

# HS2

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## **PLANET Framework Model: PFMv7.1 Assumptions Report**

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## Department for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

High Speed Two (HS2) Limited,  
Two Snowhill  
Snow Hill Queensway  
Birmingham B4 6GA

Telephone: 08081 434 434

General email enquiries: [HS2enquiries@hs2.org.uk](mailto:HS2enquiries@hs2.org.uk)

Website: [www.hs2.org.uk](http://www.hs2.org.uk)

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# PFMv7.1 Assumptions Report

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# 1 Introduction

1.1.1 The PLANET Framework Model (PFM) has been developed by HS2 Ltd as a modelling tool to forecast the demand and economic benefits of the HS2 project. As modelling assumptions are updated and modelling techniques are revised, new versions of the model are released. The current version of PFM is PFMv7.1 which has been released following some routine updates to model inputs.

1.1.2 The modelling techniques and methodology that is used within the PFM is separately described in detail in the PFM model description report.

1.1.3 This document provides a summary of the input modelling and forecasting assumptions used by PFMv7.1 to generate what is known as the HS2 Reference Case which forms part of the economic business case for the HS2 project.

1.1.4 Throughout this document, reference will be made to 'Do Minimum' and 'Do Something'. These two expressions can generally be defined as:

- **Do Minimum** – The Do Minimum is the forecast future year scenario in which HS2 has not been constructed. It is a scenario in which currently committed infrastructure projects and expected service level agreements are implemented, providing the Reference Case against which the HS2 scheme is to be compared;
- **Do Something** – The Do Something is the forecast future year scenario in which the HS2 project has been constructed and implemented, along with any resulting changes to conventional rail services. There are three Do Something future year scenarios:
  - **Phase 1** – The high-speed rail network extends *London Euston – Birmingham* expected to be operational from 2026;
  - **Phase 2a** – The high-speed rail network extends *London Euston – Birmingham – Crewe* and is expected to be operational from 2027; and,
  - **Phase 2b** – The full high-speed rail network is in place from *London Euston – Birmingham – Manchester and Leeds* which is expected to be operational from 2033.

1.1.5 The remainder of this document is set out using the following structure:

- Chapter 2: Forecasting Assumptions – This chapter details the information that has been used to forecast demand for transport for the two modelled forecast years;
- Chapter 3: Economic Appraisal – This chapter details the information that has been used in the economic appraisal of the project;
- Chapter 4: Highway and Air Networks – This chapter provides details on what has been included in the air and highway networks for two modelled forecast years;

- Chapter 5: Rail Network: Do Minimum – This chapter provides a summary of the rail service provision in the forecast Do Minimum scenario;
- Chapter 6: Rail Network: Do Something – This chapter provides a summary of the rail service provision in the forecast Do Something scenarios;
- Chapter 7: High-Speed Rail Reliability – This chapter provides details on how the increased reliability of HS2 services is modelled in the forecast Do Something scenarios.

## 2 Forecasting Assumptions

### 2.1 Forecasting Approach

2.1.1 PFM has been set-up to model two future years: the financial years 2026/7 and 2037/8. In order to model these years, it is necessary to forecast the level of demand for travel in the forecast years. Forecasts of 'Do Minimum' passenger demand are produced by travel mode (rail / air / highway) and journey purpose (Commuter / Business / Leisure).

2.1.2 For the PFM, the processes for forecasting demand make use of the recommended Department for Transport (DfT) modal forecasting procedures for air, car and rail:

- Rail demand forecasts are generated in line with DfT's Transport Appraisal Guidance (WebTAG) using the DfT's Exogenous Demand Growth Estimation (EDGE)<sup>1</sup> forecasting software;
- Car forecasts are generated using the National Trip End Model in the DfT's TEMPro<sup>2</sup> software; and,
- Domestic air forecasts are generated using the DfT's Aviation Model<sup>3</sup>.

2.1.3 The remaining sections in this chapter outline the input assumptions used by the demand forecasting models to produce 'Do Minimum' demand forecasts for each of these travel modes.

### 2.2 Rail Demand Growth

#### Elasticities

2.2.1 Rail demand growth is generated by the DfT's EDGE software, which is based on current WebTAG<sup>4</sup> guidance for forecasting rail demand. This uses the Passenger Demand Forecasting Handbook (PDFH) Version 5.1 growth elasticities for all variables except fares that are based on PDFHv4.0 elasticities, and car cost which uses PDFHv5.0. In addition, the ticket type to journey purpose conversion is based on parameters from PDFHv5.0.

2.2.2 In PFMv7.1 (as was the case in PFMv6.1c) the forecasting approach incorporates the recommended PDFHv5.1 variable elasticity values for non-London flows. The exogenous elasticity values for GDP per Capita and Employment demand drivers vary over the short and long term forecasting horizon for non-London Core and Major city flow categories. The forecasting horizons are defined in WebTAG Unit M4.

<sup>1</sup> Exogenous Demand Growth Estimation (EDGE). Details are given in WebTAG TAG Unit M4, November 2014, Forecasting and Uncertainty.

<sup>2</sup> Details of the Trip End Model Presentation Programme (TEMPro) can be found at <https://www.gov.uk/government/collections/tempo>. Accessed 20 August 2015. TEMPro v6.2 was used for the latest PFM updates, however a newer version of TEMPro v7.2 has since been released which will be used for future updates of PFM.

<sup>3</sup> The model is described in 'UK Aviation Forecasts', DfT, January 2013, can be found at <https://www.gov.uk/government/publications/uk-aviation-forecasts-2013>. Accessed 5<sup>th</sup> April 2017.

<sup>4</sup> TAG Unit M4: November 2014, Table 1.

## Demand Drivers

- 2.2.3 Rail demand growth between the modelled base year and the modelled forecast years is generated by the DfT's EDGE forecasting software which utilises up to 14 different demand drivers to feed into the future year forecasts of rail demand growth. The rail demand drivers generally fall into two categories:
- Macro-economic drivers, such as: GDP per capita growth; growth in Employment; and growth in Population; and,
  - Costs associated with competing modes of transport.
- 2.2.4 The base year of PFMv7.1 is the financial year 2014/15, and so the demand drivers are utilised to calculate the forecast change in demand from the base year in 2014/15 to the forecast years in 2026/27 and 2037/38 for PFMv7.1.
- 2.2.5 The demand drivers for the modelling were provided by the DfT in December 2016 using the latest economic forecasts from the Office for Budget Responsibility (OBR) and Centre for Economics and Business research (CEBR).
- 2.2.6 The following sections detail the source data and assumptions used for each of these drivers in PFMv7.1 and, for ease of comparison, we also present the assumptions used in the previous model release, PFMv6.1c, the model used for the Economic Case for HS2, November 2016.
- 2.2.7 It should be noted that there is a minor change in demand forecasting methodology between PFMv6.1c and PFMv7.1. Although the model base years, and so base year demand matrices, are the same in both PFMv6.1c and PFMv7.1, the forecasting for PFMv7.1 incorporates observed growth between the base year and the present as recorded by the Office for Rail and Road (ORR), instead of forecast growth from EDGE. This means that rail growth is forecast from 2016/17 to the forecast years, rather than 2014/15 as previously.
- 2.2.8 Further detail on the demand forecasting for PFMv7.1 can be found within the "*PFMv7.1 Forecasting Report*".

## Population Growth

- 2.2.9 The growth in population used in PFMv7.1 has been sourced from Office of National Statistics (ONS) population projections, November 2015 (principal forecast which is also used by the GDP forecast), with regional and national shares-based data provided by the Centre for Economics and Business Research (CEBR), October 2016.
- 2.2.10 Table 2-1 presents the projected growth of the population for the forecast years from 2016/17.

Table 2-1: Regional and national population growth used in rail demand forecasts

Region/nation	Growth in Population from 2016/17, PFMv7.1	
	2026/27	2037/38
North East	3.3%	6.6%
North West	4.2%	8.2%
Yorkshire & Humberside	4.6%	9.1%
East Midlands	6.6%	12.7%
West Midlands	5.8%	11.5%
East of England	9.0%	17.1%
London	9.6%	17.6%
South East	8.3%	15.8%
South West	7.6%	14.7%
Wales	3.1%	5.5%
Scotland	3.0%	5.6%
Great Britain	6.5%	12.3%

## Employment Growth

- 2.2.11 The growth in employment used in PFMv7.1 has been sourced from the Office for Budget Responsibility (OBR) Economic and Fiscal Outlook Report November 2016 (for short term forecasts) and OBR's Fiscal Sustainability Report July 2015 (for long-term forecasts). Regional/national distributions are based on CEBR forecasts, October 2016.
- 2.2.12 Table 2-2 presents the predicted growth in employment as used in PFMv7.1 for the forecast years from 2016/17.

Table 2-2: Regional and national employment growth used in rail demand forecasts

Region/nation	% Growth in Employment from 2016/17, PFMv7.1	
	2026/27	2037/38
North East	2.4%	5.0%
North West	2.0%	6.8%
Yorkshire & Humberside	2.3%	7.6%
East Midlands	4.2%	10.0%
West Midlands	3.5%	8.7%
East of England	5.2%	9.6%
London	6.8%	9.9%
South East	3.3%	6.5%
South West	2.4%	6.7%
Wales	-0.2%	2.9%
Scotland	1.9%	5.0%
Great Britain	3.5%	7.6%

## Growth in Gross Domestic Product per Person

- 2.2.13 As with employment growth, the economic growth (measured by GDP per person) in PFMv7.1 has been sourced from the Office for Budget Responsibility (OBR) 'Economic and Fiscal Outlook Report November 2016' (for short term forecasts) and OBR's 'Fiscal Sustainability Report June 2015' (for long-term forecasts)<sup>5</sup>, using the ONS principle forecast numbers for population. Regional and national shares are based on CEBR, October 2016.
- 2.2.14 In 2012, HM Treasury changed its method of calculation for the GDP deflator from arithmetic to a geometric mean. This means the GDP deflator now corresponds more closely to a Consumer Price Index (CPI) measure of inflation than Retail Price Index

<sup>5</sup> <http://budgetresponsibility.org.uk/>. Accessed 5<sup>th</sup> April 2017

(RPI), although it is not quite the same as either. ONS back-calculated historic GDP using this new approach as well as using it in its GDP forecasts.

- 2.2.15 The PDFH5.1 GDP to rail demand elasticity parameter was estimated using GDP forecasts defined with the previous definition of the GDP deflator (similar to RPI), rather than the new deflator (similar to CPI). Consequently, to maintain consistency with the original calibration of the PDFH5.1 the GDP forecasts have to be rebased to the old GDP deflator.
- 2.2.16 The OBR has estimated that the new deflator increases real GDP growth by approximately 0.2 percentage points per annum; the real GDP growth forecasts have therefore been reduced by 0.2 percentage points every year to ensure the growth rates are consistent with the elasticities that are applied to them<sup>6</sup>. The resulting growth is shown in Table 2-3. The Great Britain figures are a population weighted average of the regional figures.
- 2.2.17 For this reason, the GDP forecasts used for forecasting rail growth are different to the ones used to forecast future Value of Time (VoT). The GDP series used for VoT is discussed in Chapter 3.

Table 2-3: Regional and national GDP growth used in rail demand forecasts

Region/nation	Growth in GDP per capita from 2016/17, PFMv7.1	
	2026/27	2037/38
North East	13.6%	36.2%
North West	13.0%	34.8%
Yorkshire & Humber	12.1%	32.4%
East Midlands	12.5%	34.0%
West Midlands	11.7%	31.8%
East of England	15.2%	40.8%
London	11.3%	32.9%
South East	14.8%	39.8%
South West	10.7%	29.8%
Wales	11.4%	31.4%
Scotland	14.7%	38.4%
Great Britain	13.3%	36.0%

<sup>6</sup> This was described in paragraph 1.1.5 of WebTAG unit 3.5.6, January 2014.

[http://webarchive.nationalarchives.gov.uk/20140304105410/http://www.dft.gov.uk/webtag/documents/expert/pdf/U3\\_5\\_6-Jan-2014.pdf](http://webarchive.nationalarchives.gov.uk/20140304105410/http://www.dft.gov.uk/webtag/documents/expert/pdf/U3_5_6-Jan-2014.pdf)  
 Accessed 5<sup>th</sup> April 2017.

## National Rail and London Underground Fares

- 2.2.18 All National Rail fares in PFMv7.1 are assumed to grow at a rate of RPI+1% per calendar year, except for the forecast period 2014/15-2019/20, when RPI+0% applies, in line with the Government's current policy on rail fares. Table 2-4 shows the cumulative growth used in the model from 2016/17 to the forecast years 2026/27 and to 2037/38.
- 2.2.19 The assumption of RPI+1% has been used for London Underground fares in PFMv7.1 forecast period, except for 2014/15-2015/16 when the actual increase of RPI+0% applies, and for the period 2017/18-2020/21 in which a nominal fare freeze has been applied.

Table 2-4: Rail fare growth used in rail demand forecasts

	Growth in Rail Fares from 2014/15, PFMv7.1	
	2026/27	2037/38
National Rail	6.4%	18.7%

## Car Ownership

- 2.2.20 The change in car ownership in PFMv7.1 has been sourced from the National Trip End Model (NTEM) in TEMPro version 6.2. This provides forecasts for the number of car-owning households.
- 2.2.21 Table 2-5 shows the growth in car-owning households for key RIFF<sup>7</sup> zones within the HS2 corridor.

Table 2-5: Car ownership growth used in rail demand forecasts

RIFF zone	Growth in Car Owning Households from 2016/17, PFMv7.1	
	2026/27	2037/38
Central London	4.6%	10.1%
Central Manchester	1.4%	3.6%
Rest of Manchester	1.5%	3.4%
Central Birmingham	3.2%	6.8%
Rest of West Midlands	1.1%	2.5%
Leeds	1.8%	4.4%
Rest of West Yorkshire	1.6%	3.4%
Great Britain	1.2%	2.7%

<sup>7</sup> RIFF zones are groups of areas defined within the EDGE model.

## Car Journey Times

- 2.2.22 The change in average car journey times used in the EDGE model for PFMv7.1 has been sourced from the DfT's TAG Databook<sup>8</sup>. The assumptions for travel times to London from the rest of Great Britain are shown in Table 2-6.

Table 2-6: Car journey time growth used in rail demand forecasts

	Growth in Car Journey Times from 2016/17, PFMv7.1	
	2026/27	2037/38
Rest of Great Britain to London	4.1%	8.2%

## Car Cost

- 2.2.23 This parameter represents the forecast cost of car use taking account of growth in car fuel prices and projected changes in the fuel efficiency of the vehicle fleet. This method is consistent with a change in WebTAG since February 2014 to include vehicle efficiency; previously WebTAG had recommended using only car fuel price growth as a proxy for growth in all car costs.

Table 2-7: Car cost growth used in rail demand forecasts

	Growth in Car Cost from 2016/17, PFMv7.1	
	2026/27	2037/38
Great Britain	-10.6%	-14.7%

## Bus and Coach Fares

- 2.2.24 Bus and coach fares in PFMv7.1 are based on projections by DfT Local Economics of bus fare and bus service forecasts. Forecast growth for PFMv7.1 from 2016/17 is shown in Table 2-8.

Table 2-8: Bus and coach fare growth used in rail demand forecasts

	Growth in bus costs from 2016/17, PFMv7.1	
	2026/27	2037/38
Great Britain	12.3%	27.7%

<sup>8</sup> Refers to <https://www.gov.uk/government/publications/webtag-tag-data-book-december-2015> Accessed 5<sup>th</sup> April 2017.

## Bus and Coach Journey Times

- 2.2.25 The forecast change in average bus and coach journey times in PFMv7.1 has been sourced from the WebTAG Databook, the same as for Car Journey Times. The change from 2016/17 for travel times to London from the rest of Great Britain is shown in Table 2-9.

Table 2-9: Bus and coach journey time growth used in rail demand forecasts

	Growth in Bus Journey Times from 2016/17, PFMv7.1	
	2026/27	2037/38
Rest of GB to London	6.6%	12.4%

## Bus and Coach Frequency

- 2.2.26 The forecast change in average bus and coach frequency<sup>9</sup> used in PFMv7.1 are based on projections by DfT Local Economics of bus fare and bus service forecasts. The change from 2016/17 is shown in Table 2-10.

Table 2-10: Bus and coach frequency growth used in rail demand forecasts

	Growth in Bus Frequency from 2016/17, PFMv7.1	
	2026/27	2037/38
Great Britain	0.2%	0.2%

## Air Passengers

- 2.2.27 The forecast change in domestic air passengers used in PFMv7.1 has been sourced from 2013 outputs of DfT's aviation model<sup>10</sup>. Table 2-11 shows forecasts growth from 2016/17 of air passengers by airport.

Table 2-11: Air passenger growth used in rail demand forecasts

Airport	Growth in air passengers from 2016/17, PFMv7.1	
	2026/27	2037/38
Gatwick Airport	9.8%	14.4%
Heathrow Airport	9.9%	17.1%
Stansted Airport	42.6%	64.3%
Birmingham Airport	31.1%	136.6%
Manchester Airport	28.5%	73.4%
Southampton Airport	50.1%	287.4%
Cardiff Airport	15.6%	67.9%

<sup>9</sup> In WebTAG frequency is referred to as 'headway'.

<sup>10</sup> The model is described in UK Aviation Forecasts, DfT, January 2013.

## 2.3 Rail Demand Forecasts

### Forecast years

2.3.1 The forecast years for PFMv7.1 are taken as:

- an opening year for the first phase of the scheme – assumed to be 2026/27; and,
- a second forecast year of 2037/38.

2.3.2 Using the rail demand drivers detailed in Section 2.2, the EDGE model produces rail growth forecasts for the opening year 2026/27 and the second forecast year 2037/38. The growth is summarised in Table 2-12 for PLD and in Table 2-13 for the regional PLANET models.

2.3.3 Whilst the PFM model Base year is 2014/15, the change to the rail demand forecasting approach to incorporate observed growth since the Base year (see paragraph 2.2.7) means that demand forecasts for rail are from 2016/17, whereas Air and Highway are from 2014/15 as before.

Table 2-12: Input forecast PLD matrices – growth in rail demand by journey purpose – PFMv7.1

Journey Purpose	Growth in Rail Demand from 2016/17 (growth in PLD matrices only)	
	2026/27	2037/38
Commuting NCA	5%	10%
Commuting CA from	13%	31%
Commuting CA to	13%	31%
Business CA from	22%	54%
Business CA to	22%	56%
Leisure NCA	13%	30%
Leisure CA from	21%	51%
Leisure CA to	21%	53%
<b>Total</b>	<b>18%</b>	<b>45%</b>

NCA = No Car Available. CA = Car Available.

Note 2: The car available/non-car available split does not apply for rail business trips.

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Table 2-13: Forecast regional PLANET matrices – growth in rail demand PFMv7.1

Regional Model	Journey Purpose	Growth in Rail Demand from 2016/17 (note this is the growth in regional matrices only)	
		2026/27	2037/38
PLANET South (PS)	Business PA	24%	62%
	Business AP	23%	57%
	Leisure PA	20%	52%
	Leisure AP	19%	47%
	Commuting PA	9%	17%
	Commuting AP	10%	20%
	<b>Total</b>	<b>11%</b>	<b>24%</b>
PLANET Midlands (PM)	Business CA	18%	48%
	Business NCA	10%	26%
	Leisure CA	18%	46%
	Leisure NCA	9%	25%
	Commuting CA	13%	34%
	Commuting NCA	5%	15%
	<b>Total</b>	<b>13%</b>	<b>33%</b>
PLANET North (PN)	Business CA	16%	41%
	Business NCA	8%	20%
	Leisure CA	15%	38%
	Leisure NCA	7%	17%
	Commuting CA	9%	23%
	Commuting NCA	1%	5%
	<b>Total</b>	<b>8%</b>	<b>22%</b>

PA = Production Attraction. AP= Attraction production CA= Car Available NCA = No Car available

## 2.4 Highway Demand Forecasts

### Economic Growth

2.4.1 The highway demand forecasts were developed using factors derived from TEMPro v6.2. To ensure consistency between these TEMPro based forecasts and the rail forecasts, which used a more recent OBR GDP growth forecast, a GDP elasticity was applied to the matrices to correct for the discrepancy.

2.4.2 Use was made of the DfT Long Distance Model forecasts using a high and low GDP estimate to derive implied arc elasticities of highway demand to GDP. The elasticities that were derived are shown in Table 2-14.

