East West Rail Performance Assessment

Systems Analysis Team
Safety, Technical & Engineering

20 January 2020

Wilson Fung, Matthew Bates, Tim Gordon

Background

The Systems Analysis team was remitted to undertake a range of performance analysis to assess the proposed East West Rail (EWR) scheme. Three work packages were carried out for this assessment.

1. **TRAIL Whole System Modelling**

   To provide an estimate of service performance for a specified working timetable and input assumptions. It captures service operations within a Railway System with defined infrastructure, rolling stock and operational Reliability, Availability and Maintainability (RAM) characteristics.

2. **Signalling Performance Assessment (SPA) and Timetable Validity**

   To investigate the proposed values in the timetable are valid and within the technical values. This involves simulating junction margin and examining historic delay and dwell overruns.

3. **Performance benchmark of the existing railway system**

   Involved interrogation of the NR Business systems to establish the infrastructure reliability, and examine at a high level, the impact of any service affecting failures within the East West Rail area. The main objective of this work package was to assess the observed performance of infrastructure assets, in terms of impact on train service.

East West Rail TRAIL
Whole System Modelling

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TRAIL

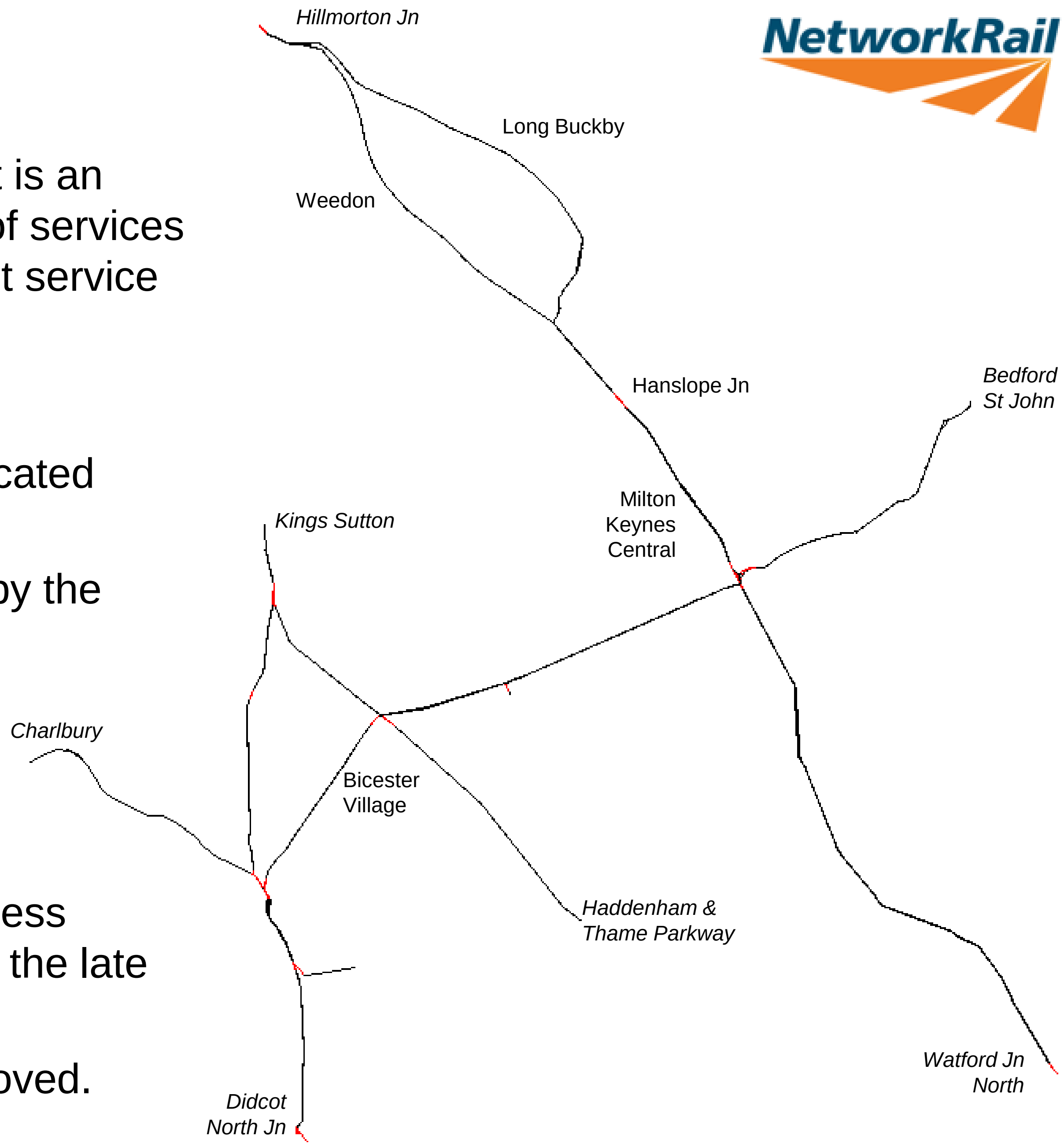
TRAIL is a discrete event simulator (Monte Carlo). It is an occupancy model which simulates the movements of services across the infrastructure network. It is used to output service reliability (journey lateness).

