1 The preceding sections identify available capacity on each part of the infrastructure. This section sets out the constraints encountered when trying to use the available southbound freight capacity between Bedford and Cricklewood, as identified in section 2.2 and appendix C, for traffic from Leicester.
- 2.7.2 The following table considers each unused Up direction freight path between 0600 and 2300 (times shown are passing Bedford):

Path	Analysis
0958	Path taken on reversible Slow line by 6D32 Down direction
1058	6O41 QJ Kettering to Dollands Moor strategic path. Path taken north of Kettering: via Market Harborough by 1C27 Up direction; via Corby by 1M16 Down direction on single line
1158	Path taken north of Kettering: via Market Harborough by 1C30 and 1B31 Up direction; via Corby by 5M17 Down direction on single line
1358	Path taken on reversible Slow line by 6M09/6E69 Down direction
1428	Path taken on reversible Slow line by 6M53 Down direction
1458	Path taken on reversible Slow line by 6D31 Down direction (unused path) and blocked at Kettering by 6M09/6E69 Down direction overtaking 6M53 Down direction

1528	Path taken on reversible Slow line by 6M54, 6M31 and 6M11 Down direction
1558	Path taken on reversible Slow line by 6M10 and 6M31/6M11 Down direction
1633	Path taken on reversible Slow line by 6M79 Down direction
1658	Path taken on reversible Slow line by 6M22 Down direction
1858	Path taken at Kettering by 1M56 Down direction passing 1P69 Up direction
1928	Path taken on reversible Slow line by 1M61 Down direction
2001	Path taken on reversible Slow line by 6F50 Down direction (QJ path) and blocked at Kettering by 1M61 Down direction passing 1P74 and 6V08/6M19 Up direction
2058	Path taken at Kettering by 1M66 Down direction passing 1P79 Up direction
2257	Path taken north of Kettering: via Market Harborough by 1C87 and 1B89 Up direction; via Corby by 1M76 Down direction on single line.

2.7.3 Between 2300 and 0600, freight paths are available south of Bedford but constraints remain between Bedford and Leicester due to the patterns of engineering access. Use of the available capacity is considered in the table below, by reference to the southbound paths identified in appendix C.

Between trains at Bedford	Analysis
6E09 and 3Q10	No path south of Bedford: taken by GTR empty stock
3Q10 and 7O54	Path could leave Humberstone Road approx. 2350, adjacent to 6L59 Up direction over reversible Slow line between 1D91 and 1F89 Down direction
7O54 and 6V91	Potentially one path, depending on variations in planned services
6V91 and 6O05	No path between these trains north of Bedford
6O05 and 6L25	Path could leave Kilby Bridge Jn approx. 0200 but unlikely to succeed Leicester – Wigston North Jn
6L25 and 6E25	No path between these trains
6E25 and 6V48	Path taken by 6D28/6D33 Down direction on reversible Slow line
6V48 and 6M85	No path between these trains

6M85 and 6V76	No path between these trains
6V76 and 6C37	No path south of Bedford: taken by GTR empty stock

## 2.8 Conclusions

- 2.8.1 The congestion on this route is caused by a combination of factors. Limited capacity can be found on each section of the infrastructure, but given the current use and limitations of the infrastructure, these different elements of capacity cannot be joined up in a way that would produce a path that adequately satisfies the original request for access.
- 2.8.2 One theme to emerge from this analysis is the difficulty of accommodating significant speed differentials on this mixed traffic main line. Although there are fewer sections of this route available for operation at over 100 mph than on the West Coast or East Coast main lines, and there are fewer fast passenger services each hour than on those routes, this must be set against a majority of freight trains conveying heavier, slower Class 6 aggregates traffic rather than lighter, faster Class 4 intermodal traffic.
- 2.8.3 As a consequence, there are limited opportunities to use the Fast lines for freight services, whether between Sharnbrook Jn and Kettering or between Kettering and Leicester.
- 2.8.4 A second theme is the significant capacity taken by the use of the reversible Slow line between Bedford and Kettering for traffic in both directions. There is broad, though not exclusive, use of the reversible Slow line between Sharnbrook and Kettering for Up trains in the morning and Down trains in the afternoon, which improves overall utilisation but means that it is nearly impossible to find an additional path against the prevailing flow. Similarly, the relatively short Kettering – Corby single line loses almost half its capacity to the hourly out-and-back passenger service.
- 2.8.5 These constraints on Slow line capacity mean that the short double-track section at Kettering station is used for passing services 22 times a day (not to a regular pattern), so there are occasions when a path can be found on the reversible Slow line south of Kettering but it cannot be extended through Kettering station.

### **3 Potential measures to alleviate the congestion**

#### **3.1 Principles**

- 3.1.1 This section considers potential measures to alleviate the congestion. It is informed by the analysis set out in section 2 and in the appendices.
- 3.1.2 The consideration of these measures is not constrained by Network Rail's current contractual commitments, nor by any contractual commitments entered into by timetable participants. It is quite possible that the congestion may to some extent be due to a timetable pattern that results from Network Rail honouring its multiple commitments, and in the medium term many of the contracts could be varied. The analysis does, however, consider the impacts of each of the four potential measures (specified in Regulation 24) on the services currently provided over this infrastructure.