Table 2-14: Implied elasticity of highway demand with respect to GDP

Attribute	Purpose		
	Commuting	Business	Other
Implied Elasticity	0.087	0.151	0.147

2.4.3 The elasticities shown above were applied to the relative growth in GDP and global factors were calculated with these values, which are shown in Table 2-15. These values were applied to the forecast matrices to correct for the change in GDP forecast. The 2036/37 highway demand forecasts have been derived by assuming linear growth between the highway demand forecasts for 2026/27 and 2040/41.

Table 2-15: Growth applied highway demand to correct for change in GDP forecasts

Year	Growth applied to TEMProv6.2 outputs		
	Commuting	Business	Other
2026/27	-0.6%	-1.0%	-1.0%
2040/41	-0.6%	-1.0%	-1.0%

### Highway Forecasts by Purpose

2.4.4 Including the adjustment described above, Table 2-16 shows the highway forecasts applied to the base matrices by the three trip purposes.

Table 2-16: Highway forecasts for long distance trips used in PFMv7.1

Journey Purpose	Growth in Highway Trips from 2014/15	
	2026/27	2037/38
Commuting	6%	11%
Business	7%	13%
Leisure	10%	18%
<b>Total</b>	<b>9%</b>	<b>16%</b>

## 2.5 Air Demand Forecasts

- 2.5.1 The PFM model description report provides a detailed description of the DfT Aviation Model and its components. PFMv7.1 uses outputs from the most recently published DfT aviation forecasts<sup>11</sup>, at the time of model development.
- 2.5.2 The resulting matrix growth used is shown Table 2-18, it should be noted that the 2014/15 base year air demand matrices were calculated using interpolation from the existing 2010/11 and 2026/27 matrices.

Table 2-18: DfT Aviation Matrices – Growth in Domestic Air Passengers in PFMv7.1 (annual domestic trips)

Journey Purpose	Growth in Domestic Air Passengers from 2014/15	
	2026/27	2037/38
Business	20%	52%
Leisure	18%	46%
Total	19%	50%

Note: There is no Air Passenger Commuting Matrix in PFM

<sup>11</sup> UK Aviation Forecasts, DfT, January 2013, <https://www.gov.uk/government/publications/uk-aviation-forecasts-2013> Accessed 5<sup>th</sup> April 2017.

## 3 Economic Appraisal

### 3.1 Background

3.1.1 The appraisal of HS2 requires a range of assumptions to compare costs and benefits in accordance with WebTAG guidance. This section outlines the assumptions that have been adopted and their sources.

3.1.2 The economic appraisal uses outputs from the 'Do Minimum' and 'Do Something' (with HS2) scenarios from the PFM to produce an appraisal of the economic benefits of each phase of the scheme over the construction period and 60 years of operation.

3.1.3 The section describes the assumptions used in the economic appraisal of the scheme.

### 3.2 Price Base

3.2.1 The costs and benefits presented in the appraisal of HS2 are based on 2015/16 prices using the HM Treasury GDP deflator as a measure of inflation. The definition of this deflator has been changed from being more consistent with an RPI metric to being more consistent with a CPI metric.

### 3.3 Appraisal Period

3.3.1 In line with WebTAG guidance the appraisal period is based on 60 years of operation of the scheme.

3.3.2 The key assumptions used in the modelling and appraisal by PFMv7.1 are:

- Phase One – Opening Year 2026;
- Phase 2A – Opening Year 2027;
- Phase 2B – Opening Year 2033;
- First Forecast Modelled Year – 2026/27;
- Second Forecast Modelled Year – 2037/38.

## 3.4 Parameters

3.4.1 Within the PFMv7.1 appraisal process there are a series of weights that are applied to each benefit component by journey purpose. These are shown in Table 3-1.

Table 3-1: Generalised cost element weights for rail – PFMv7.1

Rail Element	Business	Commute	Other
In Vehicle Time	1.0	1.0	1.0
Wait Time	2.0	2.0	2.0
Access/Egress Costs PLD	1.0	1.0	1.0
Access/Egress Costs regional PLANETS	1.0	1.0	1.0
Board Time Penalty (mins)	30.0	30.0	30.0

### Values of Time

3.4.2 The values of time in the appraisal are assumed to increase with income. The measure of income used is GDP per person (as recommended by TAG Unit A1.3<sup>12</sup>).

3.4.3 The appraisal is based on the same GDP and population sources that feed into the PFM demand (choice) model's forecasts as outlined in Chapter 2.

3.4.4 The precise inputs to the appraisal are GDP growth forecasts and population growth data taken from the DfT's WebTAG Databook Annual Parameters table in January 2017. GDP growth is measured in real terms using the GDP deflator which is based on CPI (Table A5.3.1, WebTAG Databook, January 2017).

3.4.5 These inputs to the appraisal differ slightly from their use in the demand model which is based on mainland Great Britain transport networks that exclude Scottish islands and with income growth adjusted for inflation using the retail prices index.

Table 3-2: Growth in GDP used to derive values of time in the appraisal – PFMv7.1

Attribute	Growth from 2014	
	2026	2036
GDP, UK	28%	66%
Population, UK	8%	14%
GDP per person, UK	19%	45%

<sup>12</sup> TAG unit A1.3 User and Provider Impact, March 2017.

- 3.4.6 In October 2015, the Department for Transport published the report 'Understanding and Valuing the Impact of Transport Investment' (DfT, 2015). The report set out proposals for changing the way time savings are valued within transport, and particularly, to allow the value of time applied to each impact to vary according to the trip distance.
- 3.4.7 The values of time by distance band are shown in Table 3-3 along with the previous values.
- 3.4.8 In line with guidance (TAG Unit A1.3, March 217), the values of working and non-working time are assumed to increase with income with an elasticity of 1.0.

## PFMv7.1 Assumptions Report

Table 3-3: Updated Values of Time by Distance Band for PFMv7.1

Purpose/Mode	Distance Band	Values of Time by Purpose (£/hr) (2010/11 prices)	
Business – Highway Driver	0-50km	10.02	
	50-75 kms	14.32	
	75-100 kms	17.05	
	100-125 kms	19.63	
	125-150 kms	21.92	
	150-175 kms	23.83	
	175-200 kms	25.35	
	200-225 kms	26.51	
	225-250 kms	27.38	
	Business – Highway Passenger	250-275 kms	28.01
		275-300 kms	28.46
		300-325 kms	28.78
		325-350 kms	29.01
		350-375 kms	29.16
375-400 kms		29.27	
400- kms		29.32	
Business – Rail Passenger	0-50km	10.02	
	50-75km	14.43	
	75-100 kms	18.41	
	100-125 kms	22.63	
	125-150 kms	26.77	
	150-175 kms	30.56	
	175-200 kms	33.80	
	200-225 kms	36.40	
	225-250 kms	38.40	
	250-275 kms	39.89	
	275-kms	40.96	
Commuting	All	9.95	
Other	All	4.54	

## Annualisation Factors

- 3.4.9 PFMv7.1 provides outputs for an average weekday. In order to undertake an appraisal of HS2, these weekday values are annualised to represent a calendar year. Table 3-4 shows the annualisation factors that have been derived for each mode and journey purpose for use in PLD.
- 3.4.10 The factors for rail and air are consistent with the method adopted to de-annualise weekday demands from annual matrices. In the case of highway there is no de-annualisation in the matrix development process and the factors have been sourced from an analysis of NTS.

Table 3-4: Annualisation factors – PFMv7.1 PLD

Purpose	Rail	Air	Highway
Business	255	313	275
Commuting	264	n/a	282
Other	428	313	361
Average	316	313	306

- 3.4.11 In addition, there are a set of factors used to annualise information from the regional PLANET models which are given in Table 3-5. The regional PLANET models represent the morning peak period and so higher annualisation factors are used.

Table 3-5: Regional PLANET annualisation factors – PFMv7.1

Purpose	7AM to 10 AM	10AM to 4PM	4PM to 7PM	7PM to 7AM	Total (incl. Weekend)
Business User	304	539	365	169	1,376
Commuting User	278	86	260	73	697
Leisure User	303	1,181	602	476	2,562
Business Crowding	253	0	304	0	557
Commuting Crowding	253	0	237	0	490
Leisure Crowding	253	0	503	0	756

## Fares

- 3.4.12 In accordance with WebTAG, benefits and costs in the appraisal are presented in real terms using the GDP deflator. As such the definition of inflation used in the calculation of revenue (RPI) and the definition of inflation used in the rest of the appraisal (GDP deflator) are inconsistent.
- 3.4.13 In order to define fares growth on the basis of the GDP deflator, revenues are uplifted by the difference in the RPI and GDP deflator indices over time. The difference between these indices is around 0.9% per annum; in effect, this means real fares growth defined

on the basis of RPI+1% per annum is equivalent to growth of the GDP deflator +1.9% per annum.

3.4.14 For the purpose of our modelling, all National Rail and London Underground fares are assumed to grow at a rate of RPI+1% per year between 2014/15 and the second forecast year except between 2014/15 and 2020/21, when RPI+0% applies. Within the appraisal there is no further real growth in fares for the remainder of the appraisal period beyond that point.

3.4.15 The regional uni-modal sub-models do not contain a fares matrix, and revenue is therefore calculated on the basis of average fares per kilometre as shown in Table 3-6.

Table 3-6: Fares yield – PFMv7.1

Purpose	Fares £/passenger kilometre (2015/16 prices)		
	PLANET South	PLANET Midlands	PLANET North
Business	0.153	0.172	0.164
Commuting	0.143	0.154	0.174
Other	0.139	0.157	0.153

### Ramp-up Effects

3.4.16 The full benefits of HS2 will not be experienced in the first few years of operation as not all additional demand will be realised from day one. To reflect this, a series of ramp up assumptions for demand benefits are applied within the appraisal as shown by Table 3-7.

Table 3-7: Assumptions related to ramp-up effects, PFMv7.1

Year After Opening	Year Phase One	Year Phase 2a	Year Phase 2b	Growth adjustment applied to Demand and Benefits
0	2026	2027	2033	-20%
1	2027	2028	2034	-10%
2	2028	2029	2035	-5%
3 and beyond	2029	2030	2036	0%

### Discount Rates

3.4.17 In line with TAG Unit A1.1 and WebTAG Databook, November 2014<sup>13</sup>, a series of discount rates are applied from 2011. The annual discount rates assumed are:

- until 2046: annual discount rate = 3.5%;
- between 2047 and 2091: annual discount rate = 3.0%; and

<sup>13</sup> WebTAG Databook, December 2015.

- beyond 2092: annual discount rate = 2.5%.

## Highway Factors Used in the Appraisal

3.4.18 Vehicle operating costs are derived using the approach outlined in TAG Unit A1.3<sup>14</sup>. Fuel consumption is estimated using the function:

$$L = (a + b.v + c . v^2 + d.v^3) / v$$

where: L= fuel consumption, expressed in litres per kilometre;

v = average speed in kilometres per hour; and

a, b, c, d are parameters defined for each vehicle category.

3.4.19 The input for speed of highway traffic, v, is taken from PLD’s highway model, which estimates average traffic speed using DfT link type specific volume delay functions and traffic estimates. The vehicle operating cost parameters adopted within the HS2 appraisal are based on the parameters used by TAG Unit A1.3<sup>15</sup>.

3.4.20 The impacts of road decongestion are assessed in line with TAG A5.4, December 2015<sup>16</sup>. In the absence of more specific evidence TAG suggests the use of a diversion factor based on results from the DfT’s National Transport Model which suggest 26% of a change in rail passenger kilometres would be diverted from car kilometres.

3.4.21 The TAG Unit A5.4 values are used to derive Highway External Costs for 2026 and 2037 are presented in Table 3-8. These have been derived by interpolation and extrapolation of the values quoted in WebTAG Databook, December 2015.

Table 3-8: Highway external costs (pence / car km)

Element	Pence/ car km (2015)			Pence/ car km (2026)			Pence/ car km (2037)		
	Motor-ways	A road	Other Roads	Motor-ways	A road	Other Roads	Motor-ways	A road	Other Roads
Congestion (London)	0.1	68.6	45.8	1.2	135.9	72.9	3.1	213.4	104.6
Congestion (Conurbations)	1.6	32.8	23.4	5.5	54.7	41.1	11.2	85.0	62.1
Congestion (Other Urban)	n/a	13.2	10.3	n/a	22.2	15.3	n/a	33.7	20.8
Congestion (Rural)	1.0	2.2	2.9	3.8	3.9	5.5	10.4	6.2	8.3
Infrastructure (London)	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.2	0.2
Infrastructure (Conurbation)	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.2	0.2
Infrastructure (Other Urban)	n/a	0.1	0.1	n/a	0.1	0.1	n/a	0.2	0.2
Infrastructure (Rural)	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.2	0.2

<sup>14</sup> TAG unit A1.3 User and Provider Impacts, November 2014.

<sup>15</sup> TAG unit A1.3 User and Provider Impacts, November 2014.

<sup>16</sup> TAG unit A5.4 Marginal External Costs, December 2015.

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Element	Pence/ car km (2015)			Pence/ car km (2026)			Pence/ car km (2037)		
	Motor-ways	A road	Other Roads	Motor-ways	A road	Other Roads	Motor-ways	A road	Other Roads
Accident (London)	0.0	3.2	3.2	0.0	3.9	3.9	0.0	4.8	4.8
Accident (Conurbations)	0.0	3.2	3.2	0.0	3.9	3.9	0.0	4.8	4.8
Accident (Other Urban)	n/a	3.2	3.2	n/a	3.9	3.9	n/a	4.8	4.8
Accident (Rural)	0.0	0.7	0.7	0.0	0.9	0.9	0.0	1.1	1.1
Local Air Quality (London)	0.2	0.1	0.2	0.0	0.0	0.0	0.1	0.0	0.0
Local Air Quality (Conurbations)	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Local Air Quality (Other Urban)	n/a	0.1	0.1	n/a	0.0	0.0	n/a	0.0	0.0
Local Air Quality (Rural)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Noise (London)	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Noise (Conurbations)	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Noise (Other Urban)	n/a	0.2	0.2	n/a	0.3	0.3	n/a	0.3	0.3
Noise (Rural)	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.2
Greenhouse Gases (London)	0.9	0.9	1.2	0.7	0.8	1.0	1.1	1.4	1.6
Greenhouse Gases (Conurbations)	0.8	0.8	0.9	0.7	0.7	0.8	1.1	1.1	1.2
Greenhouse Gases (Other Urban)	n/a	0.8	0.9	n/a	0.7	0.8	n/a	1.0	1.2
Greenhouse Gases (Rural)	0.9	0.8	0.8	0.7	0.7	0.7	1.1	1.0	1.0
Indirect Taxation (London)	-4.2	-4.4	-5.6	-3.2	-3.6	-4.4	-2.9	-3.5	-4.3
Indirect Taxation (Conurbations)	-4.1	-4.1	-4.5	-3.1	-3.2	-3.5	-2.8	-3.0	-3.3
Indirect Taxation (Other Urban)	n/a	-3.8	-4.3	n/a	-3.0	-3.3	n/a	-2.8	-3.1
Indirect Taxation (Rural)	-4.2	-3.8	-3.7	-3.1	-2.9	-2.9	-2.9	-2.7	-2.7

### Wider Impacts

- 3.4.22 The wider impacts of HS2 that are additional to transport user benefits have been estimated in line with TAG Unit A2.1, January 2014. The impacts are estimated by using DfT's Wider Impacts in Transport Appraisal (WITA) software. In the case of the output change in imperfectly competitive markets WebTAG recommends these are estimated as being equivalent in value to 10% of the business user transport benefits.

### Carbon Impacts

- 3.4.23 The impacts of HS2 on emissions of carbon from highway and diesel train use have been appraised using a bespoke model which applies PFM assumptions. These are:
- Assumptions for car fuel consumption, car emissions and the value of a non-traded tonne of carbon from WebTAG;

- Train kms and highway kms from PFM;
- Car speeds for long distance and local from the DfT’s National Transport Model; and
- Diesel train energy consumption is sourced from DfT’s Rail Emissions Model.

## 4 Highway and Air Networks

### 4.1 Background

4.1.1 Within PLD and the regional PLANET models are a series of networks for the ‘Do Minimum’ and ‘Do Something’ scenarios. Chapter 4 outlines the assumptions made for the air and highway networks. Chapters 5 and 6 outline the assumptions related to the rail networks.

### 4.2 Do Minimum and Do Something Highway Networks

4.2.1 Within PFMv7.1 no additional highway schemes were added between 2026/27 and 2036/37, hence the 2026/27 and 2036/37 networks are identical. In addition, they are also identical in the ‘Do Minimum’ and ‘Do Something’ scenarios.

4.2.2 The schemes that were included in the PFMv7.1 model are listed in Table 4-1. Note the infrastructure schemes include the DfT’s list of under-construction and committed Road Investment Scheme Period 1 (RIS1) infrastructure programs.

Table 4-1: Highway Schemes in PFMv7.1 - 2026/27 and 2036/37

Scheme Assumed	
A1 Bramham – Wetherby	A11 Fiveways to Thetford Improvement
A3 Hindhead Improvement	A160 / A180 Improvements, Immingham
A421 Bedford to M1 Junction 13	A465 Dualling Scheme between Abergavenny and Hirwaun
M1 Junctions 25-28 Widening Scheme	A556 Knutsford to Bowdon Environmental Improvement
M25 Junctions 16-23 Widening	M1 Junctions 28-31 Managed Motorways
M25 Junctions 27-30 Widening	M1 Junctions 32-35a Managed Motorway
M27 J3-4 Widening	M1 Junctions 39-42 Managed Motorway
M42 J7-9 Hard Shoulder Running	M25 Junctions 23-27 Managed Motorways
M6 J4-5 Hard Shoulder Running	M25 Junctions 5-7 Managed Motorways
M6 Junctions 8-10A Managed Motorways (Birmingham Box Phase 2)	M60 Junctions 15-12 Lane Gain
M74 Completion	M60 Junctions 8-12 Managed Motorways
M80 Steps to Haggs	M62 Junctions 18-20 Managed Motorway

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<b>Scheme Assumed</b>	
A1 Dishforth to Leeming Improvement Scheme (A1 Dishforth to Barton)	M8 M73 M74 Motorway Improvements
A23 Handcross to Warninglid	A453 Widening (M1 Junction 24 to A52 Nottingham)
A46 Newark to Widmerpool Improvement	A494 Drome Ewloe Improvement
M1 Junction 10-13 Improvements	A5-M1 Link (A505 Dunstable Northern Bypass)
M4 Junction 19-20 and M5 Junction 15-17 Managed Motorways	A9 Dualling
M4 Junction 3-2 Bus Lane Suspension Scheme	M3 Junctions 2-4a Managed Motorway
M6 Junctions 5-8 Managed Motorways (Birmingham Box Phase 3)	M4 Junctions 3-12 Managed Motorway
M62 Junctions 25 to 30 Managed Motorway	M54 to M6 / M6 (Toll) Link Road
M6 Junction 10A - 13 Managed Motorway	A500 Etruria Valley Widening
A1(M) Jn 5 - 9 Welyn-Baldock	M5 Junctions 4a - 6 south of Birmingham
A1(M) Jn 6 - 8 Stevenage	M53 J11 - 5 Capacity Improvements
M1 J23a – M1 J24 Smart Motorways	M56 J6 - J8
M1 Junctions 13 - 19 south of Rugby	M6 J10a-13 Widening
M1 Junctions 24 - 25 (Long Eaton)	M6 J5-8w Widening. Birmingham Box Ph3
M20 Jn3 - 5 (Maidstone)	M6 Jn16 - 19 Birmingham - Manchester
M23 Junctions 8 - 10 (Gatwick)	M6 Junctions 13 - 15 between Birmingham and Manchester
M25 J 10-12 SM widening	M6 Junctions 2 - 4 between Coventry and Birmingham
M25 J 14-16 SM Widening (a)	M6 Junctions 21a - 26 west of Manchester
M25 J 14-16 SM widening (b)	M60 J1 - 4 Widening (link to M56 Junction 3 not coded)
M27 Junctions 4 - 11 (Southampton)	M60 J24-27 Widening
M3 Junctions 9 - 14 (Southampton)	M60 J8 -12 Widening
M4: Jn 3 (Uxbridge) to Jn 12 (Reading west): upgrading to Smart Motorway, linking Reading to Heathrow	M62 J25 to J30 Widening
M40/M42 interchange: upgrading to Smart Motorway from junction 16 of the M40 and from junction 3 to 3a of the M42	M62 Junctions 10 - 12 (Manchester)
A1 Leeming to Barton Upgrade to Motorway Standard	A5036 Access to Port of Liverpool
A1 Lobley Hill	M4 J3-12 Widening
A14 Cambridge to Huntingdon	M42 J10 to M69 J1 (1) - A5 Hinckley

Scheme Assumed	
A19 Norton to Wynyard	M54 to M6 (Toll) Link - [New Road but upgrade A460]
A21 Tonbridge to Pembury	M60 J8 -12 Widening
A5: Hinckley: widening of the section of A5 near Hinckley to dual carriageway where it carries traffic for both the A5 and A47	New junction 11A M1, link road to A5

## 4.3 Do Minimum and Do Something Air Networks

4.3.1 The air passenger supply in PFM represents domestic air services wholly within mainland of Great Britain, thus excludes services to Northern Ireland, the Channel Islands, Isle of Man and Scottish islands. Within PFM the networks were taken directly from the DfT Aviation Model<sup>17</sup>.