Scope

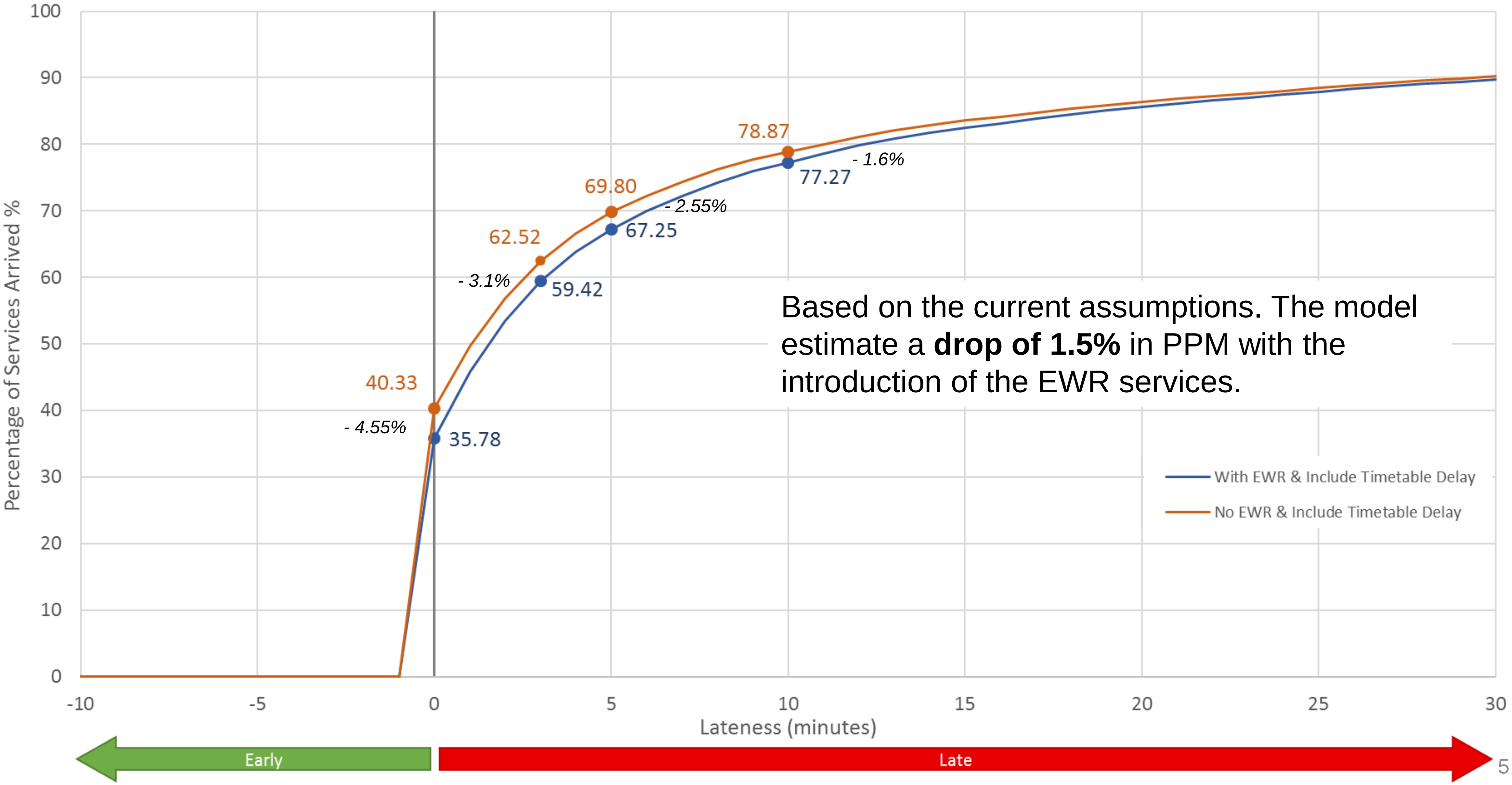
- Geographic scope of the TRAIL modelling is indicated in the diagram.
- Modelled Baseline & Option Timetable supplied by the Capacity Analysis Team.
- Performance data (Infrastructure & Operational Failures) are based on 2018/19 period.

Assumptions

- At the model boundaries, historic (2018/19) lateness distribution are modelled to simulate the effect of the late train entering the model scope.
- Duplicated freight paths in the timetable are removed.



Journey Lateness Output (1)



Based on the current assumptions. The model estimate a **drop of 1.5%** in PPM with the introduction of the EWR services.