#### **3.2 Re-routing of services**

- 3.2.1 The main alternative route for services on the Midland Main Line has been included within the infrastructure declared as congested: the route from Kettering to Syston via Corby and Manton Jn. The analysis in section 2 identified the single line between Kettering and Corby North Jn as a significant capacity constraint, so it is not considered practical to divert any services away from the Market Harborough route onto the Corby route.
- 3.2.2 The nearest parallel railways to the MML are the East Coast and West Coast main lines. Passenger and freight diversions onto each of these alternative routes are considered in the following paragraphs.
- 3.2.3 For passenger services, it would be possible to reach Leicester from London on the ECML via Peterborough without reversing, but at the cost of a much extended journey time and a reversal at Leicester if they were to continue to serve destinations further north. In each off-peak hour Two EMT services each way operate non-stop between London and Leicester and so could be diverted onto this route. However, there is unlikely to be suitable capacity at King's Cross or on the southern part of the ECML, and of course the reason that these services run non-stop south of Leicester is because journey time is important to the markets they serve. Assuming capacity could be found on the ECML for these services, their journey time between London and Leicester would be extended by at least an hour. This is therefore not considered a practical solution. The WCML would be equally unattractive, requiring a reversal at Birmingham or on the main line north of Nuneaton. Even if suitable capacity was available, which is unlikely, this would again significantly extend journey times. This is not considered a practical solution.
- 3.2.4 At first sight, freight traffic is more suitable for diversion as it does not usually serve intermediate markets. However, there are reasons why aggregates traffic is concentrated on the MML: the geographical location of the terminals

(Peak District and East Midlands quarries) and the relatively low speed of the trains. As with passenger traffic, suitable capacity is unlikely to be available on the ECML or WCML, although it might be possible to accommodate one or two paths per day the congestion on the MML. Routeing to the ECML would be much easier than the WCML, as southbound traffic could run from Syston via Peterborough without reversal. However, the southern ECML is more constrained than the WCML, principally by the double-track section between Peterborough and Huntingdon. Routeing in London (for example via the North London Line) to access the aggregates terminals would also be complex and likely to require standing time waiting for an available slot on the orbital routes. In summary, although it might be possible to find capacity for a very small number of diversions, this would be at the cost of longer transit times and consequently higher resource cost for operators.

- 3.2.5 There is very little surplus capacity on the main lines heading north from London: this fact is central to the case for investment in High Speed 2. It is unsurprising to conclude that diversions from the MML to the ECML or WCML could only make a marginal difference to MML capacity and would cause significant disbenefits to customers of the diverted service.

### 3.3 Re-timing of services

- 3.3.1 Trains could be re-timed to take up less capacity on the existing infrastructure, creating additional paths.
- 3.3.2 Appendix D shows that a large amount of capacity is used whenever Up and Down trains alternate over the reversible Slow line. One measure that could be taken is to make the *de facto* 'tidal flow' arrangement more rigid, so that only Up trains could use this line in the morning, and only Down trains in the afternoon. This would require 6D32 (northbound) to be re-timed from the morning to the afternoon, and 1O07, 6V08/6M19 and 6E10 (southbound) to be re-timed from the afternoon/evening to the morning. In each of these cases, there would be consequential re-timings to other services to make rolling stock diagrams work, and the traffic could be lost because of terminal constraints or (in the case of 1O07) the need for an out-and-back operation from London in a day. If this were implemented, it is likely that a small number of additional paths could be found in the direction of the 'flow' each day, limited by the other capacity constraints on the route.
- 3.3.3 An alternative or additional measure could be to retime passenger trains so that more freight services can use the Fast lines. The key would be to create wider intervals for the slower freight trains by closing up gaps in between passenger trains. For example, the 6D32 retiming discussed above could be avoided if it could run on the Down Fast line between Sharnbrook Jn and Harrowden Jn (where it is scheduled to take the Down Fast towards Leicester). This would require a change to the standard pattern EMT passenger timetable, either in this single hour or for all hours, because 6D32 is overtaken south of Wellingborough by 1F15. A gap could be created by



retiming 1F15 later, immediately preceding 1D16, and by moving the previous passenger service 1D14 earlier. This would cause adjustments with GTR services and likely difficulties with platform capacity for EMT services at St Pancras; and both the Nottingham and Sheffield routes would have to be retimed throughout because these are the destinations of 1D14 and 1F15 respectively. A similar measure could be taken for Up services, with similar consequences.

- 3.3.4 If the MML passenger timetable was recast in this way, there would be an immediate detrimental effect on the passenger business. The current standard pattern is carefully constructed to balance frequency of calls at intermediate stations, frequency of services to different destinations and short journey times for the majority of users, all constrained by the limited overtaking opportunities on the infrastructure. As described in the previous paragraph, creating additional freight capacity on the Fast lines would need EMT services to be 'flighted' more closely; this would extend the gaps between calls at the stations along the route which is a key part of the attractiveness of the timetable.
- 3.3.5 Services on the MML are currently timed as closely as possible to the times desired by train operators to meet the needs of their various markets. A small increase in overall capacity could be achieved on the route if significant re-timing was undertaken and the operators and funders were prepared to accept the consequent negative effects on their businesses.