4.3.2 Table 4-2 shows the changes in routes between the various forecast years used in PFM.

Table 4-2: Air Network Changes in PFM

2026/27 Routes added relative to 2010/11	2026/27 Routes removed relative to 2010/11
Exeter – Stansted	Aberdeen – Luton
Inverness – Bristol	Aberdeen – Durham
Inverness – Edinburgh	Edinburgh – Gatwick
Inverness - London City	Edinburgh – Manchester
London City – Inverness	Edinburgh – Stansted
Newquay - Leeds Bradford	Exeter – Edinburgh
Stansted – Exeter	Glasgow – Luton
	Glasgow – Southampton
	Gatwick – Edinburgh
	Luton – Aberdeen
	Luton – Glasgow
	Luton – Inverness
	Manchester – Bristol
	Manchester – Edinburgh
	Manchester – Norwich
	Durham – Aberdeen
	Prestwick - Stansted
	Stansted – Edinburgh

<sup>17</sup> <https://www.gov.uk/government/publications/uk-aviation-forecasts-2013>

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	Stansted - Prestwick
<b>2037/38<sup>18</sup> Routes added relative to 2026/27</b>	<b>2037/38 Routes removed relative to 2026/27</b>
Cardiff - Inverness	Gatwick - Glasgow
Edinburgh - Gatwick	Gatwick - Manchester
Gatwick - Edinburgh	Glasgow - Gatwick
Inverness - Cardiff	Inverness - Bristol
Manchester - Bristol	Manchester - Gatwick
Manchester - Norwich	Stansted - Glasgow
Newquay - Manchester	
Prestwick - Stansted	

### Air fares

4.3.3 The networks in PFM take the base year domestic air fare matrix unadjusted from the DfT Aviation Model which provides air fares between all modelled airports in constant 2008 prices and values. These are adjusted to the 2014/15 base year and the forecast years using the index of changes in real domestic business and leisure fares supplied by the DfT.

4.3.4 The index of changes in real air fares is shown in Table 4-3.

Table 4-3: Real Fare Index Factors – Air Fares, PFM

Purpose	Growth in air fares from 2008		
	2014/15	2026/27	2037/38
Business	-3.8%	-1.1%	-0.1%
Leisure	-2.5%	16%	21.3%

<sup>18</sup> 2040/41 air networks have been adopted for 2037/38 in PFM

# 5 Rail Network: Do Minimum

## 5.1 Background

- 5.1.1 The rail networks within PFM include a representation of a timetable and its associated capacity. The 'Do Minimum' provides a reference against which the 'Do Something' HS2 option is compared.
- 5.1.2 A summary of the key assumptions used within the PLD sub-model of PFM for the Train Operating Companies (TOC) affected by HS2 are given in this chapter. For each TOC, a summary of the service pattern is presented. The summary for each TOC does not show every single service operated by the TOC, the descriptions and diagrams are simplifications for the purpose of reporting.
- 5.1.3 With a few exceptions, the 'Do Minimum' timetable assumptions are based on future committed schemes only. The 'Do Minimum' makes use of information provided by the DfT for National Rail services and Transport for London (TfL) for London Underground Limited (LUL) services. The national rail and LUL 'Do Minimum' networks are assumed to be identical in the 2026/27 (first forecast year model) and 2037/38 (second forecast year).
- 5.1.4 In the PLD model these assumptions relate to the average service pattern on weekdays. Information used within the regional PLANET models relates to services during the morning peak period on an average weekday.
- 5.1.5 **These assumptions are designed only for the purpose of providing a suitable reference case for the appraisal of HS2. Decisions have not yet been taken about train service requirements – or which stock will operate them – in any of the relevant franchises in any of the forecast years, and therefore these service patterns should be considered to be indicative.**

## 5.2 Chiltern Railways

5.2.1 The 'Do Minimum' service and rolling stock assumptions for Chiltern Railways in PFMv7.1 have not been updated from PFMv6.1c.

5.2.2 The assumed future year 'Do Minimum' timetable includes Evergreen 3, which allows for new London Marylebone - Oxford services via Bicester Town introduced in 2016 to be included, as well as a small amount of train lengthening on some peak services between Aylesbury and High Wycombe.

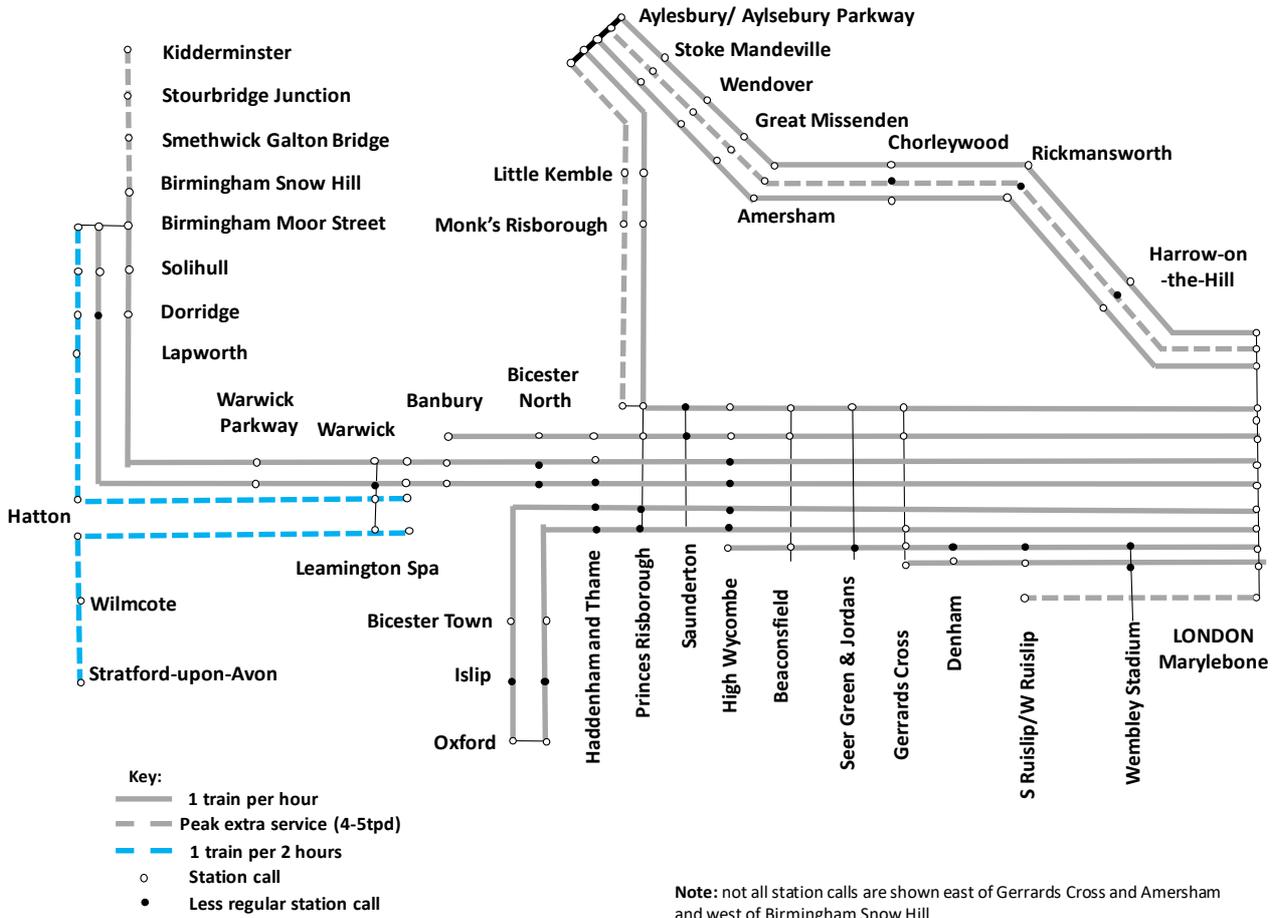
5.2.3 The main services included in the specification are:

- 2 trains per hour (tph) + peak extras between London Marylebone and Aylesbury Vale Parkway/Aylesbury via Amersham;
- 2tph London Marylebone – Birmingham Snow Hill/Birmingham Moor Street;
- 2tph London Marylebone – Oxford;
- 1tph London Marylebone – Gerrards Cross;
- 1tph London Marylebone – Banbury;
- 1tph London Marylebone – High Wycombe;
- 1tph London Marylebone - Aylesbury Vale Parkway/Aylesbury via Princes Risborough;
- 0.5tph Leamington Spa – Birmingham Moor Street;
- 0.5tph Stratford-Upon-Avon – Leamington Spa;
- 5 trains per day (tpd) Princes Risborough – Aylesbury; and,
- 4tpd peak only London Marylebone – West Ruislip.

5.2.4 Figure 5-1 shows a simplified summary of the service and service pattern assumed in the 'Do Minimum'.

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Figure 5-1: Chiltern - Average Service Pattern used in PFMv7.1 – 'Do Minimum'

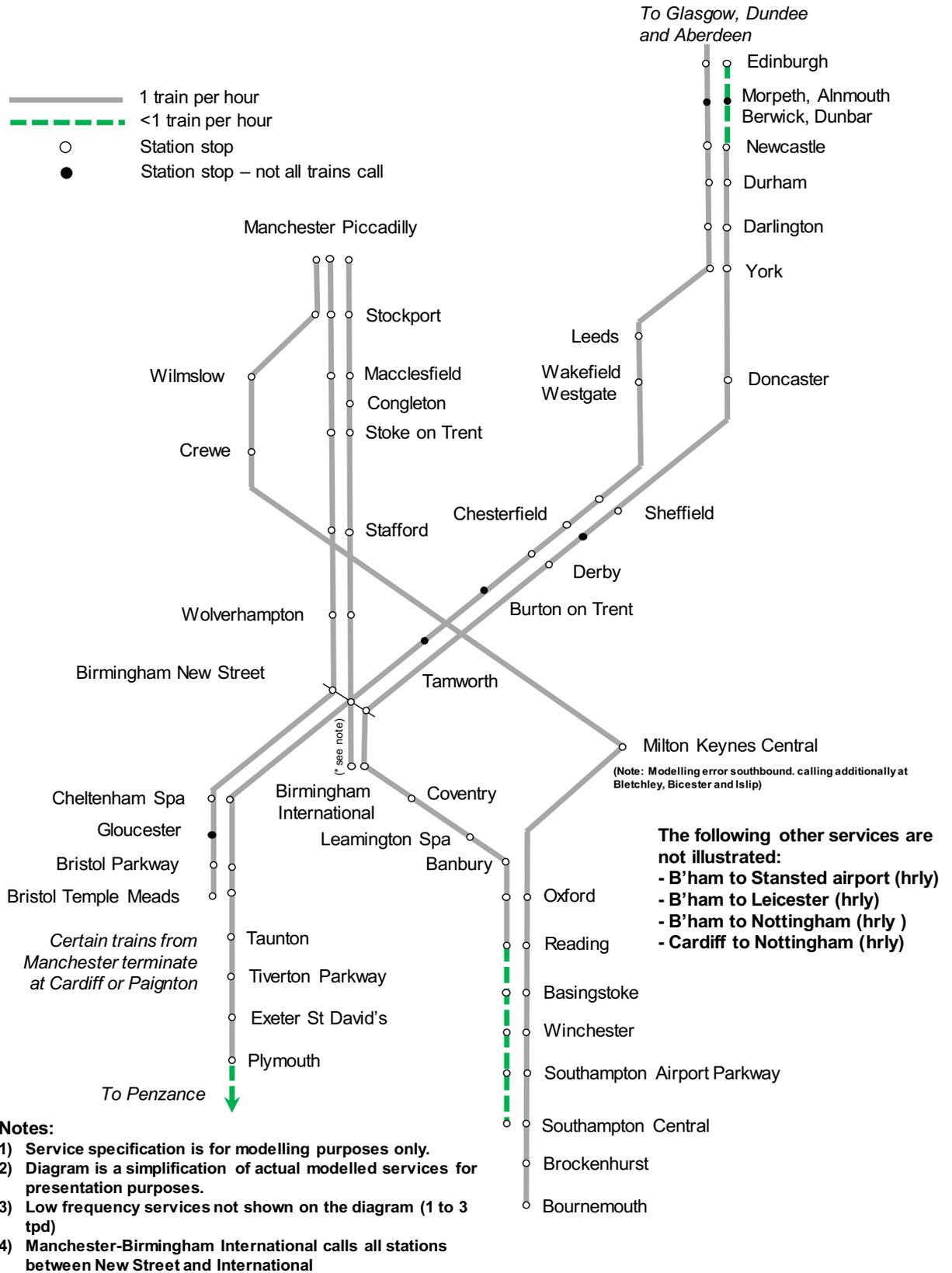


## 5.3 Cross Country

- 5.3.1 The 'Do Minimum' assumptions for Cross Country in PFMv7.1 have not been updated from PFMv6.1c.
- 5.3.2 The future year 'Do Minimum' timetable includes electrification, with a fleet of 5-car Intercity Express Programme (IEP) trains on the Cross-Country network with the exception of the Cardiff to Nottingham route which remain as Class 170 trains.
- 5.3.3 The following service pattern for Cross Country is represented in the Do Minimum:
- 1tph Scotland – Plymouth with some services extended to Penzance;
  - 1tph Reading – Newcastle with some services extending to Edinburgh and Southampton Central;
  - 1tph Manchester Piccadilly – Bournemouth;
  - 1tph Manchester Piccadilly – Bristol Temple Meads; and,
  - 1tph Manchester Piccadilly – Birmingham International.
- 5.3.4 There are small changes in the future year 'Do Minimum' timetable from the modelled base year. The biggest change is the re-routing of Bournemouth – Manchester services via East West Rail, Milton Keynes and Crewe, and the addition of an hourly service between Manchester and Birmingham International to replace the diverted service on this section of the route.
- 5.3.5 Figure 5-2 shows a summary of the service and stopping pattern assumed in the 'Do Minimum' for Cross Country services.

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Figure 5-2: Cross Country- Average Service Pattern used in PFMv7.1 – 'Do Minimum'



## 5.4 East Coast

5.4.1 The 'Do Minimum' assumptions for East Coast in PFMv7.1 have not changed from PFMv6.1c.

5.4.2 The future year 'Do Minimum' timetable uses the Intercity East Coast (ICEC) May 2020 weekday timetable developed by the new Virgin Trains East Coast franchisee.

5.4.3 Please note that the modelled timetable reflects what was assumed in the franchisee's bid. DfT is reviewing the ECML Do Minimum position in light of the subsequent decision by the Office of Rail and Road (ORR) regarding these services and the introduction of a new Open Access service between London and Edinburgh. Any changes on account of this review will be reflected in the next iteration of PFM.

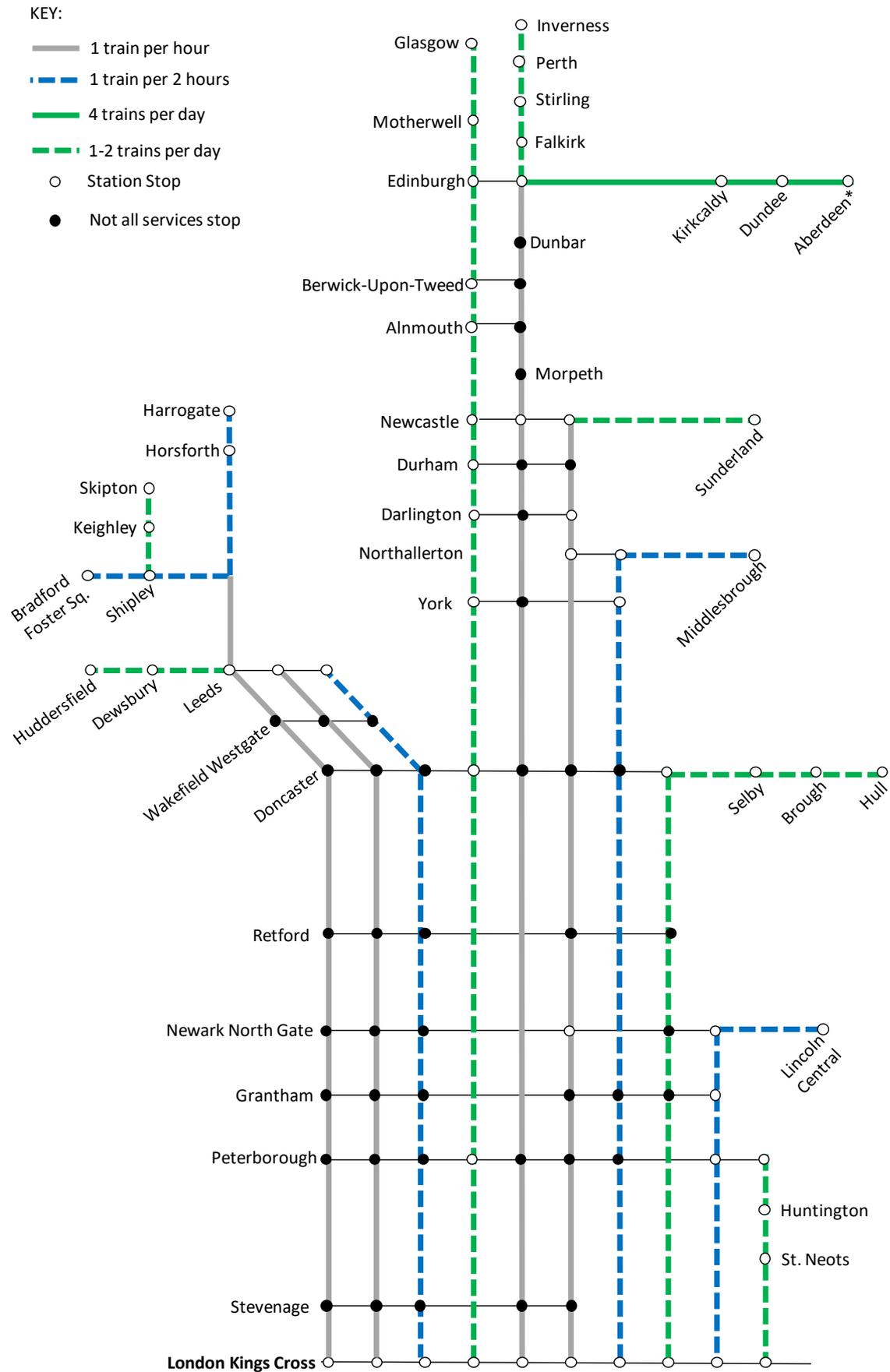
5.4.4 This timetable incorporates 5- and 9-car electric and bi-mode IEP trains and reduced formation class 91/Mk IV (2+7), replacing class 91/Mk IV (2+9) and high speed train formations. The key features of this timetable are:

- 26tpd between Edinburgh and London King's Cross with the fastest journey time of four hours; four trains extend to Aberdeen, and one each to Glasgow, Stirling and Inverness;
- 1tph between Newcastle and London King's Cross, with two services extending to Sunderland;
- an additional train every two-hours between Middlesbrough and London King's Cross (six down and seven up);
- 35tpd serving Leeds, averaging 2tph with a journey time of two hours. Of these trains, 6tpd travel onwards to each of Harrogate and Bradford, and 1tpd travels onwards to each of Huddersfield and Skipton;
- 3tpd from London King's Cross to Doncaster, 1tpd from Doncaster to London King's Cross, along with 1tpd from each of Newark and Peterborough to London King's Cross; and
- One train every two hours between Lincoln and London King's Cross.