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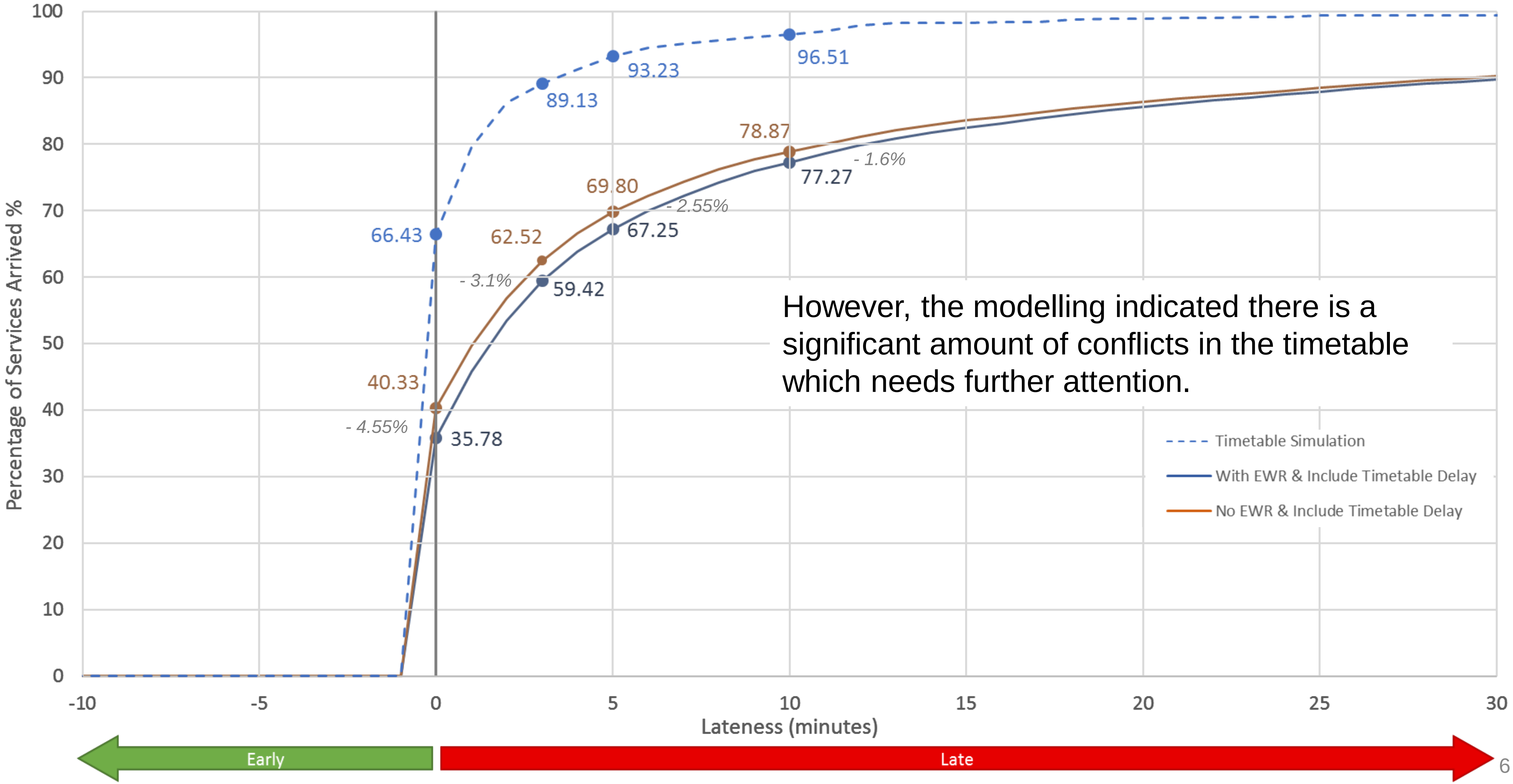
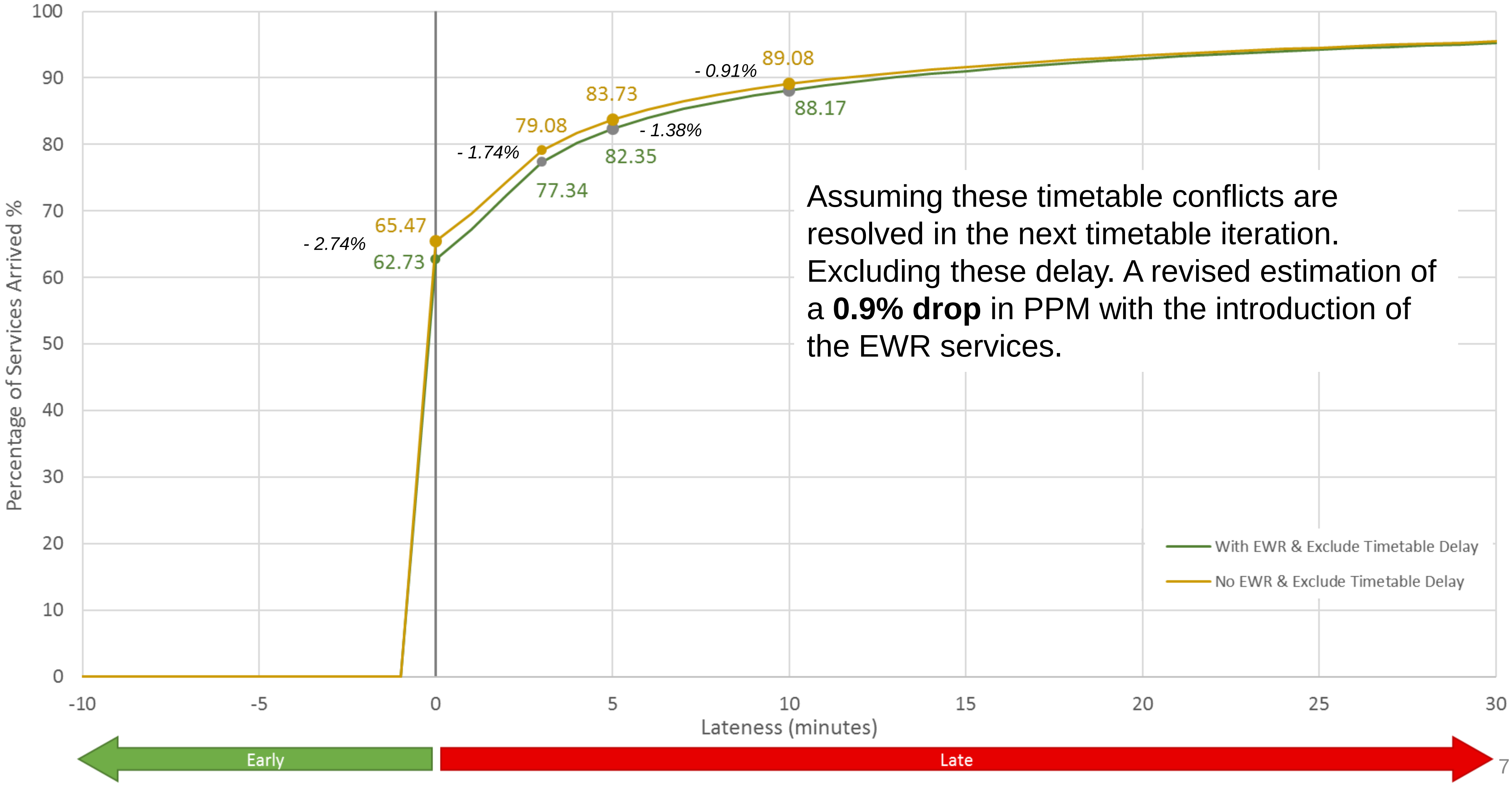


However, the modelling indicated there is a significant amount of conflicts in the timetable which needs further attention.

Journey Lateness Output (3)



Assuming these timetable conflicts are resolved in the next timetable iteration. Excluding these delay. A revised estimation of a **0.9% drop** in PPM with the introduction of the EWR services.

Summary

- Based on the current assumption, the model indicates an estimate drop of 0.9% in PPM with the introduction of EWR services.
- The output PPM figures is indicative only because to the limited scope of the model as the true impact of the service outside the geographic scope is not fully capture.
- It is recommended that a detailed timetable modelling should be carry out to deconflict the inherit delay in the plan. i.e. correct route selection for each services.
- It is also recommended that the TRAIL modelling scope should be extended so that it can capture the true impact of the delay propagation.