### **3.4 Alterations to line-speed**

- 3.4.1 This section considers changes to the planned speed of trains within the current infrastructure capability. The purpose would be to reduce the speed differential between services on the route and so increase the potential quantum of paths.
- 3.4.2 Firstly, freight services could operate faster. Currently over 90% of the freight trains south of Leicester on the MML are Class 6 because of the type of traffic: mostly aggregates from quarries in the East Midlands and Peak District to south-eastern England. The wagons used are limited to 60 mph. It is very unlikely that freight operators would re-equip their wagon fleets for these operations with faster vehicles. The realistic possibility of any increase in freight train speed, therefore, is limited to improved acceleration and uphill power from more powerful traction: new locomotives or 'double-heading' with existing locomotives. This would also be expensive for the operators, and would achieve very little reduction in transit time; certainly not enough to path a Class 6 freight train between existing passenger trains on the Fast lines.
- 3.4.3 Secondly, passenger trains could operate at reduced speed. In the Up direction a Class 6 freight typically takes 36 minutes between Kettering South Jn and Sharnbrook Jn. This would be slightly extended on the Up Fast line as the gradients are more severe, but 36 minutes is used in this analysis as an illustration. The largest interval in the standard pattern passenger

timetable is 26 minutes between an Up Fast train at Kettering South Jn and the following Up Fast train at Sharnbrook Jn. These passenger trains are 14 minutes apart at Kettering South Jn. In order to maintain the passenger service interval of 14 minutes and create a margin for the freight service (36 minutes transit time plus 9½ minutes headways and junction margins equals 45½ minutes), each passenger train would have to be slowed by 20 minutes over this section.

- 3.4.4 A similar exercise could be undertaken between Kettering North Jn and Kilby Bridge Jn or Leicester South Jn, to overcome the constraints set out in appendix E. A typical Up direction Class 6 freight train takes 38 minutes non-stop between Leicester South Jn and Kettering North Jn. The largest interval in the standard pattern passenger timetable is 40 minutes between an Up Fast train at Leicester South Jn and the following Up Fast train at Kettering North Jn. These passenger trains are 24 minutes apart at Leicester South Jn. In order to maintain the passenger service interval of 24 minutes and create a margin for the freight service (38 minutes transit time plus 9½ minutes headways and junction margins equals 47½ minutes), each passenger train would have to be slowed by 8 minutes over this section. This extension to passenger journey times could provide one non-stop freight path from Leicester South Jn to Kettering North Jn each hour.
- 3.4.5 Alternatively, if it was more advantageous to provide two consecutive freight paths from Kilby Bridge Jn to Kettering North Jn, this could be achieved by a greater slowing of passenger services. A typical Up direction Class 6 freight train takes 28 minutes non-stop between Kilby Bridge Jn and Kettering North Jn. The largest interval in the standard pattern passenger timetable is 35 minutes between an Up Fast train at Kilby Bridge Jn and the following Up Fast train at Kettering North Jn. These passenger trains are 23 minutes apart at Kilby Bridge Jn. In order to maintain the passenger service interval of 23 minutes and create a margin for the freight service (28 minutes transit time plus 19 minutes headways and junction margins equals 47 minutes), each passenger train would have to be slowed by 13 minutes over this section.
- 3.4.6 The magnitude of the disbenefit to existing users of the MML would be less with these examples of 'slow-running' than for the diversions described in section 3.2, but greater than for the re-timings described in section 3.3. The increase in passenger journey times would of course undermine the recent investment in the route which has been principally aimed at reducing journey times.

### 3.5 Infrastructure improvements

- 3.5.1 The analysis in section 2 identifies that some sections of the infrastructure are more significant constraints, in the sense that supply is less able to accommodate demand in certain places.



- 3.5.2 The single most obvious constraint is the long section of reversible Slow line between Sharnbrook Jn and Kettering South Jn. This should be the top priority for any investment to relieve the congestion.
- 3.5.3 The routes north of Kettering are a secondary constraint. The capacity of one route or the other could be enhanced – both would probably not be required.
- 3.5.4 At a tertiary level in the hierarchy of capacity constraints are:
- Leicester area (from Kilby Bridge to Syston)
  - Bedford – London

If the primary and secondary constraints are relieved by investment, and demand continues to grow, then these areas will become the next bottlenecks on this infrastructure. One particular area to note, although outside the infrastructure presently declared as congested, is Hampstead tunnels and Carlton Road Jn. Here freight services between the MML and the London orbital routes conflict with passenger services to/from St Pancras and the Thameslink core.

### **3.6 Conclusions**

- 3.6.1 The solutions considered in sections 3.2 – 3.4 all involve disadvantaging some of the current users of the route. If services are diverted onto other routes then journey times will be increased. If the line-speed is reduced then journey times will be increased. If services are re-timed then operators will face additional costs and passengers will see a less regular service pattern, increasing their generalised journey time.
- 3.6.2 Only infrastructure improvements could provide capacity for additional services without adversely impacting demand in one or more of the markets currently served by this route.