5.4.5 Figure 5-3 shows a simplified summary of the service and stopping pattern assumed in the 'Do Minimum' for East Coast services.

# PFMv7.1 Assumptions Report

Figure 5-3: East Coast – Average Service Pattern used in PFMv7.1 – 'Do Minimum'



## 5.5 East Midlands

- 5.5.1 The 'Do Minimum' assumptions for East Midlands PFMv7.1 have been updated from PFMv6.1c to reflect new assumptions surrounding the upgrade to the Midland Mainline.
- 5.5.2 The future year 'Do Minimum' PFMv7.1 timetable is based on the latest East Midlands (EM) timetable which assumes electrification of the midland main line and some line speed improvements.
- 5.5.3 The East Midlands timetable within PFMv7.1 includes the following principal services operating between London Kings Cross and the East Midlands:
- 2tph between Corby and London St Pancras (where the service is coded between Kettering and London St Pancras, as Corby is not included in PFM);
  - 2tph between Nottingham and London St Pancras; and,
  - 2tph between Sheffield and London St Pancras.
- 5.5.4 In addition to the listed services, the East Midlands TOC also operates many local and regional services out of Derby, Nottingham and Leicester.
- 5.5.5 Figure 5-4 shows a summary of the service and stopping pattern assumed in the 'Do Minimum' for East Midland services.

Figure 5-4: East Midland – Average Service Pattern used in PFMv7.1 – 'Do Minimum'



## 5.6 East-West Rail

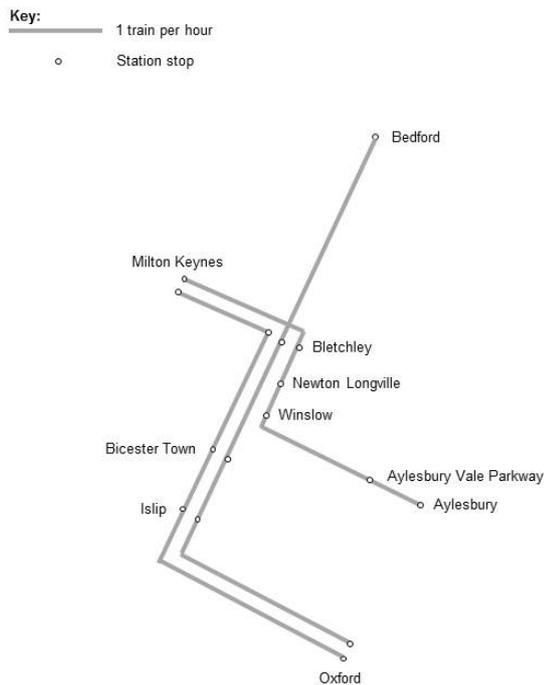
5.6.1 The 'Do Minimum' assumptions for the East West Rail Link in PFMv7.1 are the same as used in PFMv6.1c.

5.6.2 The East-West Rail western section (between Oxford and Bletchley) is assumed within PFMv7.1 based on the DfT view of the likely service patterns as late 2012. Figure 5.5 shows a summary of the service pattern assumed in the 'Do Minimum' for East-West Rail services.

5.6.3 This assumes hourly services as follows:

- Oxford and Bedford;
- Oxford and Milton Keynes; and
- Aylesbury and Milton Keynes.

Figure 5-5: East- West Rail – Average Service Pattern used in PFMv7.1 – 'Do Minimum'



**Notes:**

- 1) Service specification is for modelling purposes only.
- 2) Diagram is a simplification of actual modelled services for presentation purposes.

## 5.7 Great Western

5.7.1 The 'Do Minimum' assumptions for Great Western services within PFMv7.1 have not been updated from PFMv6.1c.

5.7.2 A summary of the main assumptions in PFMv7.1 are the following:

- More than 4tph serving Oxford;
- 1tph to Worcester Foregate Street, half of these travelling onwards to Hereford;
- 1tph to Cheltenham Spa;
- 2tph to Cardiff Central, one of which travels onwards to Swansea;
- 4tph serving Bristol Temple Meads, half of these route via Bristol Parkway and half via Bath;
- 1tph serving Plymouth, with half of these services travelling onwards to Penzance;
- Two trains per hour serving Newbury; and,
- Paddington to Birmingham New Street services are modelled to retain the same level of service between Oxford and Birmingham when Cross-Country services get re-routed via East-West rail in the future year scenario. This is achieved by extending one hourly fast Oxford service to Birmingham New Street.

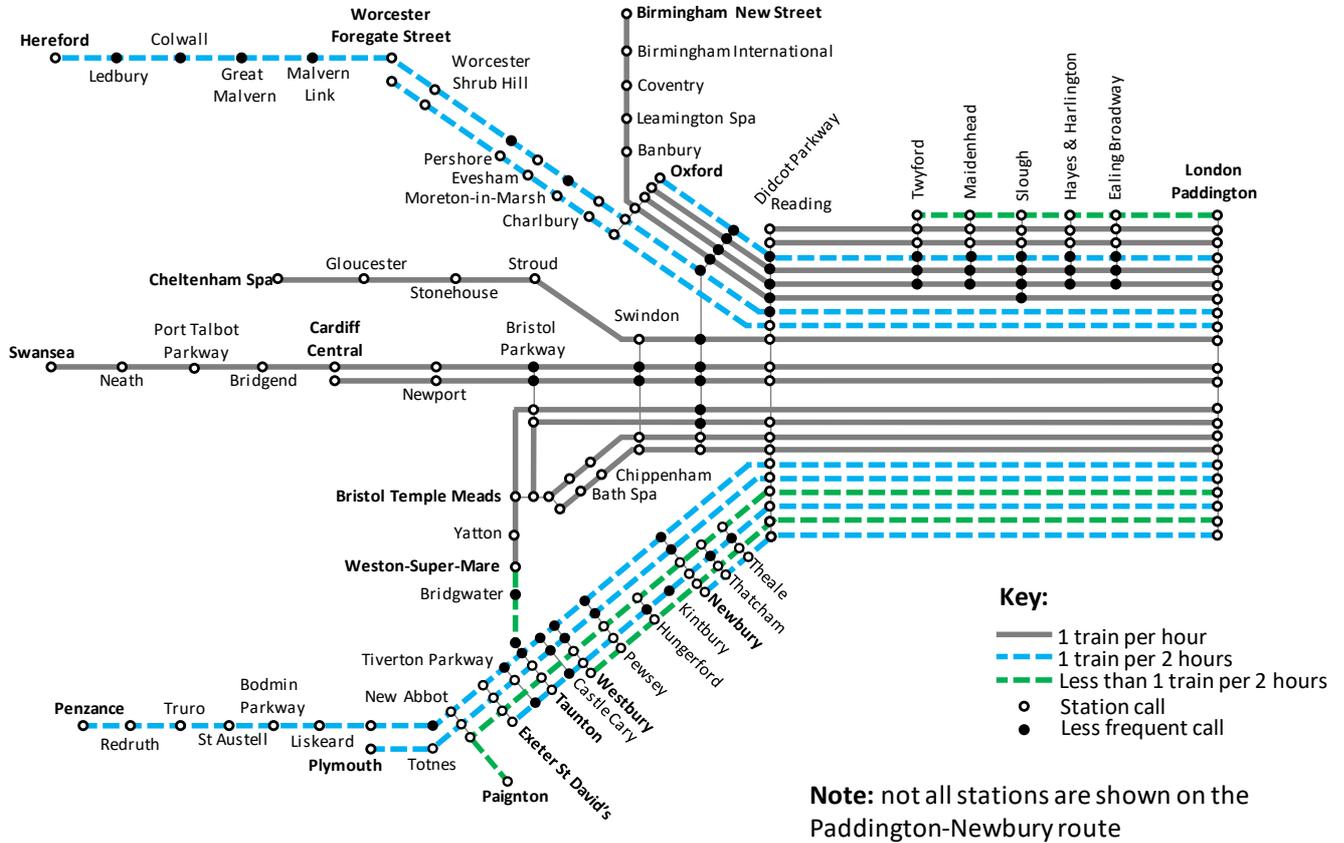
5.7.3 The vehicle types for the new GW services were updated in PFMv6.1c, and these assumptions have been retained in PFMv7.1. Three primary data sources have been used to add stock types to the Great Western timetable modelled within the PFM:

- Firstly, data was provided by the DfT for parts of the Great Western network, primarily for service groups linked to Paddington and the Thames Valley area. Outside of this area and where information was deemed to be out of date further sources of data were required;
- Secondly, a press-release by First Great Western which was released to coincide with the extension of the franchise was printed in Modern Railways March 2015 edition and information within this has been used to fill the gaps in the specification. Where information in the press-release has been deemed to be more up to date than information within the DfT specification this has superseded the latter; and,
- Finally, where information on stock types for some routes was not held within either of the first two documents a view was taken further research was carried out to best ascertain the vehicle type to use.

5.7.4 The additional stock types that were coded in PFMv6.1c for use within the Great Western timetable are presented in section 5.13.

5.7.5 Figure 5-6 shows a summary of the service frequency and stopping patterns assumed in the 'Do Minimum' for Great Western services.

Figure 5-6: Great Western – Average Service Pattern used in PFMv7.1 – 'Do Minimum'

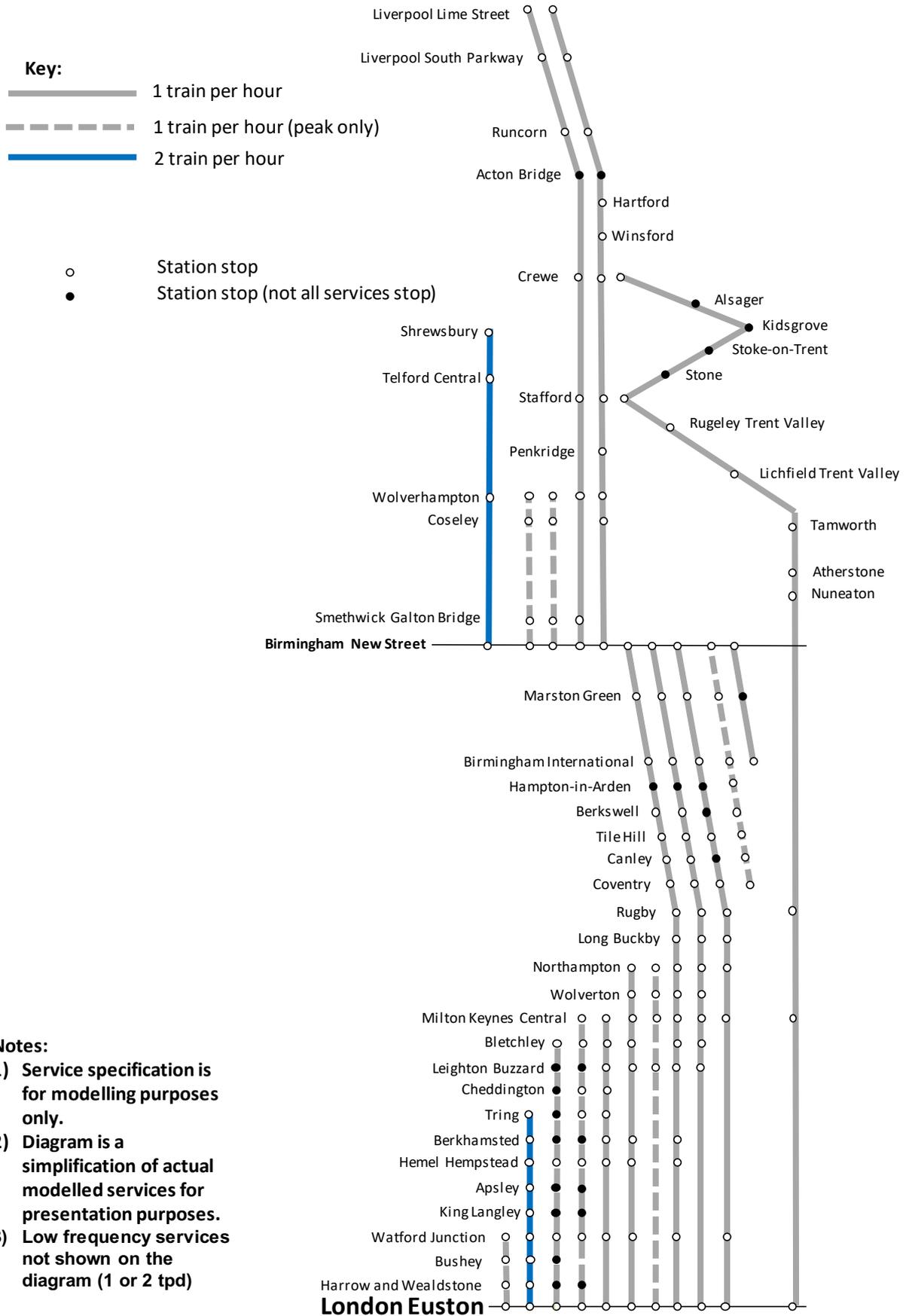


## 5.8 London Midland

- 5.8.1 The 'Do Minimum' assumptions for London Midland have been completely updated for PFMv7.1 since the release of PFMv6.1c.
- 5.8.2 The coding reflects the requirements in the DfT's Invitation to Tender (ITT) for the London Midland franchise competition issued August 2016.
- 5.8.3 The London Midland service specification within PFM includes:
- 3tph between Birmingham New Street and London Euston;
  - 5tpd between Coventry and Birmingham New Street;
  - 1tph between London Euston and Crewe;
  - 1tph between Birmingham International and Birmingham New Street;
  - 1tph peak services between London Euston and Northampton;
  - 2tph between Birmingham New Street and Liverpool Lime Street;
  - Local services starting at Northampton, Milton Keynes Central and Tring to London Euston.
- 5.8.4 In addition to the services listed which are primarily on key routes for the HS2 scheme, London Midland also provides local and regional rail services out of Birmingham New Street.
- 5.8.5 Figure 5-7 shows a simplified summary of the service and stopping pattern assumed in the PFM 'Do Minimum' for London Midland services.

# PFMv7.1 Assumptions Report

Figure 5-7: London Midland – Average Service Pattern used in PFMv7.1 – 'Do Minimum'



## 5.9 Northern Railway

5.9.1 The 'Do Minimum' services in PFMv7.1 for Northern Railway have not been updated from PFMv6.1c. The updates are based on December 2019 timetable and a train plan including stock information and peak loading points.

5.9.2 For key corridors in the Northern Railway network, the PFMv7.1 future year timetable assumes the following services through the corridors:

- On the Leeds-Doncaster corridor the following services to/from Leeds:
  - 1tph Bradford Interchange to Nottingham via Leeds;
  - 1tph Leeds to Knottingley via Wakefield Westgate;
  - 1.5tph to Sheffield via Rotherham stopping service; and,
  - 1tph to Doncaster calling all stations.
- On the South Manchester corridor, the following services to/from Manchester Piccadilly:
  - 1tph to Crewe via Stockport;
  - 1tph to Alderley Edge via Stockport;
  - 1tph to Macclesfield;
  - 1tpd to Stoke on Trent semi-fast;
  - 1tph to Crewe via Manchester Airport;
  - 4tph all day Manchester – Hazel Grove with 2tph to New Mills Newtown and 1tph to Buxton;
  - 2tph all day Manchester – Stockport – Greenbank with 1tph to Chester;
  - 1tph all day semi-fast Manchester Victoria – Warrington Bank Quay – Chester, extended to Calder Valley; and,
  - Fast services via Chat Moss and CLC routes swap between Northern and TPE, with Northern operating Liverpool – Warrington – Manchester Airport fast service.
- On the Calder Valley corridor, the following services to/from Leeds:
  - 1tph to Huddersfield via Bradford;
  - 1tph York to Blackpool North;
  - 3tph to Manchester Victoria, extended to Liverpool, Chester and Southport;
  - 1tph Bradford Interchange to Manchester Victoria and Manchester Airport; and,
  - 2tph Manchester Victoria – Rochdale stopping service enabling all through trains to Yorkshire to be non-stop on this section.

- On the North West Electrification corridor, the following services to/from Manchester Piccadilly / Manchester Victoria:
  - 2tph to Blackpool via Bolton;
  - 1tph to Preston;
  - 1tph to Wigan Wallgate;
  - 1tph to Kirkby;
  - 2tph to Blackburn, of which 1tph to Clitheroe;
  - 1tph to Southport (from Calder Valley);
  - 1tph to Southport stopping service;
  - 1tph Liverpool Lime Street stopping service; and,
  - 1tph Liverpool Lime Street fast service (from Calder Valley).

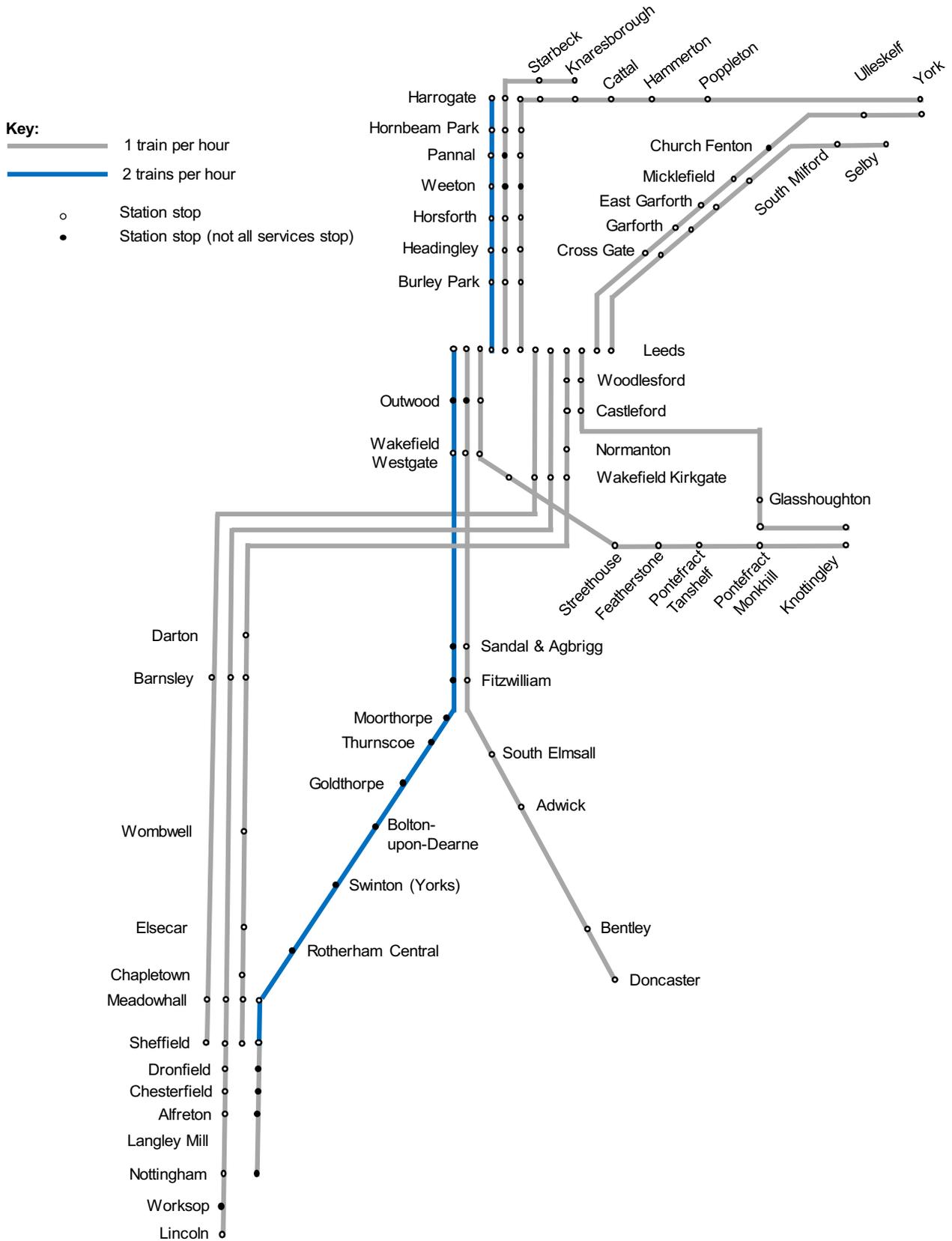
5.9.3 The additional service specification includes:

- York – Hull service becomes 1tph all day with DMU prior to TransPennine and Hull electrification;
- Retain peak direction only Manchester Piccadilly – Huddersfield stopping service;
- Remove all stops other than Church Fenton from Northern Blackpool – York DMU, with 2tph stopping service to Selby;
- New 1tph Middlesbrough – Newcastle via Durham in addition to existing service via Sunderland. New train calls at Thornaby, Stockton, Durham and Chester-le-Street;
- Darlington – Bishop Auckland hourly as extensions of Saltburn services;
- Extension of Bridlington – Hull services via Selby to Leeds;
- 4tph all day Leeds - Harrogate; and,
- 1tph Knottingley – Wakefield extended to Leeds, with 1tph Huddersfield – Wakefield extended to Castleford.