East West Rail
SPA & Timetable Validity

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Matthew Bates

Executive Summary

- In the option timetable, 42 services at Oxford have less than 10 minutes planned turnaround time. However, in the base timetable there are no planned passenger services with less than 10 minutes turnaround time. There is a risk that the current turnaround process cannot reliably achieve the reduce turnaround time.
- The service interval at MKC Platform 2A is sufficient that it poses no significant concern that it will affect the performance (Reoccupation of 3 mins. Technical value is 1 min 47 seconds).
- 14 services at Oxford is vulnerable to late departure due to late arrivals and the tight planned turnaround time. Recommend these services to be revisited in future to improve the timetable robustness.
- Recommend introducing Denbigh Hall South Jn as a mandatory timing point location. This will significantly reduce the probability of conflicting moves at the junction.
- The service interval in the CTP is sufficient on the Up Relief Line at Oxford North Junction to minimise delay.

Turnaround Time

Planned Turnaround Time is defined as the time require to prepare a train for its next planned departure. **Minimum Turnaround Time** is the minimum time require for a train to be ready for the next departure.

The turnaround time value play a significant part in performance because it act as a “sponge” to absorb any late arriving services. If the lateness of a service arrival at destination is greater than the minimum turnaround time then it will subsequently cause a late departure which in turn could cause further conflicts down the line.

Oxford

Current TPRs at Oxford allow a planned **5** minutes turnaround. Historic data shows **on average a train arrived 3 minutes late**. There are 14 services in the option timetable with less than 8 minutes planned turnaround time. These services are highly likely to be subjected to a late departure. Recommend these services to be revisited in future to improve the timetable robustness.

Milton Keynes Central

Planned timetabled turnaround times at Milton Keynes Central are significantly larger than at Oxford therefore it post less risk to performance.

Oxford Platform #	Arrival Time	Turnaround Time
1	16:47:00	05:00
1	11:51:00	06:00
1	10:50:00	07:00
2	12:20:00	07:00
1	12:50:00	07:00
2	13:20:00	07:00
1	14:50:00	07:00
2	15:19:00	07:00
1	15:52:00	07:00
2	16:20:00	07:00
1	19:46:00	07:00
2	21:50:00	07:00
2	09:19:00	08:00
2	10:19:00	08:00

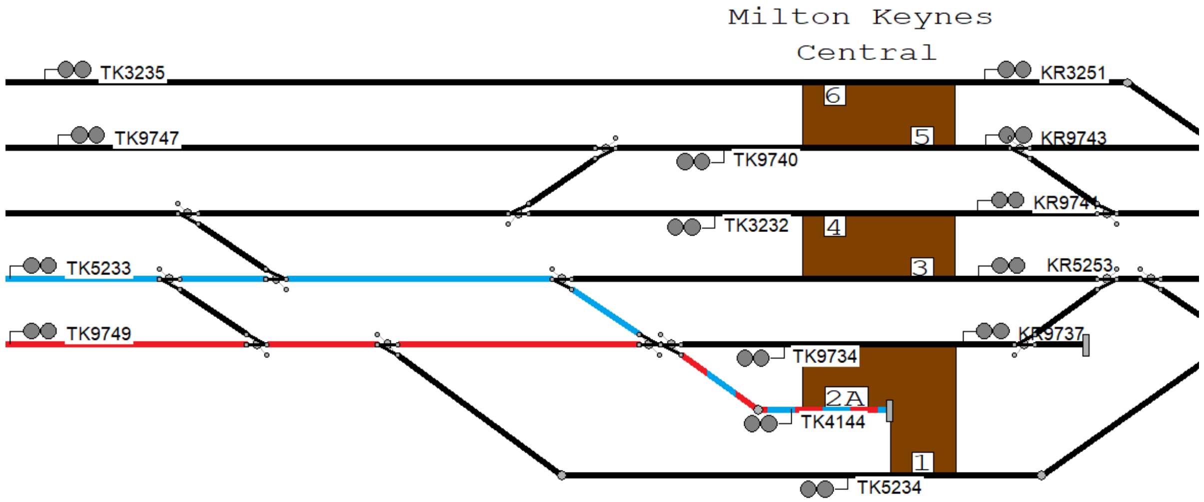
Platform Reoccupation-Milton Keynes

Platform reoccupation is the time required for one train to depart a platform and another train to stop at the platform viewing the least restrictive aspects possible on its journey.

A VISION™ analysis of reoccupation of platform 2A at Milton Keynes shows a technical time of **01:47**

The minimum timetabled reoccupation time is **03:00** and occurs at the following times

Milton Keynes Central Platform Reoccupation Time	Departure Time
03:00	11:07:00
03:00	12:06:00
03:00	12:36:00
03:00	13:07:00
03:00	14:07:00
03:00	15:36:00
03:00	16:05:00
03:00	17:07:00
03:00	18:07:00