## 4 Next steps

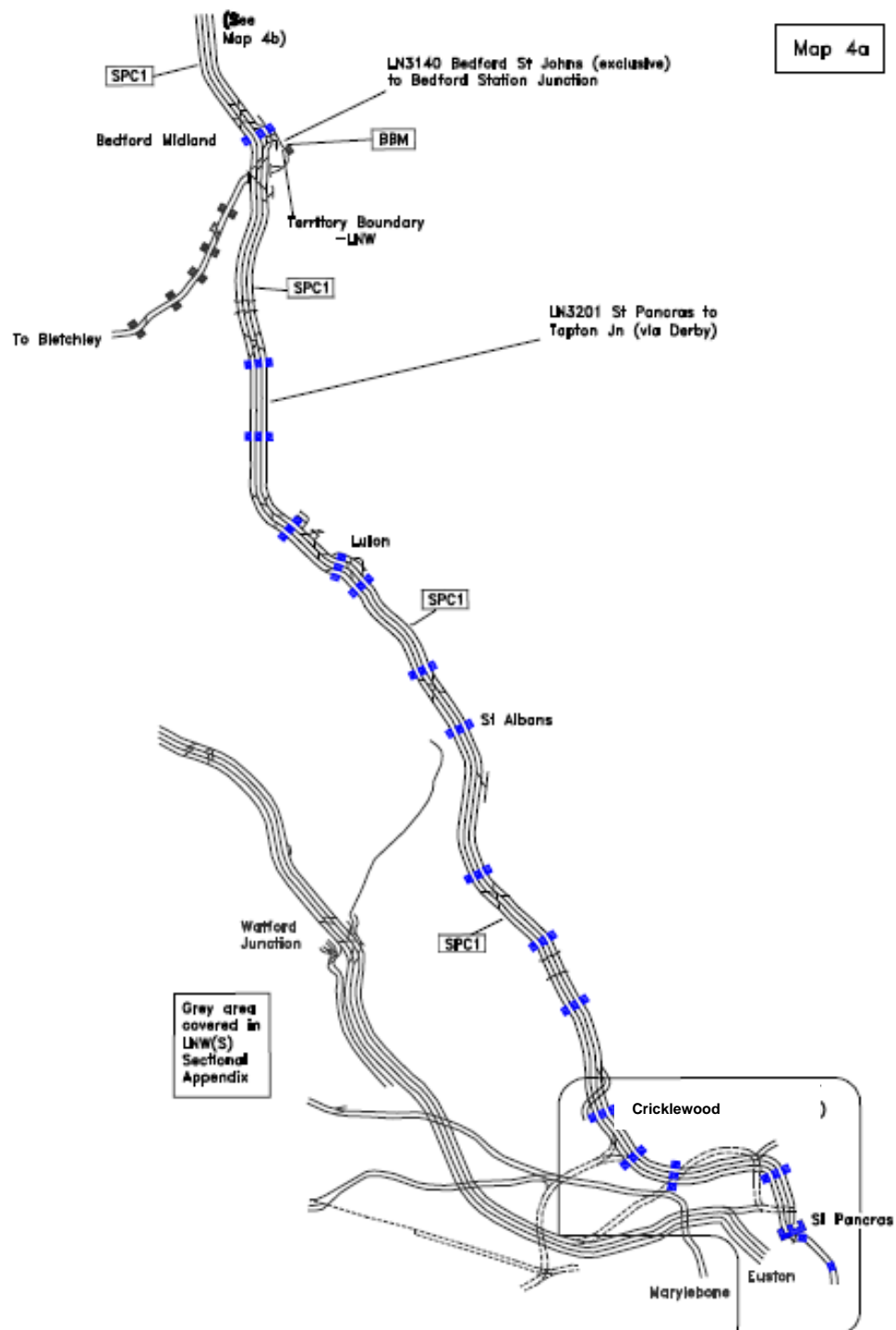
### 4.1 Capacity enhancement plan

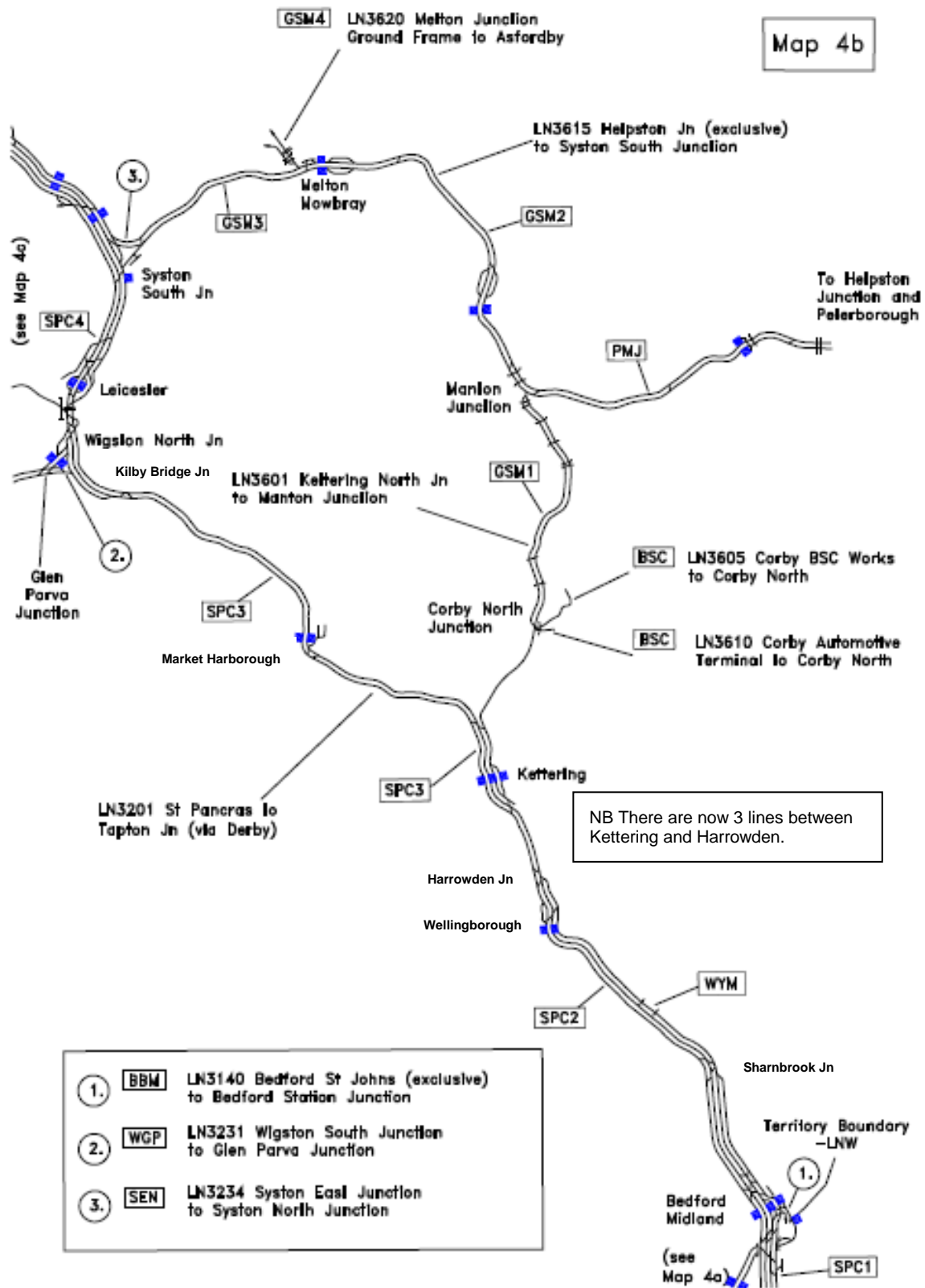
- 4.1.1 The infrastructure constraints identified as priorities for investment in section 3.4 will be taken forward in the capacity enhancement plan which Network Rail must now produce under Regulation 25 by 24 September 2015.
- 4.1.2 In January 2015 as part of the rail industry's Long Term Planning Process, Network Rail published a draft East Midlands Route Study for public consultation. The study covers, *inter alia*, the infrastructure analysed in this capacity analysis report. It considers the conditional outputs identified by published Market Studies for each sector of demand over the next 30 years, and identifies choices for the use of and investment in the infrastructure. Network Rail expects that, when finalised, the Route Study will fulfil most of the requirements of the capacity enhancement plan for this infrastructure.
- 4.1.3 However, Network Rail will also publish by 24 September 2015 a document that details how the Route Study and any other relevant publications discharge the requirements of Regulation 25.

## APPENDIX A

### Route diagrams

Adapted from diagrams in the National Electronic Sectional Appendix.