5.9.4 Figures 5-8 to 5-11 show a summary of the service and stopping pattern assumed in the 'Do Minimum' for Northern services.

# PFMv7.1 Assumptions Report

Figure 5-8: Northern Railway – Average Service Pattern used in PFMv7.1 – 'Do Minimum'



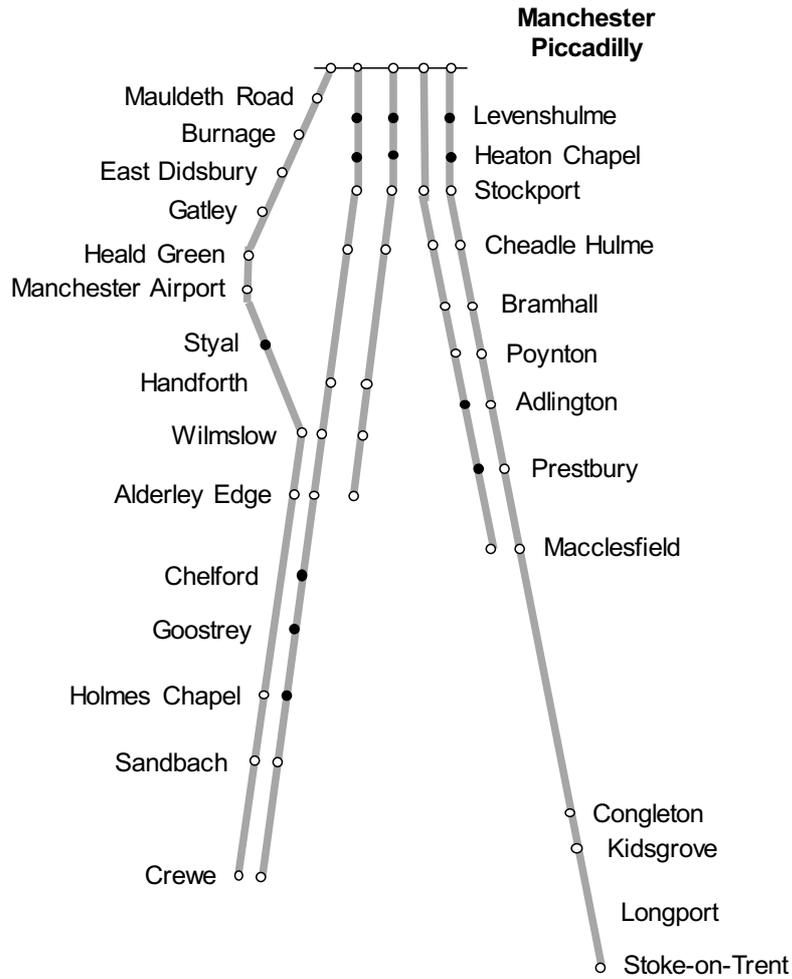
- Notes:**
- 1) Service specification is for modelling purposes only.
  - 2) Diagram is a simplification of actual modelled services for presentation purposes.

# PFMv7.1 Assumptions Report

Figure 5-9 Northern Railway – Average Service Pattern used in PFMv7.1 – 'Do Minimum' (continued)

**Key:**

- 1 train per hour
- Station stop
- Station stop (not all services stop)

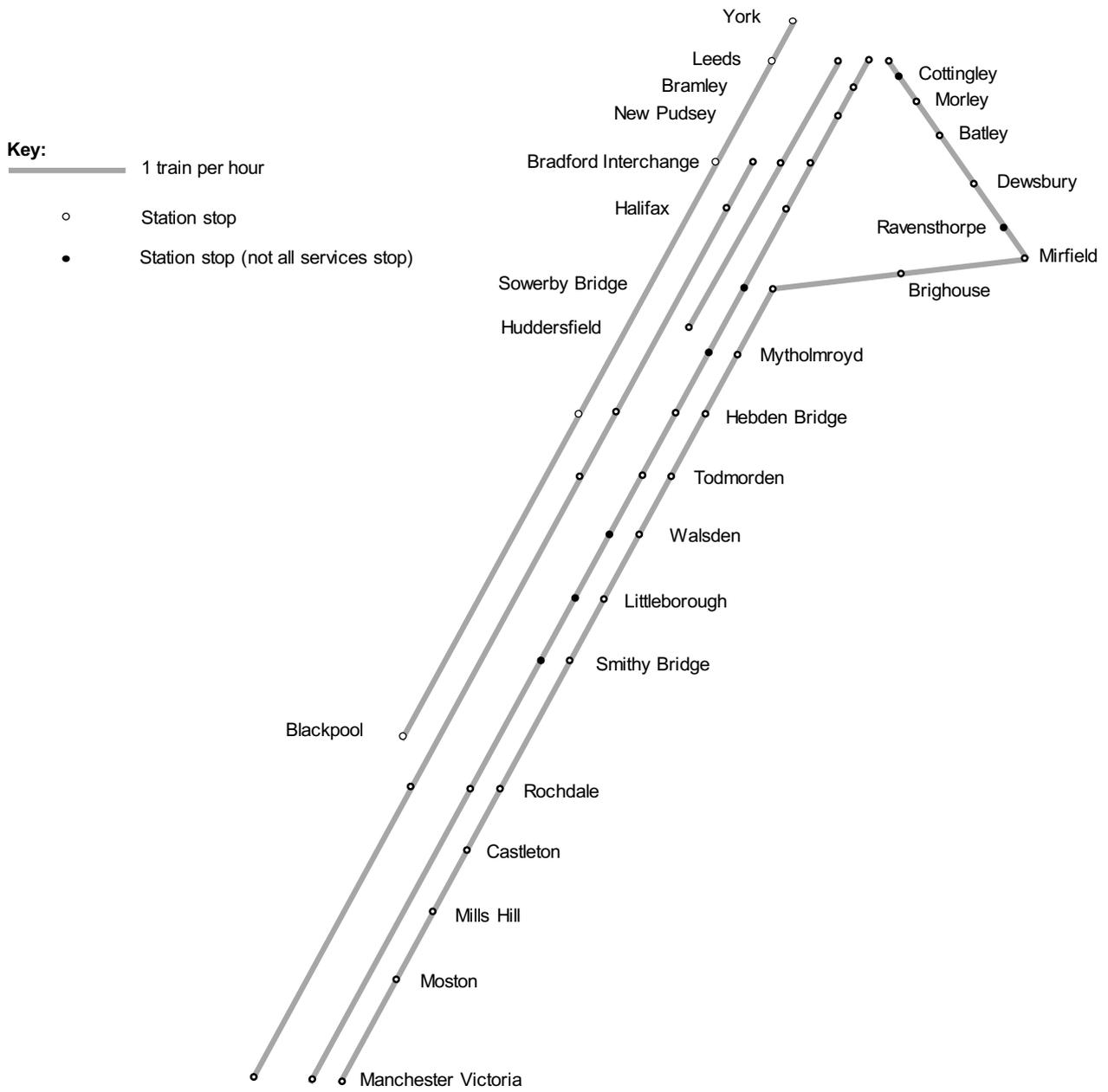


**Notes:**

- 1) Service specification is for modelling purposes only.
- 2) Diagram is a simplification of actual modelled services for presentation purposes.

# PFMv7.1 Assumptions Report

Figure 5-10 Northern Railway – Average Service Pattern used in PFMv7.1 – ‘Do Minimum’ (continued)

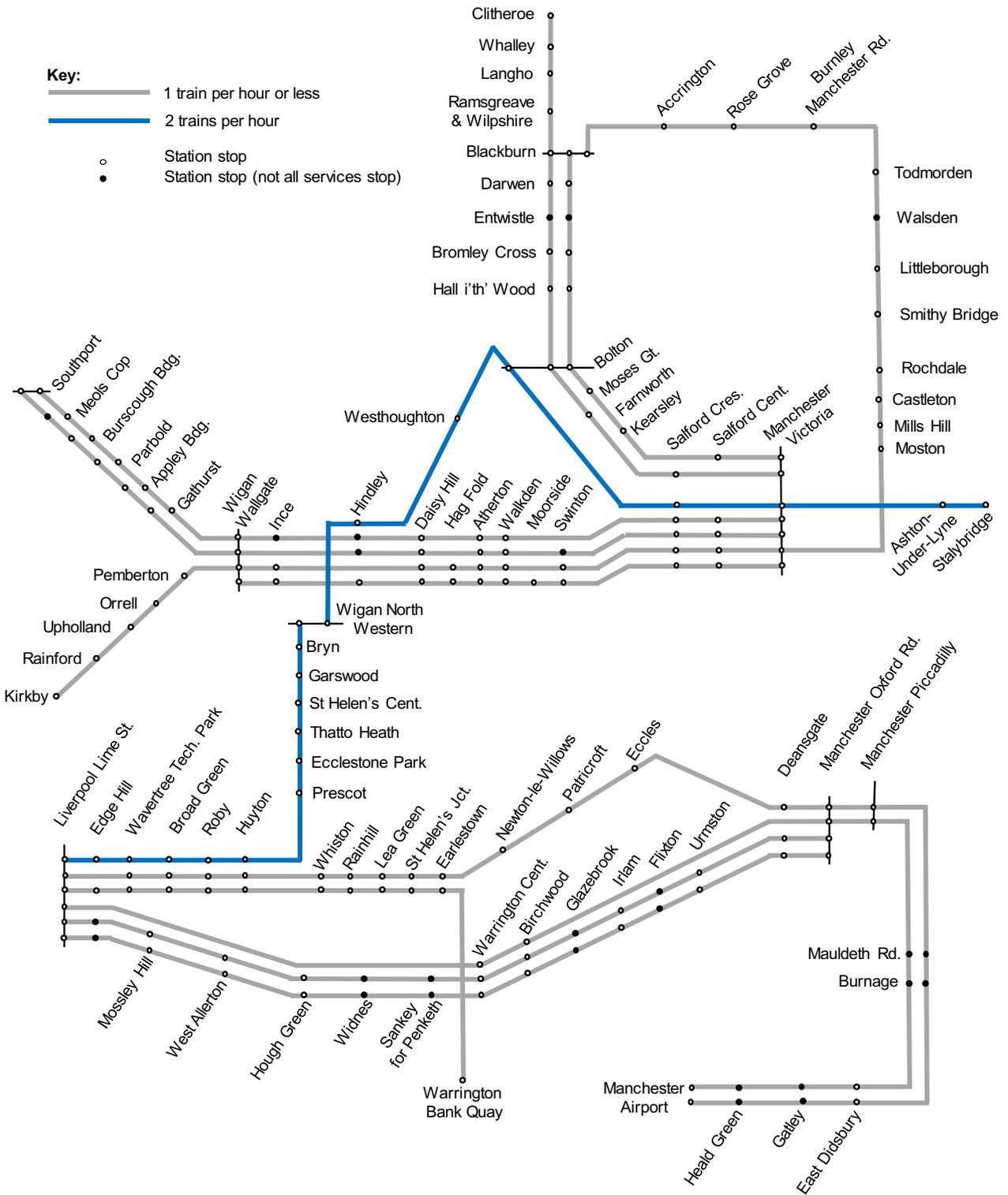


**Notes:**

- 1) Service specification is for modelling purposes only.
- 2) Diagram is a simplification of actual modelled services for presentation purposes.

# PFMv7.1 Assumptions Report

Figure 5-11 Northern Railway – Average Service Pattern used in PFMv7.1 – 'Do Minimum' (continued)

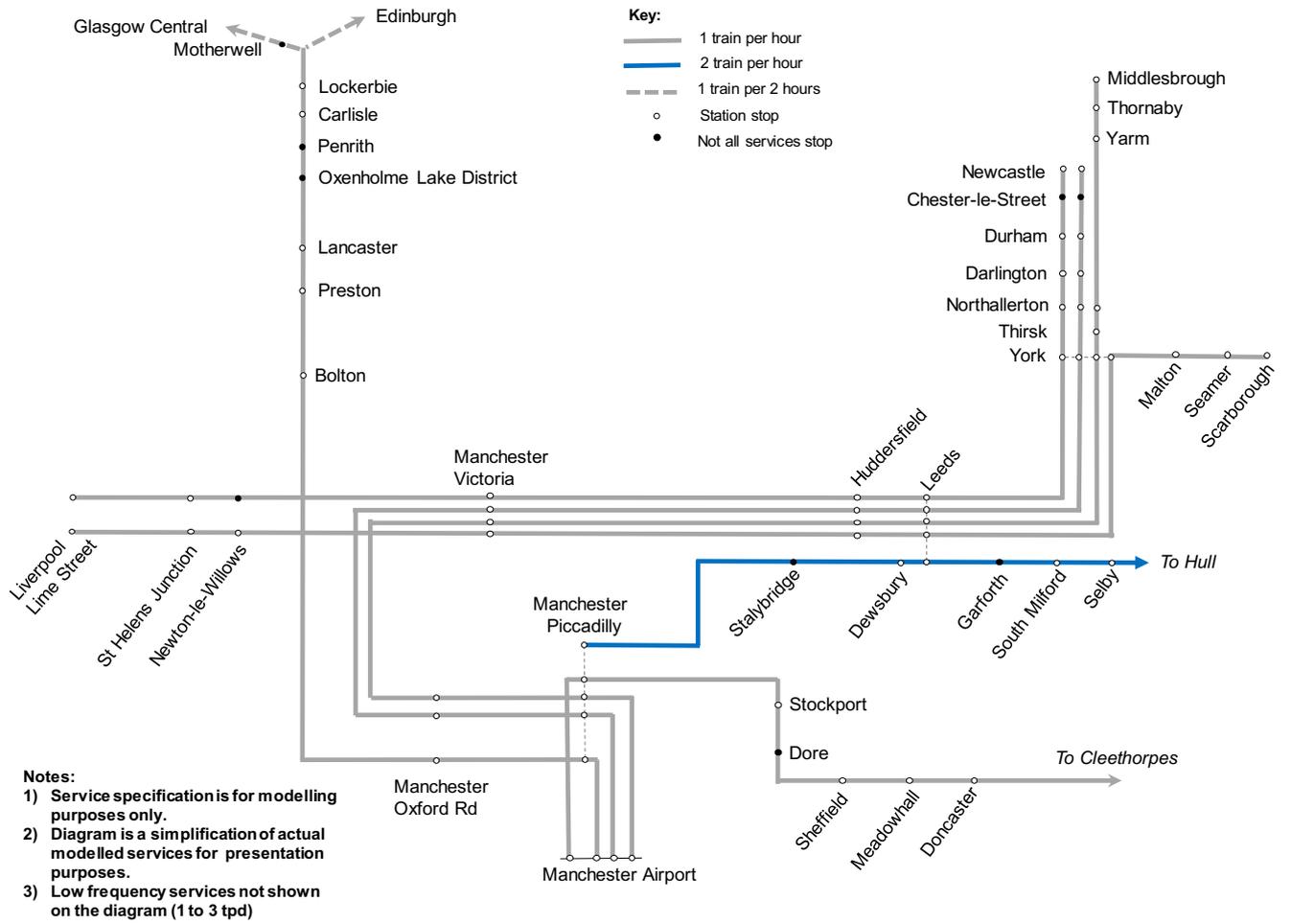


## 5.10 TransPennine

- 5.10.1 The 'Do Minimum' services in PFMv7.1 for TransPennine have not changed from PFMv6.1c.
- 5.10.2 On the TransPennine routes the PFMv7.1 future year timetable assumes the following services through the Manchester – Leeds core:
- 2tph between Manchester and Hull via Leeds;
  - 5tpd between Liverpool Lime Street and Newcastle;
  - 4tpd between Manchester Airport and York Via Leeds ;
  - 1tph between Manchester Airport and Middlesbrough Via Leeds; and,
  - 11tpd between Manchester Airport and Newcastle.
- 5.10.3 A further 1tph operates between Manchester Airport alternately to Edinburgh or Glasgow via the West Coast main line.
- 5.10.4 The following stock type assumptions are included within the TransPennine timetable in PFMv7.1 and were based on the information available at time of coding:
- Class 350 EMUs on Manchester Airport to Edinburgh/Glasgow services are replaced by 5-car EMUs (125mph 23m CAF);
  - All Class 185s on Leeds/Hull services replaced by 6-car EMUs (125mph 23m vehicles as per CAF trains for Manchester - Scotland);
  - Newcastle and Edinburgh services to become 6-car EMUs (125mph 23m vehicles as above); and,
  - Scarborough and Middlesbrough services become 5-car bi-mode AT300.
- 5.10.5 The following characteristics were included within the TransPennine service pattern in PFMv7.1:
- Retain pre-electrification stops between Stalybridge and Huddersfield (exclusive) for TPE Manchester Piccadilly to Leeds/Hull services;
  - Removal of all stops from TPE Manchester to Leeds/Hull services except for Dewsbury; and,
  - Extend TPE Man Piccadilly - Leeds service to Selby and Hull, replacing a segment of Northern Bridlington - Hull – Leeds – Bradford - Huddersfield. In the peaks the extended service calls at all stations Leeds to Selby, and then as per replaced Bridlington DMU service. In the off-peak the service is fast from Leeds to Selby, then as per superseded Bridlington DMU service as far as Hull (and no further).
- 5.10.6 Figure 5-12 shows a summary of the service and stopping pattern assumed in the 'Do Minimum' for TransPennine services.

# PFMv7.1 Assumptions Report

Figure 5-12: TransPennine – Average Service Pattern used in PFMv7.1 – 'Do Minimum'



## 5.11 West Coast Main Line

### Virgin West Coast Services

5.11.1 The 'Do Minimum' service and rolling stock assumptions for West Coast in PFMv7.1 has been updated from PFMv6.1c to reflect revised rolling stock assumptions. The Do Minimum service pattern has not been updated and remains as it was in PFMv6.1c.

5.11.2 The Do Minimum network includes:

- 1tph London Euston – Birmingham New Street;
- 1tph London Euston – Edinburgh \ Glasgow via Birmingham New Street;
- 1tph London Euston – Chester via Crewe with some services extended to North Wales;
- 1tph London Euston – Liverpool Lime Street;
- Peak Hourly service London Euston – Blackpool North;
- 1tph London Euston – Glasgow Central; and,
- 3tph London Euston – Manchester Piccadilly.

5.11.3 Modelling assumptions include the introduction of a 2 x 5-car Class 222 Super Voyager to model doubled up 5-car 'Super Voyager' trains.<sup>19</sup>

### Open Access Services

5.11.4 The 'Do Minimum' assumptions for West Coast Open Access services (GNWR, Great North Western Railways, operating as Grand Central) have not changed in PFMv7.1 from PFMv6.1c.

5.11.5 A review was undertaken by HS2 Ltd to specify the timetable for open access services to be included within the 'Do Minimum' scenario. The resulting assumptions applied from the TAG paper are:

- a) The London terminus for the Euston-Blackpool services in both directions would be modelled as Queen's Park (QPW) rather than Euston.
- b) The journey time between Queen's Park and the next stop (Milton Keynes Central) would maintain the Milton Keynes Central to Euston travel time.

5.11.6 The Do Minimum network includes:

- 6 trains Blackpool North – Queens Park (proxy for Euston).
- 5 trains Queens Park (proxy for Euston) – Blackpool North, plus 1 extra train Queens Park (proxy for Euston) – Crewe.