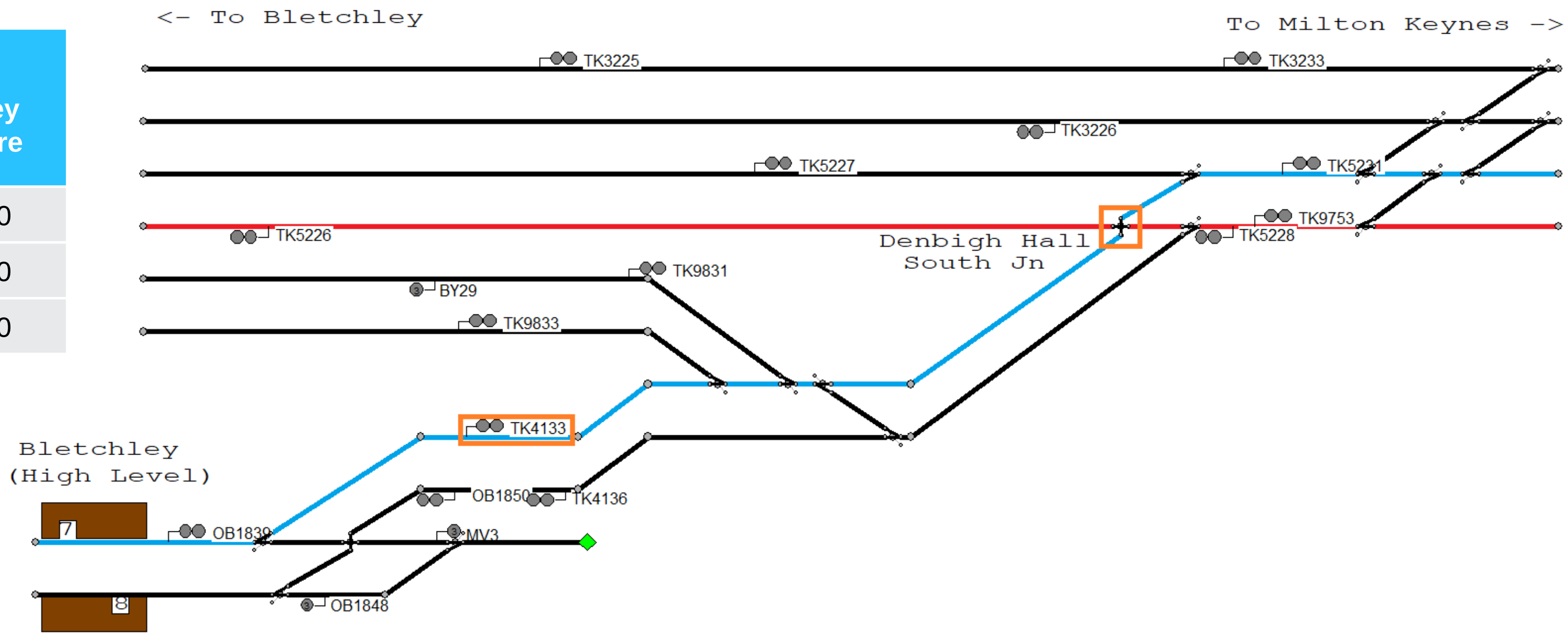
With a buffer of 01:13, there is very little risk that the 9 trains identified above departing late will delay the arrival of the next train into the platform.

The timetabled separation of one EWR train departing Oxford to the next arriving means no risk is presented at Oxford station.

Denbigh Hall South Junction (2)

- Number of services in the CTP have been identified with timetable conflicts possibly occurring at Denbigh Hall South Jn. A sample of these occurrences are indicated below.

Train 1 UID	Mainline Milton Keynes Departure	Train 2 UID	EWR Bletchley Departure
P44546	07:05:00	177005	07:06:00
H18004	15:59:00	177048	16:00:00
H17095	20:29:00	177066	20:29:00



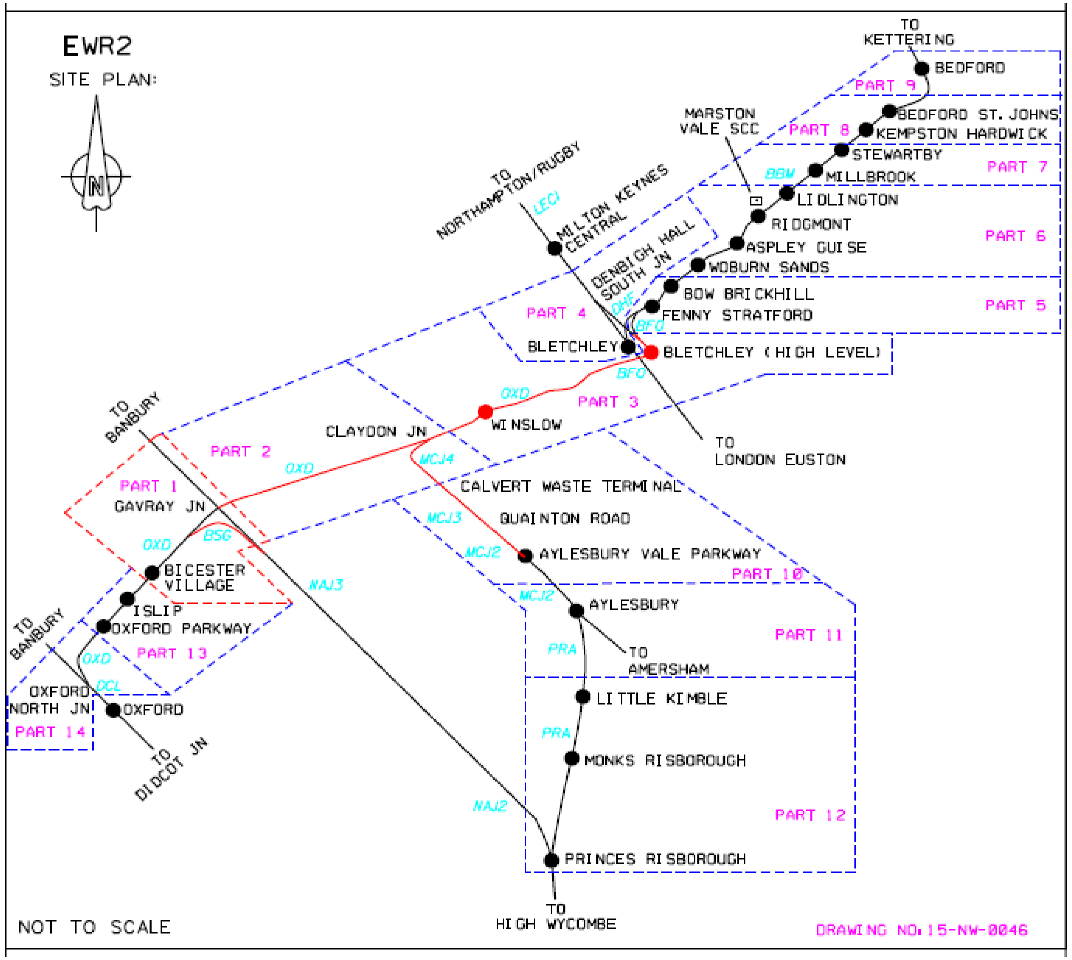
- These possible conflicts could be mitigated by introducing Denbigh Hall South Jn as a mandatory timing point location. This will significantly reduce the probability of these conflicting moves as it will create TPR specifically for this crossing move at this junction and not relying on signallers prioritising services.