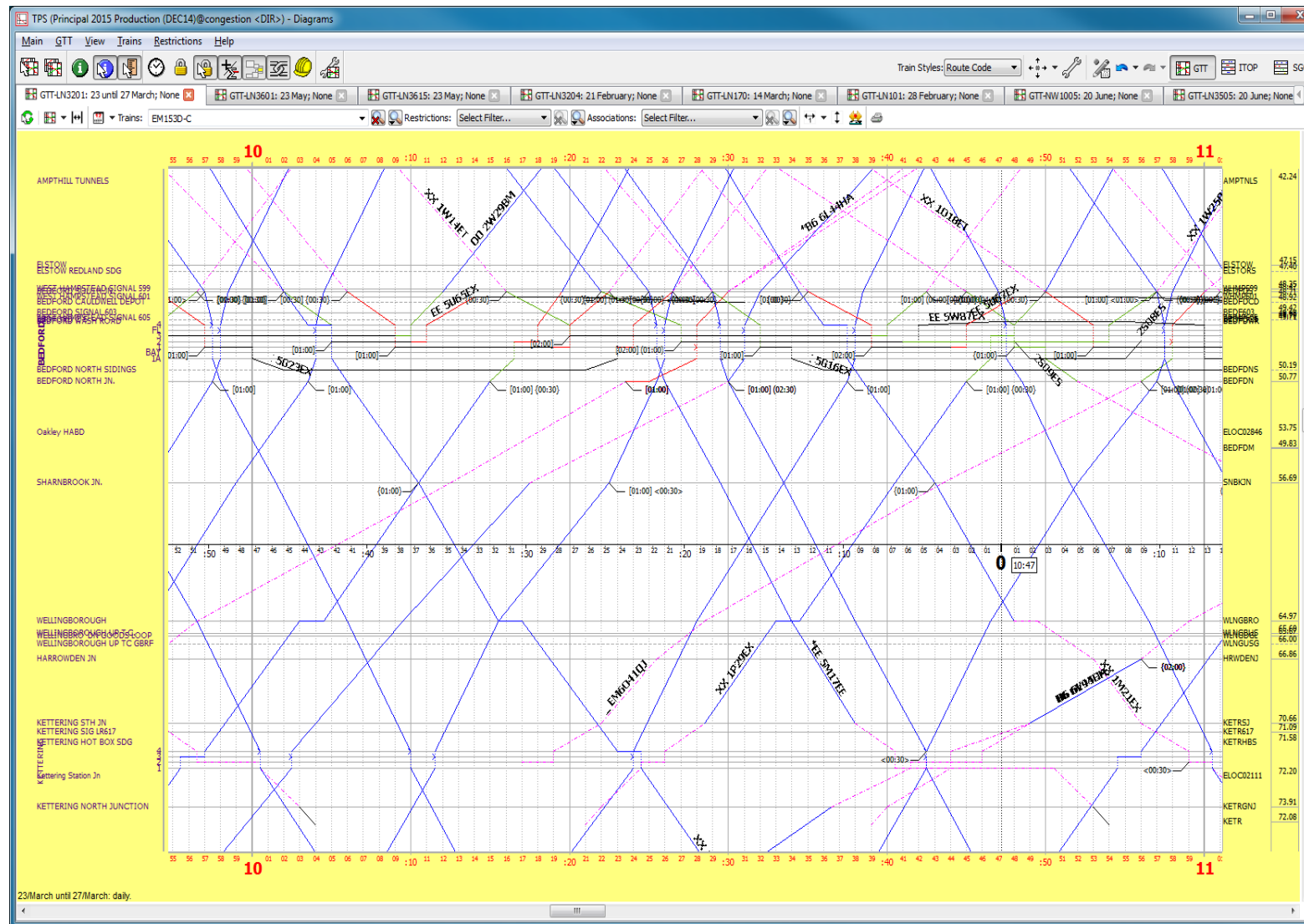


## **APPENDIX B**

### **Train graphs**

Sample hours are given on subsequent pages for the following sections of route:

- Bedford – Kettering;
- Kettering – Leicester; and
- Kettering – Manton Jn.









## APPENDIX C

### Southbound freight paths at Bedford

This table shows the availability (0600 – 2200) and use of freight paths SX on the Up Slow line south from Bedford.

Between 2200 and 0600 the standard passenger timetable does not apply so only used freight paths are listed.

Trains scheduled but not used over a three-month period have been excluded.

Time passing Bedford	Used by (headcode)	Origin	Destination
0010	3Q10 (FO)	Derby	Derby
0208	6G32/7O54/6L59	Mountsorrell/Humberstone Road/Hope	Banbury/Allington/Dagenham
0228	6L86/6V91 (FSX)	Hope	W Thurrock/Theale
0245½	6O05/6O59 (MO)	Bardon Hill	Purley/Angerstein
0350	6L25/6L26/6M25/6M28	Croft/Bardon Hill	Bow/Neasden
0355½	6E25 (MSX)	Croft	Ferne Park
0425	6V48	Bardon Hill	Colnbrook
0431	6M85	Ketton	St Pancras Churchyard
0450	6V76 (WFO)	Stud Farm	Hayes & Harlington
0523	6C32/6C37	Mountsorrell/Tunstead	Elstow
No freight paths available during the morning peak 0550 - 0840			
0858	6C75	Mountsorrell	Luton
0928	6C31	Mountsorrell	Radlett
0958	Not used		
1028	6L44/6L84/6L88	Hope/Croft/Bardon Hill	W Thurrock/Bow
1058	6O41 (QJ)	Kettering	Dollands Moor
1127	6L45/6V94	Hope	W Thurrock/Theale
1158	Not used		
1227	6M17	Croft	Neasden
1258	3Z03	Derby	Hither Green
1327	6L29/6C70	Stanton Gate/Mountsorrell	Bow/Luton
1358	Not used		
1428	Not used		
1458	Not used		
1528	Not used		
1558	Not used		
1628	No path		

Time passing Bedford	Used by (headcode)	Origin	Destination
1633	Not used		
1658	Not used		
1728	No path		
1740	6L87/6L89	Hope/Tunstead	W Thurrock
1758	No path		
1828	No path		
1858	Not used		
1928	Not used		
1938	6V08/6M19	Barrow Hill	Brentford/Cricklewood
2001	Not used		
2030	6E10	Wellingborough	Ferne Park
2058	Not used		
2126	3Q60	Derby	East Ham
2154	6C23/6C33	Mountsorrell	Elstow/Radlett
2232	6C79 (MO)	Humberstone Rd	Luton
2257	Not used		
2324	6E09	Wellingborough	Ferne Park

## APPENDIX D

### Slow line Sharnbrook - Kettering

This table shows the occupation of the reversible Slow line between Sharnbrook Jn and Kettering South Jn (SX).

Red text is used for Up trains, blue text for Down trains and black text indicates a reversing movement. Shaded cells indicate occupation of the reversible Slow line. Trains scheduled but not used over a three-month period have been excluded.