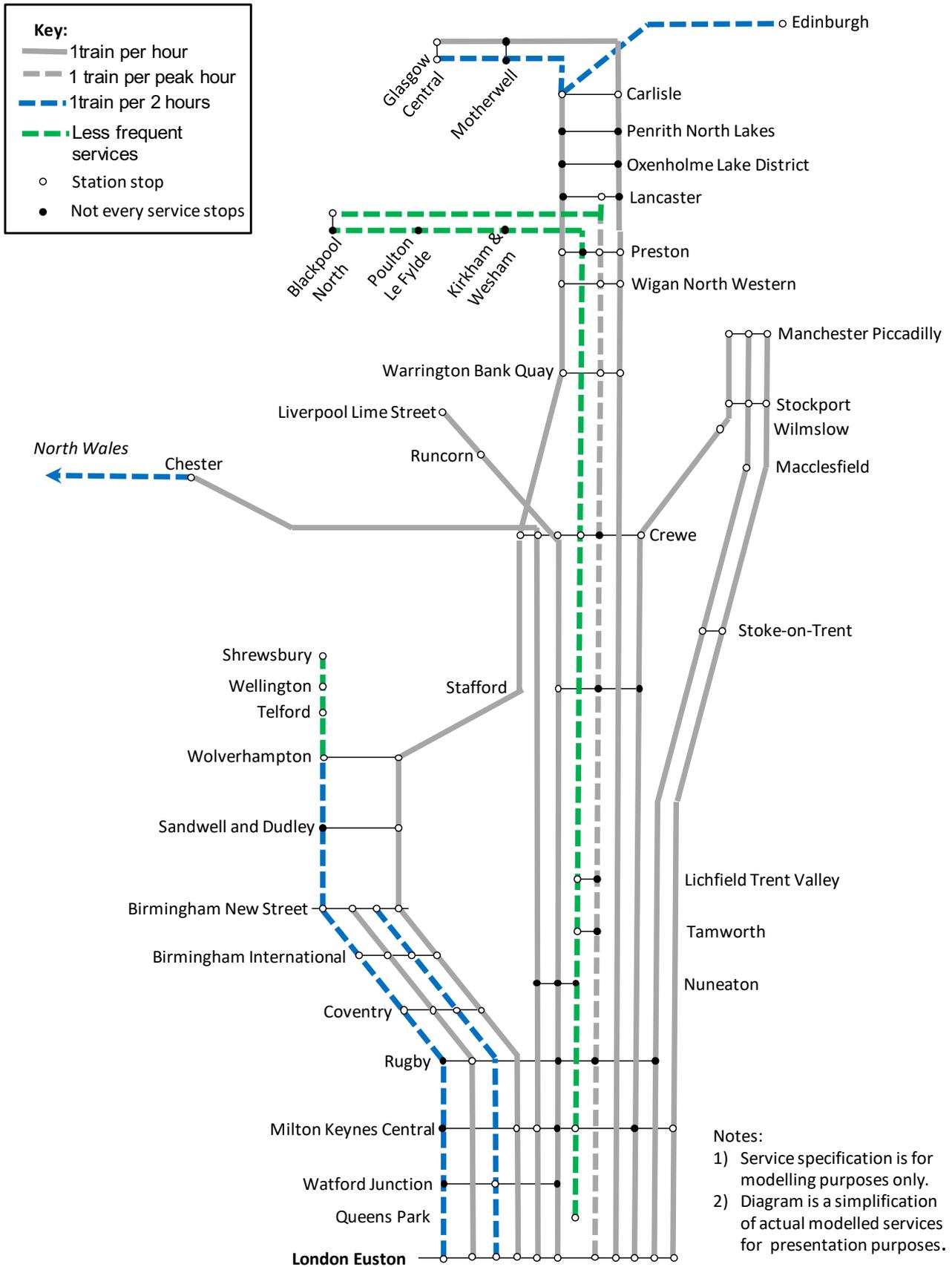
5.11.7 Figure 5-13 shows a summary of the service and stopping pattern assumed in the 'Do Minimum' for West Coast Main Line services with the Open Access additions overlaid.

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<sup>19</sup> The operating cost model treats 10-car Super Voyager units as vehicle type 222 to avoid spurious results.

# PFMv7.1 Assumptions Report

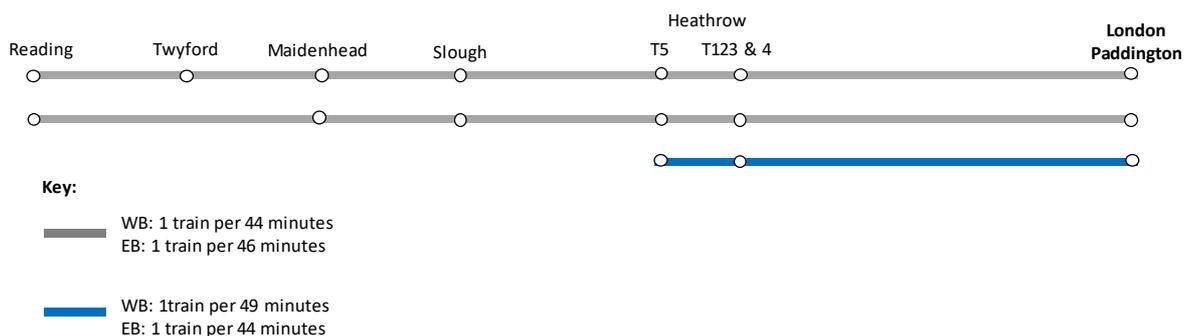
Figure 5-13: West Coast Main Line – Average Service Pattern used in PFMv7.1 – 'Do Minimum'



## 5.12 Other Services

- 5.12.1 The 'Do Minimum' assumptions for CrossRail in PFMv7.1 have not been updated from PFMv6.1c.
- 5.12.2 The Do Minimum service pattern assumes:
- A service every half an hour on the full length of the route between Shenfield and Reading in both directions;
  - A service every 15 minutes between Shenfield and Maidenhead;
  - Services on the Heathrow spur run every 15 minutes from Abbey Wood<sup>20</sup>;
  - A service approximately every 3 minutes on the core section of the route between Liverpool Street and Paddington; and,
  - Around one train per hour east to Gidea Park from London.
- 5.12.3 A Western access to London Heathrow is included within PFMv7.1. The Heathrow Express service pattern is assumed to utilise this. Figure 5-14 shows a summary of the service pattern assumed in the 'Do Minimum' for Heathrow Express services.
- 5.12.4 The service pattern in terms of frequency, journey time and stopping pattern was provided by the DfT. Supplementary Heathrow Express services between London and Heathrow Terminals are also modelled to ensure that a 15-minute frequency is maintained.
- 5.12.5 All services have been coded as 8-car Class 332's, which provides a seated capacity of 370. The total capacity of 612 has been calculated using the same ratio of seated to total capacity that was previously used for these services.

Figure 5-14: Heathrow Express – Average Service Pattern used in PFMv7.1 – 'Do Minimum'



<sup>20</sup> In practise this is coded into the model as starting/terminating at Liverpool Street as Abbey Wood is not represented in the PFM.

## London Underground

- 5.12.6 The 'Do Minimum' assumptions for London Underground in PFMv7.1 are the same as used in PFMv6.1c and are assessed to remain valid. TfL supplied London Underground network and vehicle type data extracted from TfL's Railplan model.

## 5.13 National Rail – Rolling Stock

5.13.1 PFM holds a selection of rolling stock types as defined vehicles within the model. The assumptions used or combinations thereof, for example Class 165 and Class 172 on Chiltern, are shown in Table 5-1 and have been sourced from DfT.

Table 5-1: Rolling Stock Capacity Assumed in PFMv7.1

Rolling stock type	Seated capacity	Total capacity
Class 67 with 5 Mk iii coaches incl. first class	360	435
Class 67 with 6 Mk iii coaches	432	488
Class 67 with 6 Mk iii coaches incl. first class	390	480
Class 91 9-car	477	747
Class 150 3-car	194	285
Class 150 4-car	248	380
Class 150 6-car	388	570
Class 156 2-car + Class 150 2-car	276	429
Class 156 2-car	152	239
Class 156 4-car	304	478
Class 156 2-car + Class 158 2-car	290	456
Class 158 2-car (MML specific)	138	217
Class 158 2-car (Generic)	134	232
Class 158 4-car	276	433
Class 158 2-car + Class 170 3-car	329	543
Class 165 2-car (Chiltern specific)	184	244
Class 165 3-car (Chiltern specific)	276	366
Cl165 2-car (Generic)	186	323
Cl165 3-car (Generic)	292	507
Class 165 2 x 2car	368	488
Class 165 2car & Class 165 3car	460	610
Class 165 2car & Class 172 2car	328	462
Class 165 2 x 2car & Class 165 3car	644	854
Class 165 3 x 2car	552	732
Class 168 3-car	204	348
Class 168 3car & Class 168 4car	476	812
Class 168 2 x 3car & Class 172 2car	552	914

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Class 168 3car & Class 172 2car	348	566
Class 168 4-car	272	464
Class 168 4car & Class 165 2car	456	708
Class 170 2-car	117	205
Class 170 3-car	191	326
Class 170 4-car	234	409
Class 170 5-car	308	531
Class 172 2-car	144	218
Class 172 2car & Class 165 3car	420	584
Class 176 2-car	124	221
Class 176 3-car	284	469
Class 176 4-car	248	442
Class 176 5-car	408	690
Class 176 6-car	372	663
Class 180 5-car	284	434
Class 185 3-car	169	301
Class 185 6-car	338	602
Class 185 9-car	507	903
Class 220 4-car	190	310
Class 221 5-car	252	410
Class 221 2 x 5-car	504	820
Class 222 4-car	190	310
Class 222 5-car	242	386
Class 222 7-car	343	520
Class 222 10-car	484	772
Class 225 7-car	409	644
Class 319 3-car	217	294
Class 319 4-car	289	392
Class 323 3-car	284	498
Class 333 4-car	301	558
Class 350 4-car	226	396
Class 350/1 4-car	224	392
Class 350/1 8-car	448	785

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Class 350/1 12-car	672	1177
Class 350/2 4-car	267	468
Class 350/2 8-car	534	936
Class 350/2 12-car	801	1404
Class 365 4-car	264	383
Class 365 8-car	528	766
Class 365 12-car	792	1149
Class 377 3-car	185	294
Class 377 4-car	247	392
Class 377 5-car	309	490
Class 377 8-car	494	784
Class 377 12-car	741	1176
Class 380 4-car	275	399
Class 380 8-car	550	798
Class 386 3-car	204	346
Class 386 4-car	284	464
Class 387 8-car	450	714
Class 387 12-car	675	1071
Class 390 6-car	335	518
Class 390 9-car	468	798
Class 390 11-car	597	982
Class 392 6-car	335	518
HST 5-car	271	436
HST 6-car	325	523
HST 8-car	446	658
IEP 5-car (Cross Country and Great Western)	328	763
IEP 5-car (East Coast)	303	477
IEP 5-car (East Midlands)	318	499
IEP 9-car (East Coast)	611	963
IEP 9-car (Great Western)	651	1001
IEP 2x 5-car (Great Western)	656	1018
Bi Mode 125mph 5-car	318	450
EMU125 5-car	262	418

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EMU125 6-car	322	478
EMU125+EMU125 12-car	524	836
AT300 5-car	328	509
AT300 2x 5-car	656	1018
AT300 9-car	651	1001

# 6 Rail Network: Do Something

## 6.1 Introduction

- 6.1.1 To understand the costs and benefits of the scheme, our modelling requires assumptions on a service specification for HS2 and a specification for the revised service pattern on the conventional rail network enabled by capacity being released due to the transfer of passengers and services to the HS2 network. These assumptions are set out in the following sections. TOCs where train service patterns are not impacted by the introduction of HS2 are not represented because the service pattern will be the same as in the Do Minimum.
- 6.1.2 There are many potential options for future service specifications across the network. DfT's strategic case sets out the high-level principles that will be followed in making best use of released capacity, including:
- To ensure that all places with a direct London service today retain a broadly comparable or better service after HS2 opens;
  - To provide additional commuter capacity where it is most needed;
  - To spread the benefits of long-distance and inter-regional services to the many towns and cities that can be served by the capacity created on the existing rail network;
  - To integrate HS2 services fully into the wider national rail network;
  - To provide capacity for the growing rail freight sector; and
  - To improve performance by making timetables more robust.
- 6.1.3 Final decisions on future service patterns will be taken much nearer to the opening of the HS2 scheme, as such the assumptions set out here are indicative for modelling purposes only.
- 6.1.4 In the following sections the HS2 service assumptions and assumptions on the conventional rail network are set out separately. Within the PFMv7.1 model the impacts of these are combined.
- 6.1.5 **The released capacity assumptions set out in this section have been derived for transport modelling purposes only. They are not a future proposed or agreed service specification.**

## 6.2 HS2 Service Patterns

### Phase 1

6.2.1 There are four high-speed stations assumed on the Phase 1 route:

- Birmingham Curzon Street;
- Birmingham Interchange;
- Old Oak Common; and,
- London Euston.

6.2.2 The Phase 1 service pattern is comparable to the service pattern used in PFMv6.1c with some small updates to journey times. This service pattern is shown in Figure 6-1 and comprises:

- London Euston to Birmingham Curzon Street (3 trains per hour);
- A series of services that are 'classic compatible', i.e. they use the HS2 link between London and its connection with the West Coast Main Line and then switch to the classic network;
- London Euston to Manchester Piccadilly (three trains per hour);
- London Euston to Liverpool Lime Street (two trains per hour);
- London Euston to Preston (one train per hour); and
- London Euston to Glasgow Central (one train per hour).

### Phase 2A

6.2.3 Phase 2A is assumed to have the same service pattern as Phase 1. This means that we assume the same number of services, and stopping pattern as in Phase 1, but some services gain the benefit of a reduced journey time by using the new high-speed section of track between Birmingham and Crewe. The following HS2 services take advantage of that journey time saving:

- London Euston to Glasgow Central service;
- London Euston to Preston service;
- London Euston to Liverpool Lime Street stopping at Crewe, Runcorn and Liverpool; and
- Three London Euston to Manchester Piccadilly services using the high speed track.

6.2.4 Phase 2A would become operational in 2027. The modelled service pattern is shown in Figure 6-2.

Figure 6-1: HS2 Service Pattern used in PFMv7.1 – Phase 1

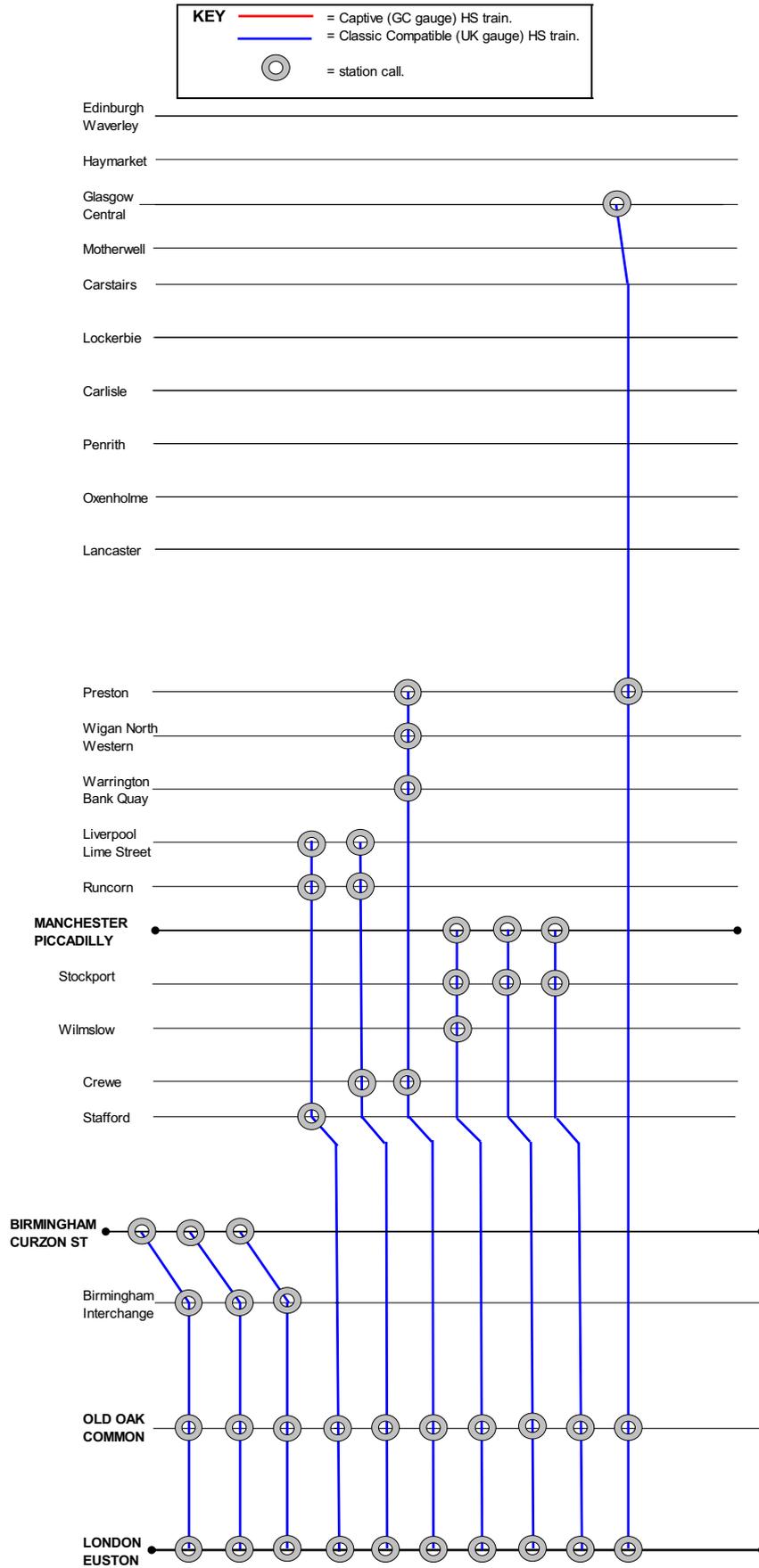
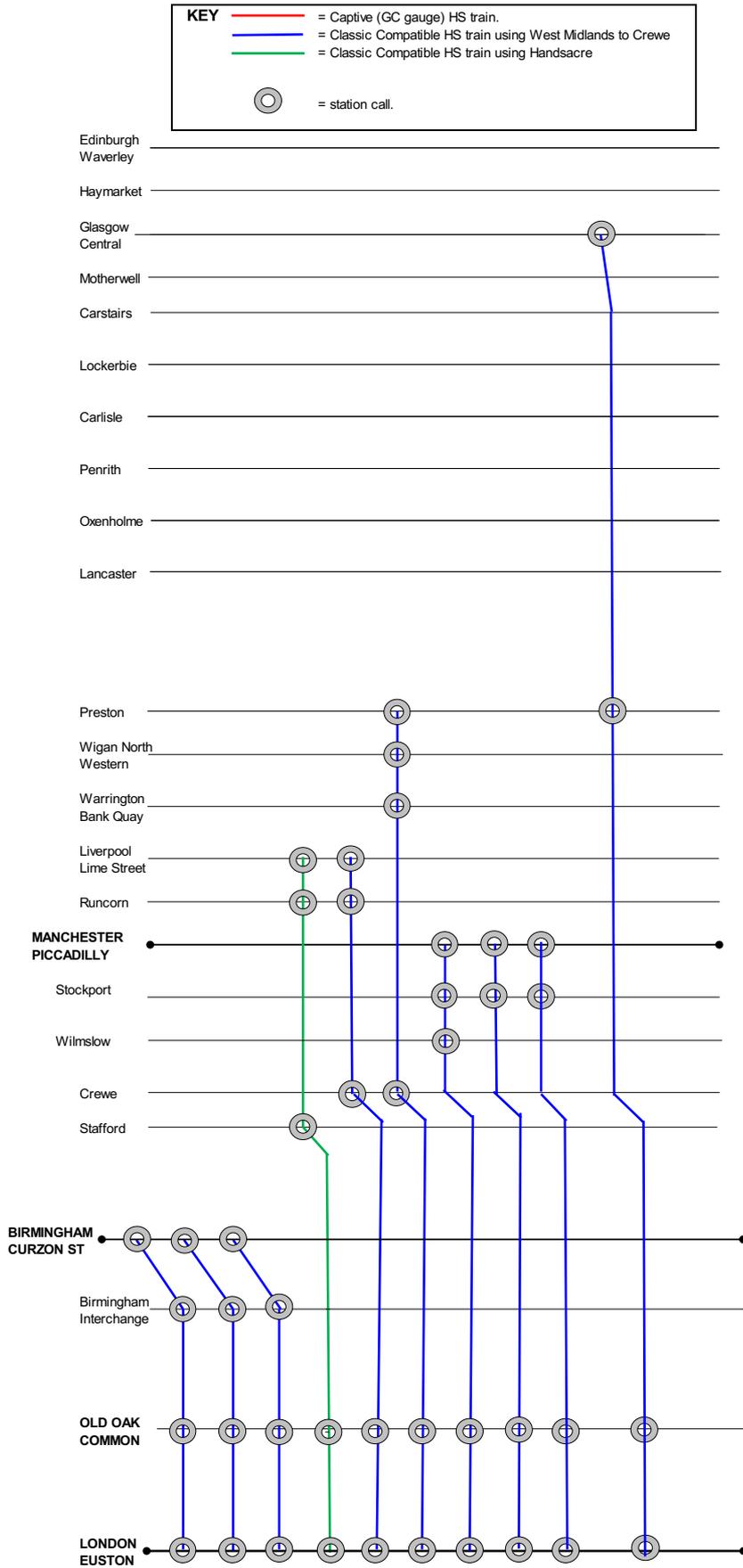


Figure 6-2: HS2 Service Pattern used in PFMv7.1 – Phase 2A



## Phase 2b - Full network

6.2.5 The Phase 2b service pattern is based on the full network between London and Birmingham with extensions to Manchester and Leeds proposed to begin operations in 2033. The modelled service specification for Phase 2b is shown in Figure 6-3 and comprises:

- HS2 services:
  - London Euston to Birmingham Curzon Street (3tph);
  - London Euston to Manchester Piccadilly (3tph);
  - London Euston to Leeds (3tph<sup>21</sup>);
  - Birmingham Curzon Street to Manchester Piccadilly (2tph); and
  - Birmingham Curzon Street to Leeds (2tph);
- And a series of services that are classic compatible, i.e. they use the HS2 link from London Euston and switch to the classic network at the appropriate location. Some of these services split into two-portions en-route to serve two different destinations:
  - London Euston to Liverpool Lime Street (2tph);
  - London Euston to Preston (1tph);
  - London Euston to Glasgow Central/ Edinburgh Waverley (2tph);
  - Birmingham Curzon Street to Glasgow Central/ Edinburgh Waverley (1tph);
  - Birmingham Curzon Street to Newcastle (1tph);
  - London Euston to York/Sheffield (1tph)<sup>22</sup>;
  - London Euston to Leeds/ Sheffield (1tph<sup>23</sup>); and
  - London Euston to Newcastle (2tph).