East West Rail
Performance Benchmark Study

Systems Analysis Team
Safety, Technical & Engineering

20 January 2020
Tim Gordon

Technical Scope & Approach



EWR Geographical Scope

EWR Route Sectors	ELR	Start (km)	End (km)	Strategic Route Desc
Midland Main Line	BBM	0.000	27.076	Bletchley to Bedford
Didcot Chester Line	DCL	102.012	105.968	Oxford - Coventry
Bicester Town Branch	OXD	0.000	51.498	Bicester Town Branch
Bletchley to Bicester Line	DHF	0.000	3.045	Denbigh Hall North Junction
	BFO	0.000	3.218	Other Freight Lines
Marylebone to Claydon Junction	MCJ2	-1.609	81.614	Amersham - Aylesbury Vale
	MCJ3	61.446	260.712	Other Freight Lines
	MCJ4	0.000	1.608	Other Freight Lines
Chiltern Main Line	NAJ2	39.62	54.49	Marylebone - Aynho Jcn
	NAJ3	0.000	29.53	Marylebone - Aynho Jcn
	BSG	0.000	32.756	Not Defined

EWR Route Sectors

Performance Benchmark is based on examination of historic FMS and TRUST data between 18 Sept16 (P7 16/17) and 14 Sep19 (P6 19/20).

Note: West Coast Mainline is excluded from the study.

Distribution of Delay by All KPI's

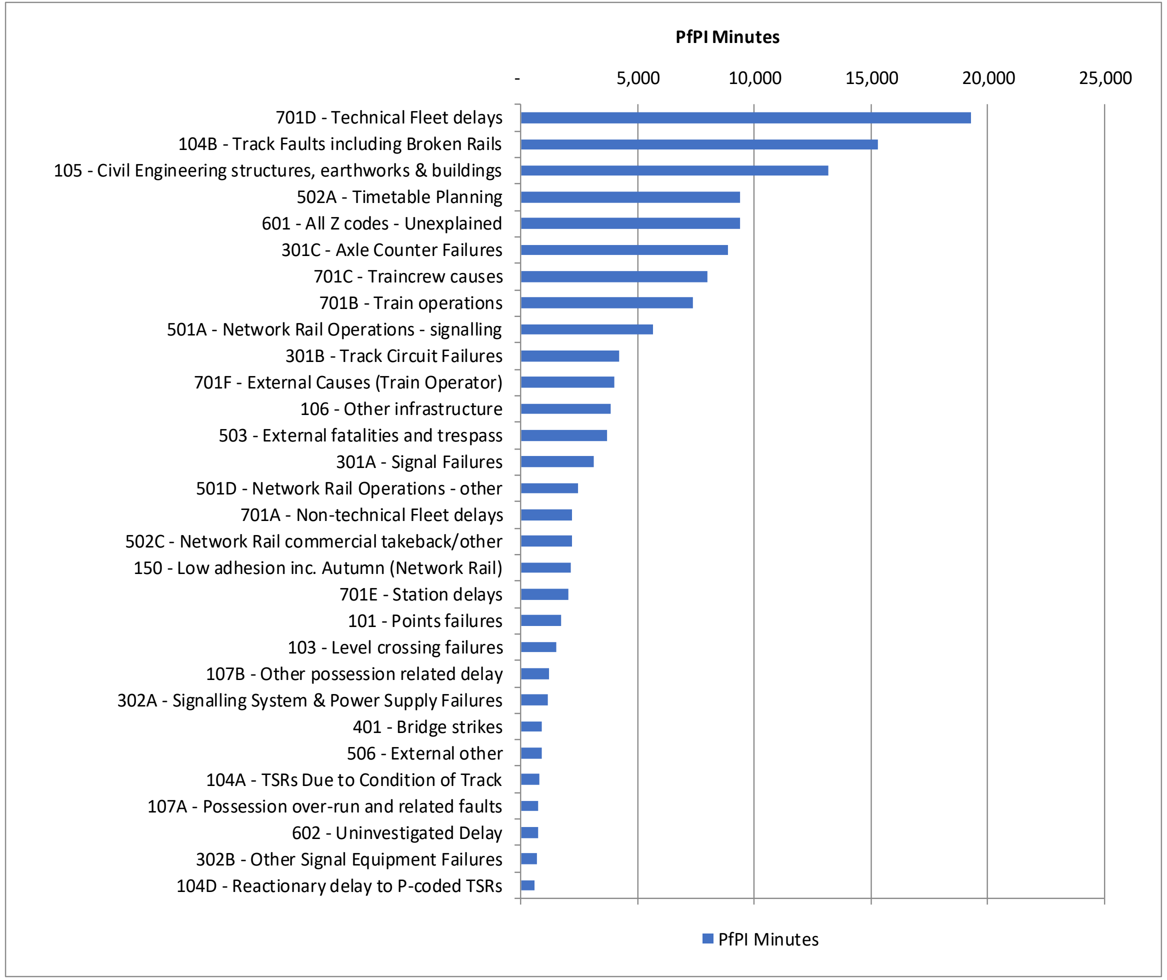
Incident Category	SA Failures	PfPI Minutes	Delay Cost	SA Failures (%)	PfPI Minutes (%)	Delay Cost (%)
Infrastructure	267	55,122	2,227,482	2.9%	39.3%	42.1%
Ops, Planning, & Commercial	2,108	25,745	1,046,958	23.2%	18.3%	19.8%
TOC - Mechanical	426	19,298	637,946	4.7%	13.8%	12.0%
T&V, Excludables & Other	1,959	16,068	575,146	21.5%	11.4%	10.9%
Freight - Ops	3,783	15,747	539,103	41.6%	11.2%	10.2%
TOC - Ops	221	6,208	195,481	2.4%	4.4%	3.7%
Stations	328	2,056	70,236	3.6%	1.5%	1.3%
Weather	7	100	3,002	0.1%	0.1%	0.1%
Grand Total	9,099	140,343	5,295,354			