Kettering S		Harrowden		Wellingborough		Sharnbrook	Headcode	From	To	Days
		0028	<	0023-0024½	<	0012	1D91	St Pancras	Derby	
0144	>	0152	>	0055	>	0111	6L59	Hope	Dagenham	FSX
0120½	<	0116½	<	0105-0112			6E87	Wellingborough	Rylstone	MO
0127½	<	0123½	<	0113-0119			6E87	Wellingborough	Rylstone	MSX
		0137	<	0132-0133½	<	0121	1F89	St Pancras	Leicester	
		0138	>	0141	>	0158	7O54	Humberstone Rd	Allington	MO
		0120-0139	>	0142	>	0155	3J92	Toton	W Hampstead	
		0139	>	0142	>	0158	6G32	Mountsorrell	Banbury	TThO
0141½	>	0145½	>	0148½	>	0204½	6L08	Mountsorrell	W Thurrock	FO
		0155	>	0158	>	0214	6L86/6V91	Hope	W Thurrock/Theale	FSX
		0214½	>	0217½	>	0233½	6O05/6O59	Bardon Hill	Purley/Angerstein	MO
		0236½	>	0239½	>	0255½	6V70	Lindsey	Colnbrook	
		0250	>	0253	>	0309	6L34	Hope	Bow	FSX
		0258	>	0301	>	0317	6L25/6M25/6L26/6M28	Croft/Bardon Hill/Hope	Bow/Neasden	
		0309	>	0312	>	0328	6E25	Croft	Ferne Park	
		0349	<	0346	<	0331	6D28/6D33	Elstow/Radlett	Mountsorrell	MSX
		0352	>	0355	>	0411	6V48	Bardon Hill	Colnbrook	
		0400	>	0403	>	0419	6M85	Ketton/Toton/Leicester	St Pancras Churchyard	



Kettering S		Harrowden		Wellingborough		Sharnbrook	Headcode	From	To	Days
		0415	>	0418	>	0434	6V76	Stud Farm	Hayes & Harlington	MSX
		0438	>	0441	>	0458	6C32	Mountsorrell	Elstow	
		0447½	>	0450½	>	0506½	6C37	Tunstead	Elstow	
		0454	>	0458-0502			6F02	Mountsorrell	Wellingborough	MSX
		0546	<	0536-0541			6H08	Wellingborough	Tunstead	MSX
		0645½	<	0635-0641			6H91/6H92	Wellingborough	Hindlow/Tunstead	
		0658	>	0701	>	0717	6C75	Mountsorrell	Luton	
		0837	>	0840-0842	>	0852½	1C92	Derby	St Pancras	
0856	<	0853	<	0848-0850			1M11	St Pancras	Corby	
		0856	>	0859	>	0915	6C31/6C35/6M39	Mountsorrell/Moreton-on-Lugg	Elstow/Radlett	
		0943	<	0940	<	0927	6D32	Elstow	Mountsorrell	
0948	>	0953½	>	0956½	>	1012½	6L84/6L88	Croft/Bardon Hill	Bow	
1022	>	1025½	>	1028½	>	1043½	6O41 (QJ)	Kettering	Dollands Moor	
1056	<	1053	<	1048-1049½			1M21	St Pancras	Corby	
		1056	>	1059	>	1115	6L45/6V94	Hope	W Thurrock/Theale	
		1141	<	1133-1137			6D02	Wellingborough	Mountsorrell	
1141½	>	1145	>	1148	>	1204	6M17	Croft	Neasden	
1156½	<	1153½	<	1148½-1150			1M26	St Pancras	Corby	
1256	<	1253	<	1248-1249½			1M31	St Pancras	Corby	
		1256	>	1259	>	1316½	6C70	Mountsorrell	Luton	
1356	<	1353	<	1348-1349½			1M36	St Pancras	Corby	
1403½	<	1359½	<	1346½-1355	<	1327-1332½	6M09/6E69	Ferne Park/Acton	Wellingborough/Scunthorpe	
1409	<	1405	<	1402	<	1338-1348	6M53	Chelmsford/W Thurrock	Mountsorrell	WThFO
1506	<	1503	<	1448-1449½			1M41	St Pancras	Corby	
1523½	<	1519	<	1516	<	1452-1502	6M54	Colnbrook	Bardon Hill	
1543½	<	1533½	<	1528	<	1515	6M31	Banbury	Mountsorrell	TThO
				1532	<	1519	6M11	Ferne Park	Wellingborough	
1556	<	1553	<	1548-1549½			1M46	St Pancras	Corby	
				1553-1555	<	1539	6M10	Acton	Wellingborough	