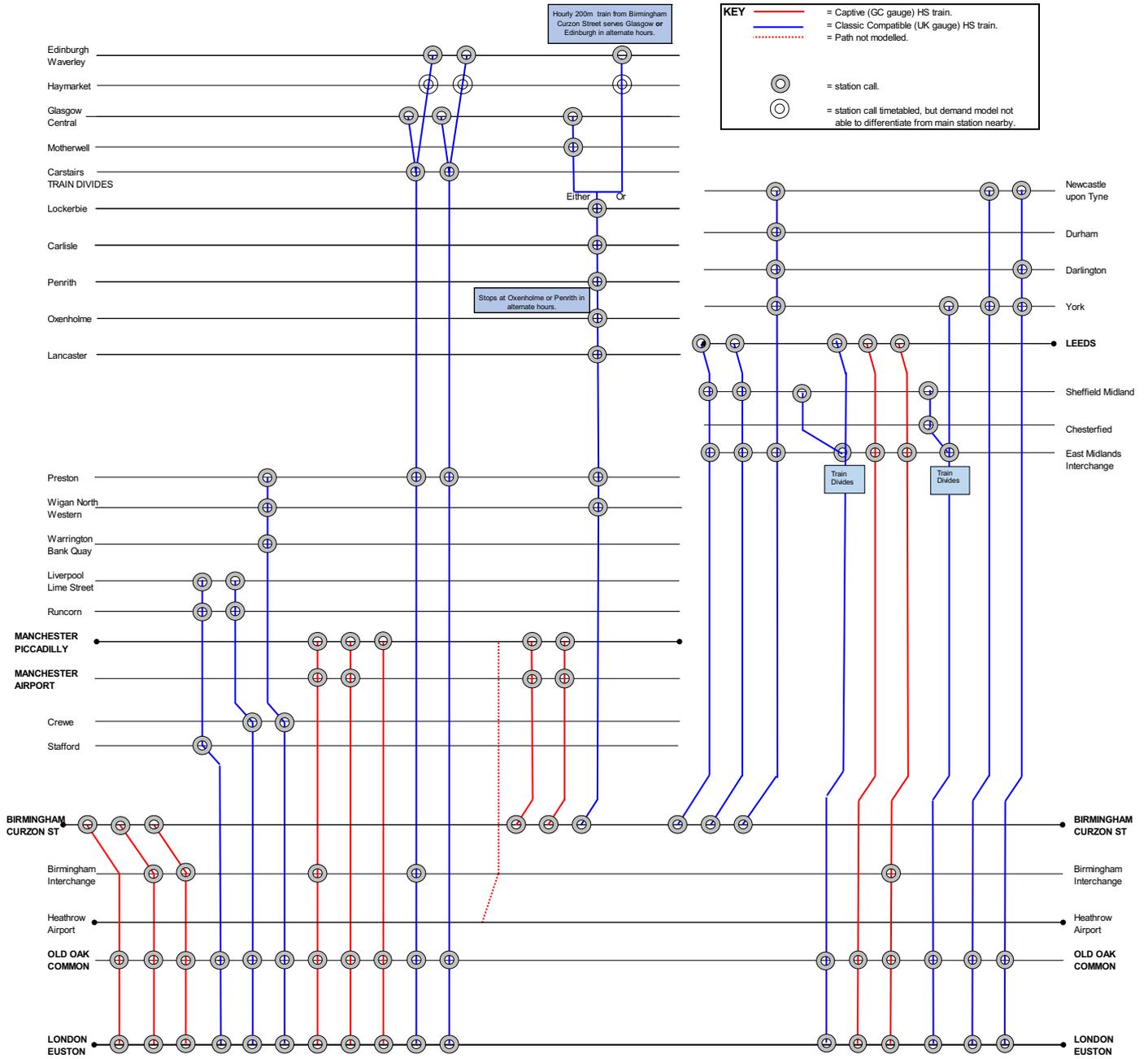
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<sup>21</sup> Two trains operate entirely to Leeds, the third combines/splits at East Midlands Interchange to serve Leeds and Sheffield Midland.

<sup>22</sup> Service divides/joins at East Midland Interchange to serve York and Sheffield Midland.

<sup>23</sup> A Leeds train combines/splits with a classic compatible York service at East Midlands Interchange.

Figure 6-3: HS2 Service Pattern used in PFMv7.1 – Phase 2b



## 6.3 Released capacity

6.3.1 With the introduction of HS2, the specification of some conventional rail services has been amended:

- to reduce duplication of service provision between conventional and HS2 services;
- to ensure that HS2 and conventional rail services are fully integrated to optimise accessibility; and
- to make use of the capacity released on the conventional rail network by the introduction of HS2 to improve the rail services to certain locations.

6.3.2 **The changes to the conventional rail services between the Do Minimum and the Do Something are referred to as the released capacity specification. Assumptions about released capacity have been included within the PFMv7.1 modelling. There are many other potential combinations of released capacity. The assumptions in PFMv7.1 represent one possible set of assumptions for business case modelling purposes. They have been developed for demand modelling purposes and they do not infer that this will be the specification implemented.**

6.3.3 The released capacity specification varies between Phase 1 and Phase 2b of HS2. The train operating companies (TOCs) where modelled services are modified as a result of the introduction of HS2 in Phase 1 and Phase 2b are summarised in Table 6-1. Note that the Phase 2a released capacity specification is the same as that for Phase 1.

Table 6-1: TOCs Impacted by the Released Capacity Specification

Train Operating Company	Phase 1 and Phase 2A	Phase 2b
Cross Country	✓	✓
Crossrail	✓	✓
East Coast Main Line		✓
East Midland Trains		✓
East West Rail		
Great Northern Trains		✓
Great Western	✓	✓
Heathrow Express	✓	✓
London Midland	✓	✓
Northern Railway		✓
Southern Trains	✓	✓
Thameslink Trains		✓
Trans Pennine Trains	✓	✓
West Coast Main Line	✓	✓

## 6.4 Cross Country

- 6.4.1 The Phase 1 and Phase 2a timetables for Cross Country services is the same as is assumed for the 'Do Minimum' in PFMv7.1.
- 6.4.2 The Phase 2b timetable is broadly the same as that in the 'Do Minimum' in PFMv7.1 except for the following:
- additional calling points are provided at Meadowhall, Chesterfield, Burton-on-Trent and Tamworth on all services to Edinburgh and York; and Congleton and Macclesfield on services to Manchester; and,
  - Reading to Newcastle services are cut back to terminate at York (and vice versa).
- 6.4.3 This then provides a service pattern as follows:
- 1tph between Manchester and Bournemouth via Milton Keynes;
  - 1tph between Manchester and Bristol via Birmingham (with some services continuing on to Cardiff or Paignton);
  - 1tph between Manchester and Birmingham International;
  - 1tph between Plymouth and Edinburgh, with some services continuing on to Penzance in the South West or Glasgow, Dundee or Aberdeen in Scotland; and
  - 1tph between Reading and Newcastle, with some services continuing on to Southampton or Guildford in the south, or Edinburgh in the north.
- 6.4.4 A summary of services and stopping patterns for Cross Country services in Phase 2b is included in Figure 6-4. Phase 1 and Phase 2a are not presented as they are unchanged from the 'Do Minimum'.

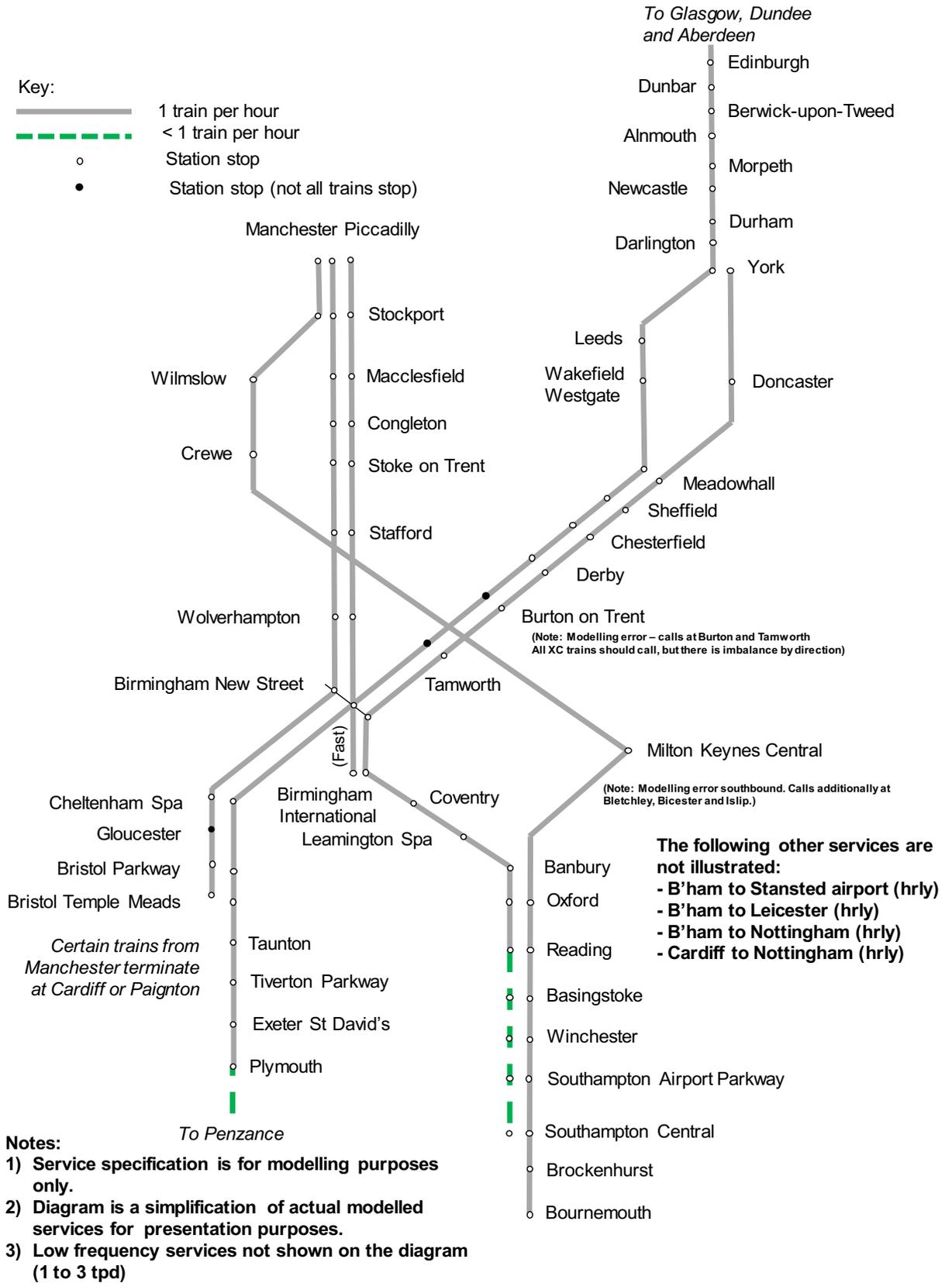
## Released Capacity Summary – Cross Country

6.4.5 This section summaries the difference in service patterns between the Do Minimum, and the Do Something service patterns for Cross Country. The table shows a summary of the released capacity changes incorporated into each modelled phase.

6.4.6 In developing service specifications, we have sought to maintain or improve the overall level of service across all TOCs. Where the level of service on a particular TOC has decreased, it will usually be compensated by enhancements to another TOC's services or by the new HS2 service.

Differences in Service Pattern between Do Minimum and Do Something	Phase 1 & Phase 2A	Phase 2b
All services via <b>Sheffield</b> additionally call at Burton-on-Trent, Tamworth and Market Harborough.		√
All services to/from <b>Manchester</b> additionally call at Congleton and Macclesfield.		√
All services to/from <b>Edinburgh</b> additionally call at Alnmouth, Berwick-upon-Tweed, Dunbar, and Morpeth.		√
All services to/from <b>Birmingham International</b> no longer call at Adderley Park, Lea Hall, Marston Green or Stechford.		√
<b>Reading – Newcastle</b> services with a frequency of 12-13tpd in the Do Minimum are truncated at York in the Phase 2b modelling.		√
<b>Edinburgh – Newcastle</b> receive an additional 1-2tpd in Phase 2b.		√
<b>Birmingham New Street – Glasgow Central</b> service reduced by 1tpd.		√
<b>Manchester Piccadilly – Birmingham New Street</b> service increased by 1tpd.		√

Figure 6-4: Cross Country Service Pattern used in PFMv7.1 – Phase 2b



## 6.5 East Coast Main Line

- 6.5.1 The Phase 1 and Phase 2a timetable is unchanged from the 'Do Minimum', whilst the Phase 2b timetable assumes the following services to/from London:
- 1tph to Leeds, with same two hourly service frequency as the Do Minimum continuing to Bradford and Harrogate, and the peak Skipton service;
  - 1tph London Kings Cross to Edinburgh;
  - 1tph London Kings Cross to Newcastle;
  - The additional two-hourly service between Middlesbrough and London King's Cross in the Do Minimum is maintained with an extra intermediate stop at Doncaster; and,
  - 1tph to between Lincoln and London King's Cross;
- 6.5.2 IEP journey time improvements introduced with the 'Do Minimum' timetable are incorporated in the 'Do Something' coding.
- 6.5.3 ECML Sunderland services from the 'Do Minimum' have been recoded under the Northern TOC. In addition, one train per hour has been coded between Leeds and Doncaster under the Northern TOC to retain the same level of service provision on this section of network as in the 'Do Minimum' scenario.
- 6.5.4 ECML services north of Edinburgh, have been recoded as ScotRail services.
- 6.5.5 A summary of services and stopping patterns for East Coast Main Line in Phase 2b is included in Figure 6-5. Phase 1 and Phase 2a are not presented as the service pattern is unchanged from the 'Do Minimum'.

## Released Capacity Summary – ECML

6.5.6 This section summaries the difference in service patterns between the Do Minimum, and the Do Something service patterns for East Coast Main Line. The table shows a summary of the released capacity changes incorporated into each modelled phase.

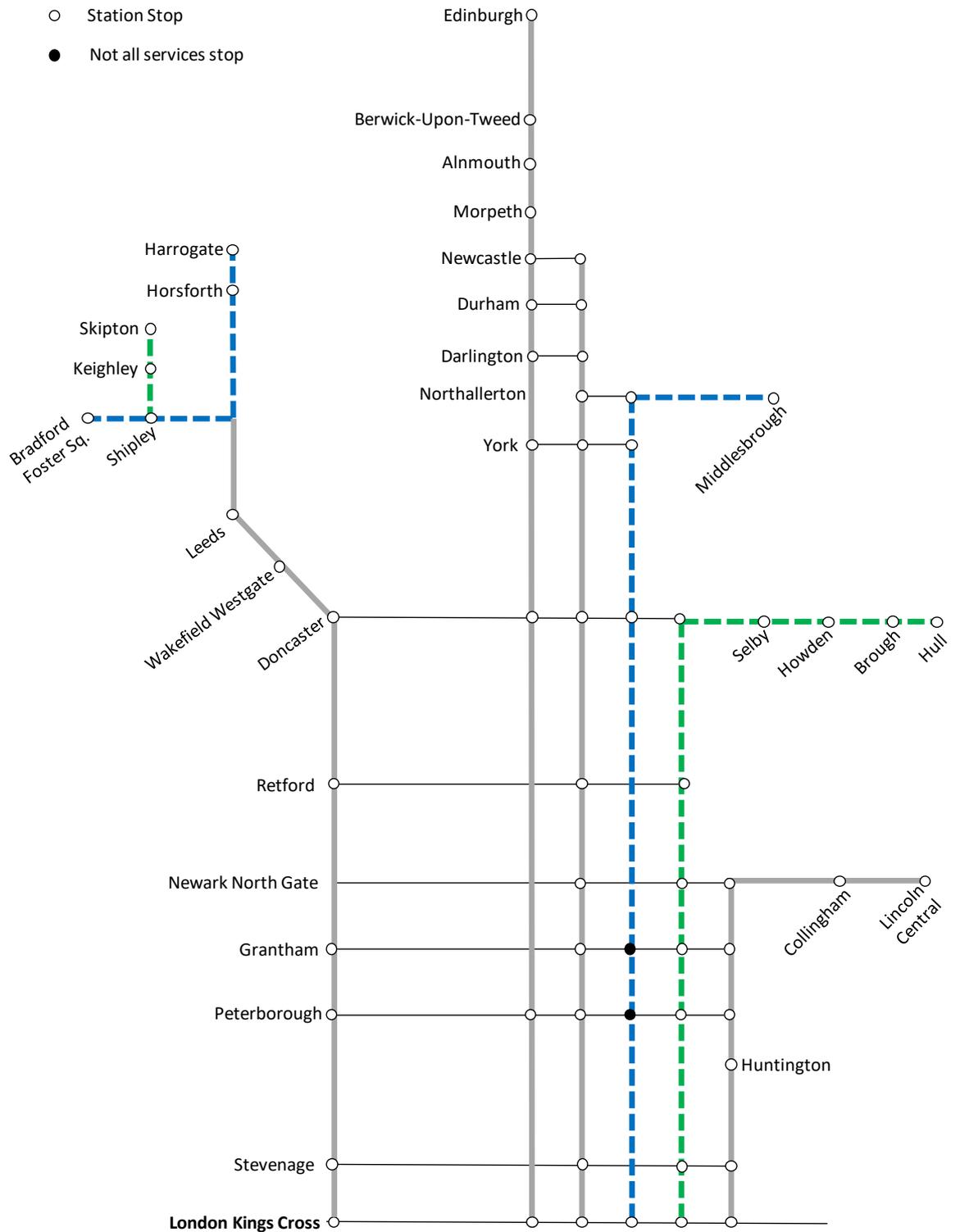
6.5.7 In developing service specifications, we have sought to maintain or improve the overall level of service across all TOCs. Where the level of service on a particular TOC has decreased, it will usually be compensated by enhancements to another TOC’s services or by the new HS2 service.