Performance Delay Minutes and Cost (%) by Incident Category

The Distribution of Delay by KPI shows that infrastructure related KPI codes account for approximately:

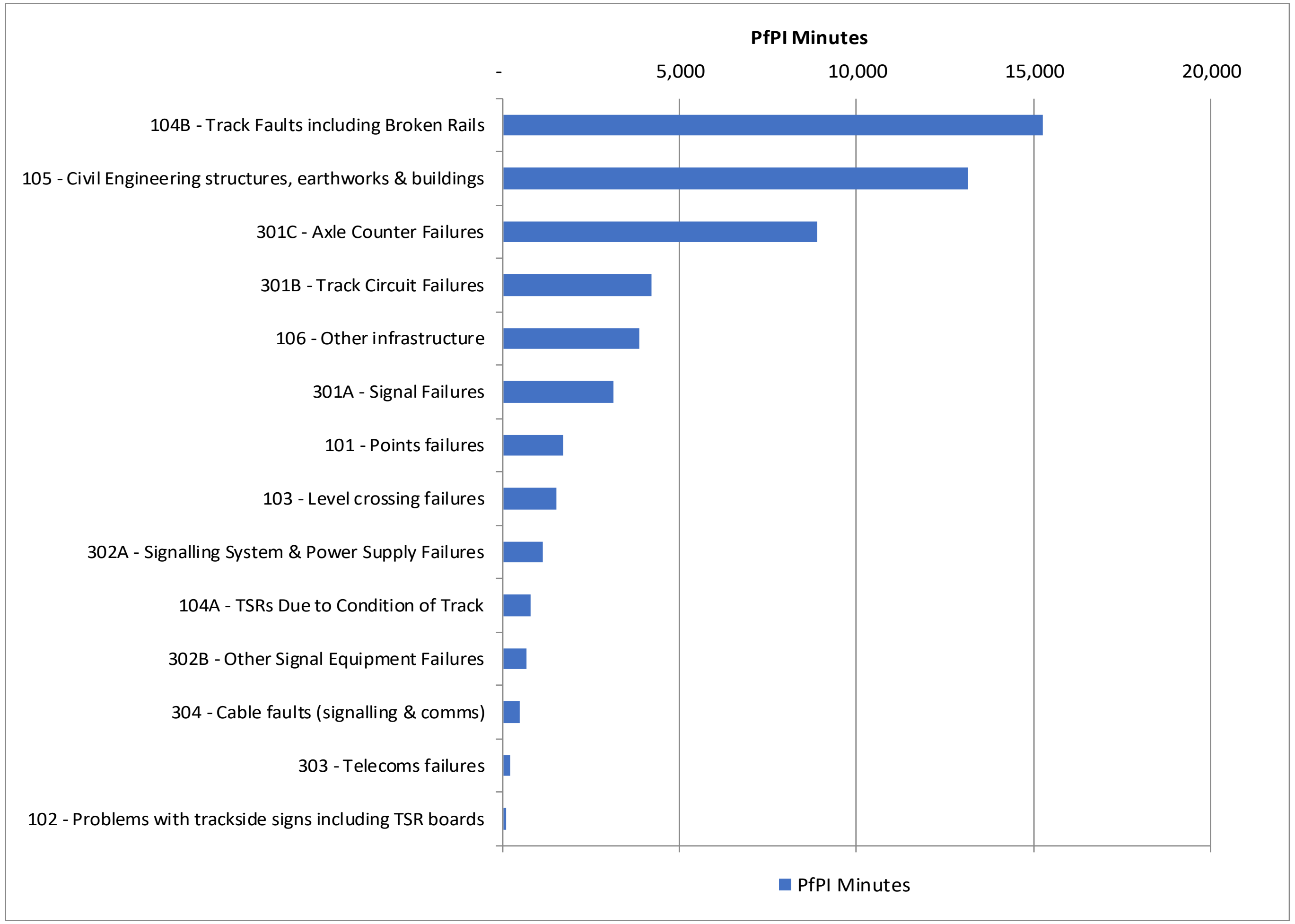
- 39.3% of the total delay minutes,
- 42.1% of the total cost