Kettering S		Harrowden		Wellingborough		Sharnbrook	Headcode	From	To	Days
1600½	>	1604	>	1607½-1612½			4M10	Scunthorpe	Wellingborough	TO
1631½	<	1625	<	1622	<	1607	6M79	Angerstein	Bardon Hill	
1656½	<	1653½	<	1648½-1650			1M51	St Pancras	Corby	
		1711½	>	1714½-1718½			0F02	Mountsorrell	Wellingborough	MSX
		1735-1742½	<	1729	<	1708½	6E38	Colnbrook	Lindsey	
1757½	<	1754½	<	1748-1751			1M56	St Pancras	Corby	
1825½	>	1828½	>	1832-1834½			1P69	Derby via Corby	St Pancras	
1840½	<	1837½	<	1832-1833½			1D90	St Pancras	Derby	
1842	>	1847	>	1850	>	1859	1O07	Chesterfield	Victoria	WO
1857½	<	1854½	<	1849-1851			1M61	St Pancras	Melton Mowbray	
1900½	>	1904½	>	1907½(-1914)	>	1921½	6V08/6M19	Barrow Hill	Brentford/Cricklewood/Wellingborough	
		1941½	<	1938½	<	1920-1924½	6F50 (QJ)	Bletchley	Bardon Hill	
				1946½	>	2001½	6E10	Wellingborough	Ferne Park	
1943½	>	1948½	>	1951½-1956			0M62	Peterborough	Wellingborough	FO
2001½	<	1958½	<	1952½-1954½			1M66	St Pancras	Corby	
2056½	<	2053½	<	2048-2050			1M71	St Pancras	Corby	
2109	<	2105	<	2102	<	2049	6M68	Hayes	Stud Farm	
2146	>	2155	>	2158	>	2213	6C79	Humberstone Rd	Luton	MO
			>	2251			6E09	Wellingborough	Ferne Park	
2321-2321½	>	2329-2329½	>	2334	>	2350½	3Q10	Derby	Derby	FO
		2359	<	2351-2355			0F02	Wellingborough	Mountsorrell	

## APPENDIX E

### Kettering - Kilby Bridge

This table shows the use of freight paths in the Up direction between Kilby Bridge Jn and Kettering North Jn (SX).

From about 0900 a standard hourly freight path exists between the Nottingham stopping service (usually xx00 departing Leicester) and the following Sheffield service (usually xx24 departing Leicester then non-stop to London).

Trains scheduled but not used over a three-month period have been excluded.

Hour starting (Kilby Bridge Jn)	Analysis
0001	2 paths used: 3J92 and 7O54
0101	3 paths used: 6G32/6L08, 6L86/6V91 and 6O05/6O59
0201	3 paths used: 6V70, 6L25/6L26/6L34/6M25/6M28 and 6E25
0301	3 paths used: 6V48, 6M85 and 6V76
0401	2 paths used: 6C32/6C37 and 6F02
0501	No paths used
0601	2 paths used: 6C75 and 6M39
0701	No path, taken by 1B12 and 1C93
0801	No path, taken by 1C92
0901	6L84
1001	Path taken south of Kettering by 6L45
1101	6M17
1201	6C70/6L29
1301	4F30
1401	Path taken at Kilby Bridge by 6F93 Down direction
1501	No path across Down Fast at Kilby Bridge between 6D31 and 6M91
1601	No path across Down Fast at Kilby Bridge between 6M54 and 6M31
1701	No path across Down Fast at Kilby Bridge between 6M79 and 6M92
1801	No path across Down Fast at Kilby Bridge between 6M84 and 6E38
1901	Path taken at Kilby Bridge by 6D45 Down direction
2001	3Q60/3Q39 (Up Fast line from Leicester)
2101	Not used
2201	3Q07 (Up Fast line from Leicester); path also taken at Kilby Bridge by 6M18 Down direction
2301	3Q24 (Up Fast line from Leicester)

## APPENDIX F

### Single line Kettering - Corby

This table shows the occupation of the slow lines at Kettering and the single line between Kettering North Jn and Corby North Jn for a sample standard hour 1030-1130 at Kettering (SX).

Red text is used for Up trains, blue text for Down trains and black text indicates a reversing movement. Shaded cells indicate occupation of the reversible Slow line / Corby single line. Trains scheduled but not used over a three-month period have been excluded.

Corby N Jn		Corby		Kettering N Jn		Kettering		Kettering S Jn	Headcode	From	To	Days
1028	>	1030	>	1040	>	1044	>	1049	6L45/6V94	Hope	W Thurrock/Theale	
1040½	<	1038½							6V92	Corby	Margam	
1102½	<	1100½	<	1053	<	1040½-1050½	<	1038	5M17	St Pancras	Cricklewood	ThO
		1109-1116	<	1103	<	1059-1100½	<	1056	1M21	St Pancras	Corby	
		1109-1116	>	1122	>	1124½-1126	>	1128½	1P34	Corby	St Pancras	

## APPENDIX G

### Manton - Syston

This table shows the quantum of paths scheduled in the Up (eastbound) direction each hour. Empty coaching stock movements have been counted within the freight quantum.

Hour starting (Syston E Jn)	Passenger	Freight	Total
0001	0	1	1
0101	0	3	3
0201	0	4	4
0301	0	3	3
0401	0	2	2
0501	1	3	4
0601	2	2	4
0701	1	3	4
0801	1	3	4
0901	1	4	5
1001	1	1	2
1101	1	2	3
1201	1	3	4
1301	1	4	5
1401	1	4	5
1501	1	3	4
1601	1	2	3
1701	2	3	5
1801	2	2	4
1901	1	1	2
2001	1	4	5
2101	1	1	2
2201	0	4	4
2301	0	1	1