Distribution of Delay by All KPI's



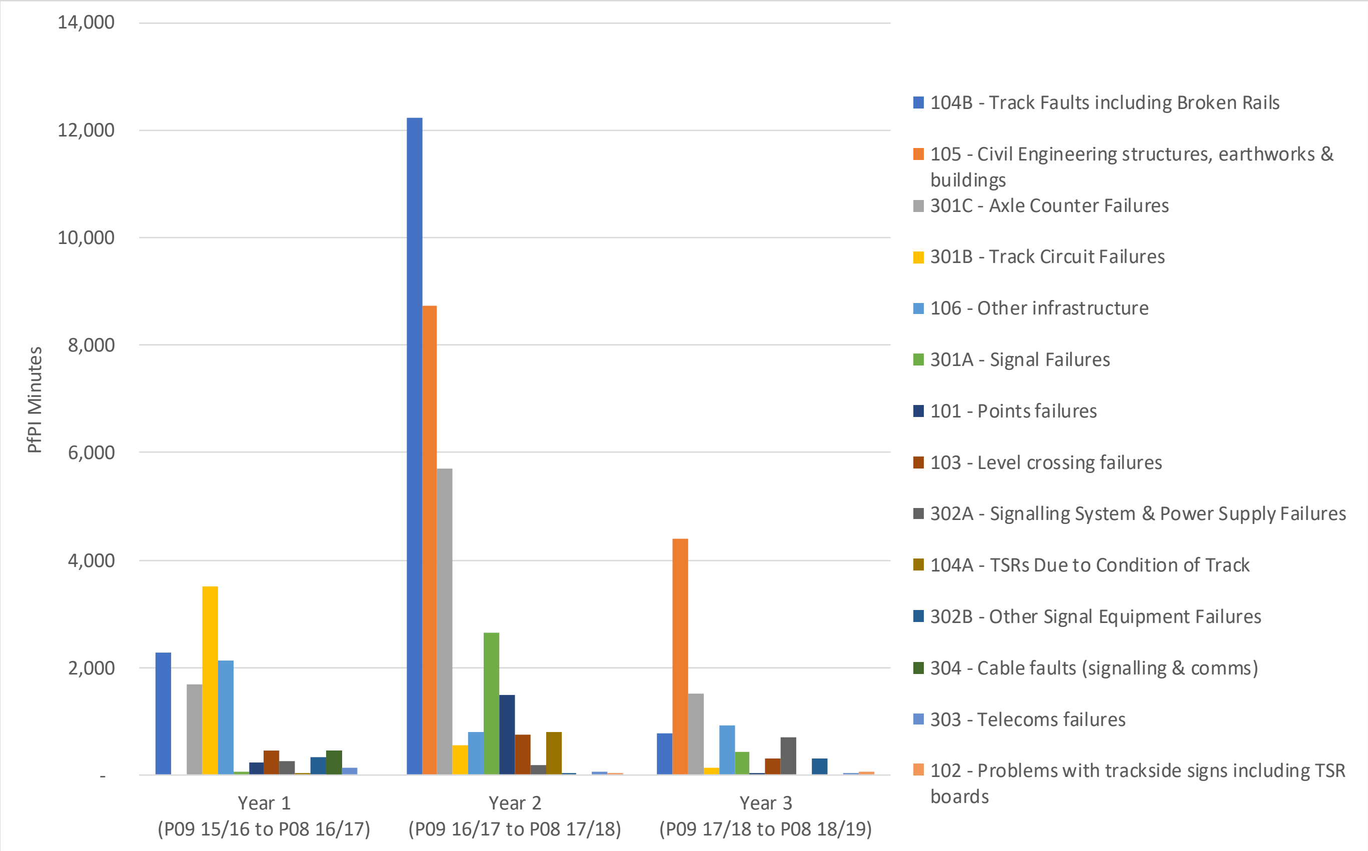
Top 30 Delay Minutes Causes by All KPI's

Distribution of Delay by Infrastructure KPI's



Top 14 Delay Minutes Causes by Infrastructure KPI's

Infrastructure KPI’s Delay Minutes Distribution by Year



Infrastructure Delay Minutes Distribution by Year

High Level Performance Summary

Engineering Suffix	Failures	SA Failures	PfPI Minutes	Delay Cost	Failures (%)	SA Failures (%)	PfPI Minutes (%)	Delay Cost (%)
Track (incl S&C)	648	183	21,986	£753,882	25.6%	32.8%	50.4%	41.5%
Level Crossing	337	85	2,213	£29,255	13.3%	15.2%	5.1%	1.6%
Track Circuit	132	64	4,318	£140,996	5.2%	11.5%	9.9%	7.8%
Signal	162	41	1,628	£47,139	6.4%	7.3%	3.7%	2.6%
POE	145	37	3,465	£188,684	5.7%	6.6%	7.9%	10.4%
Signalling Control	141	31	1,021	£12,291	5.6%	5.6%	2.3%	0.7%
Train Protection	152	26	564	£38,849	6.0%	4.7%	1.3%	2.1%
Radio - Coverage / Mobile	50	17	446	£18,311	2.0%	3.0%	1.0%	1.0%
Bridge	33	14	1,224	£39,376	1.3%	2.5%	2.8%	2.2%
Other Signalling	84	13	631	£44,541	3.3%	2.3%	1.4%	2.5%
Telecoms	257	12	385	£15,531	10.2%	2.2%	0.9%	0.9%
Boundary	81	8	1,648	£74,459	3.2%	1.4%	3.8%	4.1%
Axle Counter	16	7	3,396	£392,385	0.6%	1.3%	7.8%	21.6%
Mechanical Lever Equipment	32	6	389	£9,708	1.3%	1.1%	0.9%	0.5%
Lighting System	43	6	72	£233	1.7%	1.1%	0.2%	0.0%
Signalling Power	30	3	113	£7,063	1.2%	0.5%	0.3%	0.4%
CCTV Security	11	2	63	£2,305	0.4%	0.4%	0.1%	0.1%
Building	10	1	54	£1,211	0.4%	0.2%	0.1%	0.1%
Recorders	29	1	37	£1,389	1.1%	0.2%	0.1%	0.1%
Access Point	66	1	5	£105	2.6%	0.2%	0.0%	0.0%
Other Engineering Suffix	71				2.8%	0.0%	0.0%	0.0%

Grand Total	2,530	558	43,658	£1,817,712

Delay Minutes and Cost (%) by Engineering Suffix

Overview of Route Section Performance

Route Section	Failures	SA Failures	PfPI Minutes	Delay Cost	Failures (%)	SA Failures (%)	PfPI Minutes (%)	Delay Cost (%)
Chiltern Main Line	390	109	18,857	£673,656	15.4%	19.5%	43.2%	37.1%
Marylebone to Claydon Junction	612	157	7,402	£272,094	24.2%	28.1%	17.0%	15.0%
Midland Main Line	1,042	189	6,827	£86,059	41.2%	33.9%	15.6%	4.7%
Didcot Chester Line	158	40	6,200	£603,020	6.2%	7.2%	14.2%	33.2%
Bicester Town Branch	305	61	4,305	£177,156	12.1%	10.9%	9.9%	9.7%
Bletchley to Bicester Line	23	2	67	£5,728	0.9%	0.4%	0.2%	0.3%

Grand Total	2,530	558	43,658	£1,817,712

Delay Minutes and Cost (%) by Route Section