Differences in Service Pattern between Do Minimum and Do Something	Phase 1 & Phase 2A	Phase 2b
London Kings Cross – Leeds reduction in services (-23tpd) in Phase 2b with the removal of the hourly and bi-hourly service direct to Leeds.		√
London Kings Cross – Edinburgh services reduced by 4tpd in Phase 2b.		√
London Kings Cross – Lincoln \ Newcastle services increased in frequency by 11-12tpd in Phase 2b.		√
Truncation and removal of services in Phase 2b means that East Coast services no longer originate\terminate at the following stations:  Aberdeen  Glasgow Central  Huddersfield  Inverness  Sunderland		√
London Kings Cross – Bradford Foster Square is served by an extra 1tpd in Phase 2b.		√
The following non-London services are removed in Phase 2b:  Doncaster – Leeds  Doncaster – Edinburgh  Newcastle – Edinburgh  Leeds - Aberdeen		√

Figure 6-5: East Coast Service – Average Service Pattern used in PFMv7.1 – Phase 2b

KEY:

- 1 train per hour
- - - 1 train per 2 hours
- 4 trains per day
- - - 1-2 trains per day
- Station Stop
- Not all services stop



## 6.6 East Midlands Trains

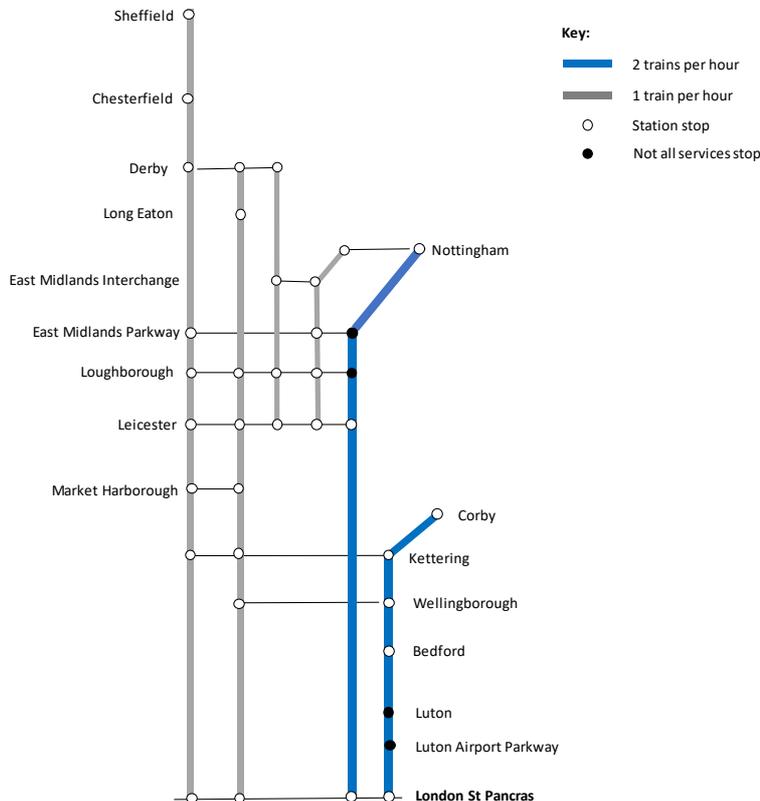
- 6.6.1 The Phase 1 and Phase 2a 'Do Something' timetable for East Midlands Trains is the same as the 'Do Minimum' scenario as there are no released capacity assumptions on these services in Phase 1 and Phase 2a.
- 6.6.2 The Phase 2b timetable assumes the following service pattern for London services on the Midland main line:
- 2tph between Nottingham and London St Pancras;
  - 1tph between Sheffield and London St Pancras;
  - 1tph between Derby and London St Pancras; and,
  - 2tph between Corby (Kettering) and London St Pancras. Note that services to/from Corby are coded to/from Kettering as Corby station is not directly represented in PLD.
- 6.6.3 London services to Nottingham\Sheffield\Derby are assumed to be 10-car IEP trains in the peak and 5-car IEP trains in the off-peak.
- 6.6.4 The Phase 2b timetable is also amended within the East Midlands area to allow for released capacity and connectivity to the East Midlands Interchange station:
- The Liverpool to Norwich services group is re-routed in Phase 2b to stop at Toton. This incurs an increased journey time by six minutes;
  - The Nottingham to Norwich service is extended to start/terminate at the East Midlands Interchange incurring an additional 14-minute journey time;
  - Both the Matlock to Nottingham and Derby to Nottingham service groups are re-routed via the East Midlands Interchange in Phase 2b, incurring an additional 14-minute journey time; and,
  - New shuttle services are introduced between Leicester-Derby and Leicester-Nottingham via the East Midlands Interchange station.
- 6.6.5 A summary of services and stopping patterns for East Midlands Trains services to/from London in Phase 2b is included in Figure 6-6. Phase 1 and Phase 2a are not presented as they are not impacted by released capacity assumptions from the 'Do Minimum'.

## Released Capacity Summary – East Midlands

- 6.6.6 This section summaries the difference in service patterns between the Do Minimum, and the Do Something service patterns for East Midlands. The table shows a summary of the released capacity changes incorporated into each modelled phase.
- 6.6.7 In developing service specifications, we have sought to maintain or improve the overall level of service across all TOCs. Where the level of service on a particular TOC has decreased, it will usually be compensated by enhancements to another TOC's services or by the new HS2 service.

Differences in Service Pattern between Do Minimum and Do Something	Phase 1 & Phase 2A	Phase 2b
<b>London St Pancras – Sheffield</b> service reduced from 32tpd in the Do Minimum to 16tpd in the Phase 2b modelling.		√
<b>London St Pancras – Derby</b> service introduced at 16tpd frequency replacing much of the reduction in services to Sheffield.		√
<b>Norwich – Nottingham</b> service (2tpd) extended to East Midlands Interchange.		√
<b>Liverpool – Norwich</b> service (11tpd) extended to East Midlands Interchange.		√
<b>Matlock – Nottingham</b> and <b>Derby – Nottingham</b> services extended to call at East Midlands Interchange.		√
<b>Leicester-Nottingham</b> and <b>Leicester-Derby</b> services (1tph) introduced calling at East Midlands Interchange.		√

Figure 6-6: East Midlands Service Pattern used in PFMv7.1 – Phase 2b



## 6.7 London Midland

6.7.1 The 'Do Something' London Midland network is consistent with the 'Do Minimum' and the same in Phase 1, Phase 2a, and Phase 2b scenarios.

6.7.2 The Do Something timetable assumes the following services to/from London Euston:

- 2tph peak services between London Euston and Watford Junction;
- 3tph between London Euston and Tring;
- 2tph between London Euston and Bletchley;
- 1tph between London Euston and Milton Keynes;
- 2tph peak services between London Euston and Northampton;
- 2tph peak services between London Euston and Rugby;
- 2tph between London Euston and Birmingham New Street; and,
- 1tph between London Euston and Crewe.

6.7.3 The Do Something timetable (in all phases) also assumes the following services starting at Birmingham New Street:

- 2tph peak services between Birmingham International and Shrewsbury;
- 1tph peak services between Birmingham New Street and Crewe; and,
- 2tph between Birmingham New Street and Liverpool Lime Street.

6.7.4 An simplified summary of services and stopping patterns for London Midland services in Phase 1, Phase 2a, and Phase 2b is shown in Figure 6-7.

### Released Capacity Summary – London Midland

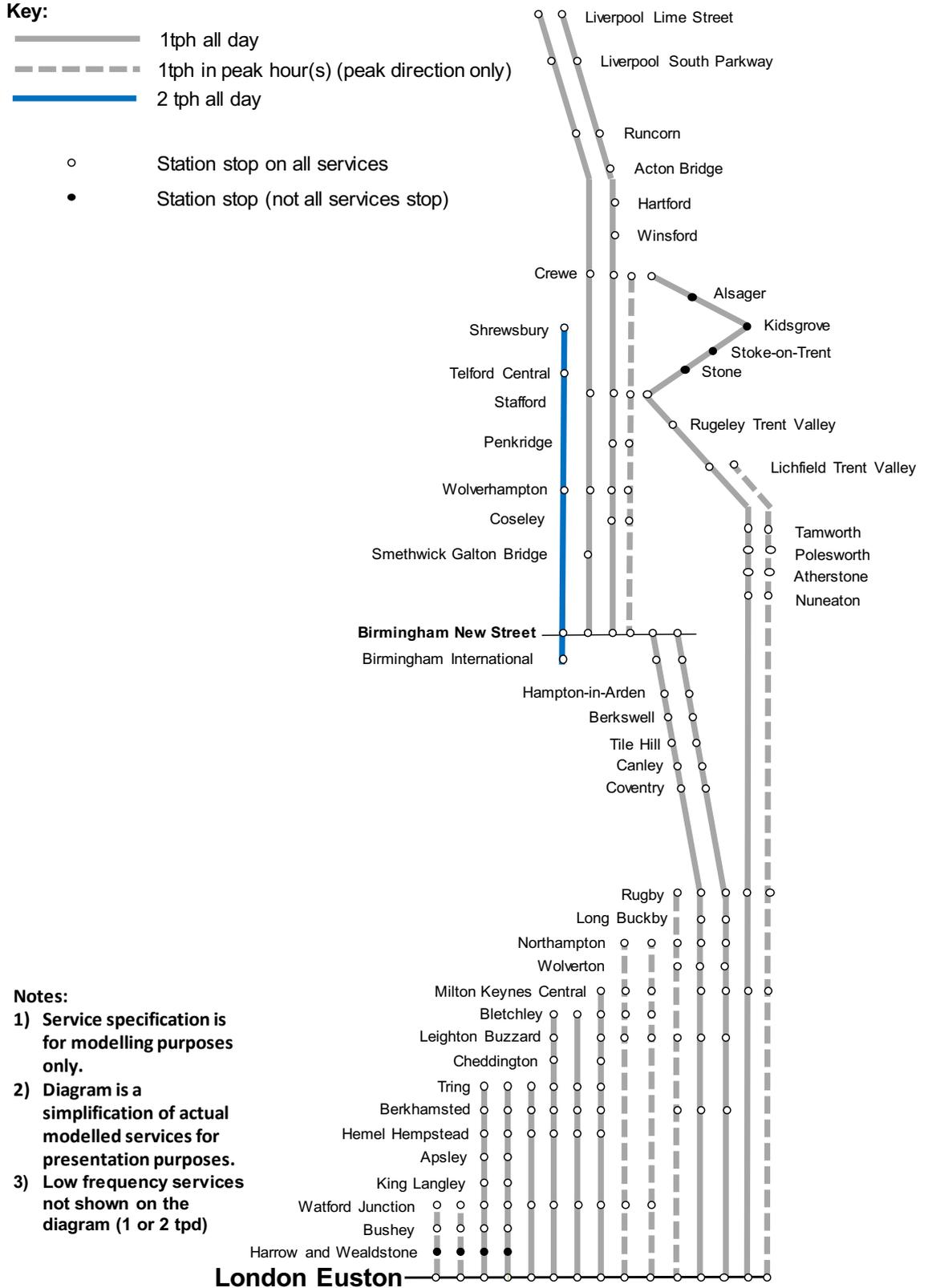
6.7.5 This section summaries the difference in service patterns between the Do Minimum, and the Do Something service patterns for London Midland. The table shows a summary of the released capacity changes incorporated into each modelled phase.

6.7.6 In developing service specifications, we have sought to maintain or improve the overall level of service across all TOCs. Where the level of service on a particular TOC has decreased, it will usually be compensated by enhancements to another TOC's services or by the new HS2 service.

Differences in Service Pattern between Do Minimum and Do Something	Phase 1 & Phase 2A	Phase 2b
London Euston - Watford Junction service level updated from 1-2tpd in each direction in Do Minimum to 6tpd in the Do Something.	√	√
London Euston - Tring service level changed from 29-31tpd in Do Minimum to 48tpd in the Do Something.	√	√

<b>London Euston – Bletchley</b> service level changed from 3tpd in the Do Minimum to 32tpd in the Do Something.	√	√
<b>London Euston – Milton Keynes Central</b> changed from 19-17tpd in Do Minimum to 16tpd in the Do Something.	√	√
<b>London Euston – Northampton</b> changed to 3 peak hour services in each direction	√	√
<b>London Euston – Rugby</b> service introduced as 2 peak hour trains per day in each direction.	√	√
<b>London Euston – Birmingham New Street</b> service amended to 2tph in each direction.	√	√
<b>London Euston – Lichfield Trent Valley</b> 1tpd peak service introduced in each direction.	√	√
<b>London Euston – Crewe</b> minor timetable change to 1tph in each direction.	√	√
<b>Birmingham New Street – Liverpool Lime Street</b> service pattern adjusted slightly to 2tph throughout the day.	√	√
<b>Birmingham New Street – Shrewsbury</b> service changed from 27-29tpd in the Do Minimum to 32tpd in the Do Something and extended to Birmingham International.	√	√
<b>Birmingham New Street – Walsall</b> (3-4tpd) service extended to Leamington Spa via Coventry.	√	√
<p>The following services are removed or incorporated into extensions of other services as part of the released capacity assumptions:</p> <ul style="list-style-type: none"> <li><b>Coventry – London Euston</b> (1tpd) service removed.</li> <li><b>Birmingham New Street – Birmingham International</b> (1tph) incorporated into extension of Shrewsbury service to Birmingham International.</li> <li><b>Coventry – Birmingham New Street</b> (5tpd)</li> <li><b>Coventry – Wolverhampton</b> (1tpd) service removed.</li> <li><b>Northampton – Birmingham New Street</b> – all services removed.</li> <li><b>Northampton – Crewe</b> (2tpd) services removed.</li> <li><b>Walsall – Liverpool Lime Street</b> (3tpd) services removed.</li> <li><b>Wolverhampton – Birmingham New Street</b> (3-4tpd) services removed.</li> </ul>	√	√

Figure 6-7: London Midland Service Pattern used in PFMv7.1 – Phase 1, Phase 2a, Phase 2b



## 6.8 Northern Railway

6.8.1 The Phase 1 and Phase 2A timetables are unchanged from the 'Do Minimum'. Released capacity assumptions for Northern Railway are applied within the Phase 2b timetable only.

6.8.2 The Phase 2b timetable assumes the following for each corridor.

- On the Leeds-Doncaster/Sheffield corridor the following services to/from Leeds:
  - 2tph to Sheffield;
  - 1tph to Sheffield via Rotherham stopping service;
  - 1tph to Doncaster calling all stations; and
  - 1.5tph to Doncaster semi-fast (backfilling for removed East Coast services).
- On the South Manchester corridor, the following services to/from Manchester Piccadilly:
  - 2tph to Crewe via Stockport;
  - 1tph to Alderley Edge via Stockport;
  - 2tpd to Stoke on Trent stopping service;
  - peak extra services to Macclesfield; and,
  - 1tph to Crewe semi-fast.
- On the Calder Valley corridor, the following services to/from Leeds:
  - 3tph to Huddersfield;
  - 1tpd to Manchester Victoria; and,
  - 1tpd Bradford Interchange to Manchester Victoria.
- On the North West Electrification corridor, the following services to/from Manchester Piccadilly / Manchester Victoria:
  - 1tph Wigan Wallgate;
  - 1tph Kirkby;
  - 1tpd Clitheroe;
  - 4tpd Southport;
  - 1 tpd Liverpool Lime Street stopping service;
  - 1tpd Liverpool Lime Street peak fast service; and,
  - 2tph Liverpool Lime Street to Manchester Airport.

6.8.3 A summary of services and stopping patterns for Northern services on the key corridors are presented in Figures 6-8 to 6-11 for Phase 2b. Phase 1 and Phase 2a services for Northern Railway are not shown as they are as per the 'Do Minimum'.

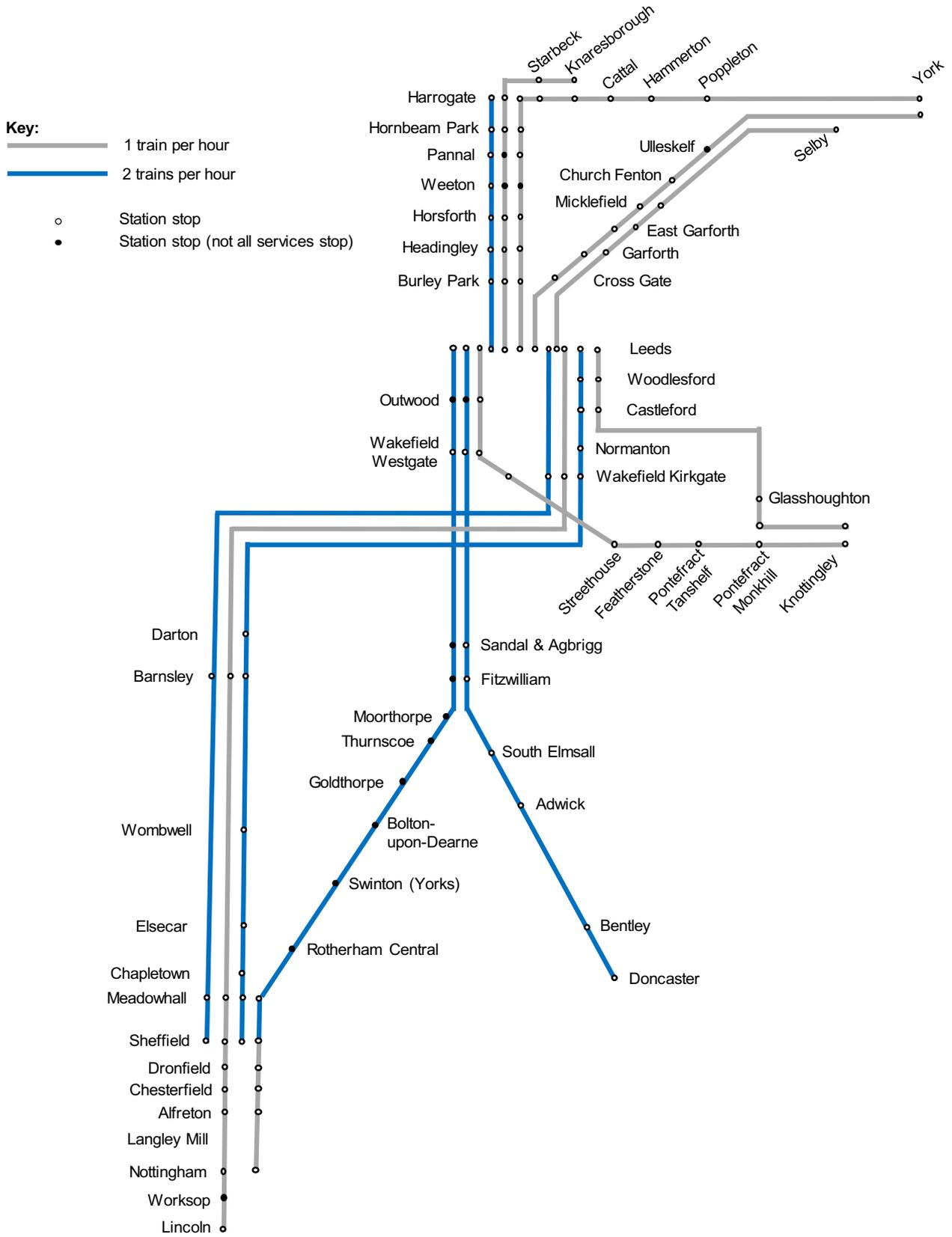
### Released Capacity Summary – Northern Railway

6.8.4 This section summaries the difference in service patterns between the Do Minimum, and the Do Something service patterns for Northern Railway. The table shows a summary of the released capacity changes incorporated into each modelled phase.

6.8.5 In developing service specifications, we have sought to maintain or improve the overall level of service across all TOCs. Where the level of service on a particular TOC has decreased, it will usually be compensated by enhancements to another TOC's services or by the new HS2 service.

Differences in Service Pattern between Do Minimum and Do Something	Phase 1 & Phase 2A	Phase 2b
<b>Crewe – Manchester</b> hourly service added as part of Phase 2b release capacity.		√
<b>Sunderland – Newcastle</b> service added with frequency of 2tpd in each direction.		√
<b>Doncaster – Leeds</b> service added with a frequency of 24tpd in each direction.		√
<b>Manchester – Stoke</b> service added with a frequency of 10tpd in each direction.		√

Figure 6-8: Northern Railway Services- Leeds-Sheffield & Doncaster Corridor Service Pattern used in PFMv7.1 – Phase 2b



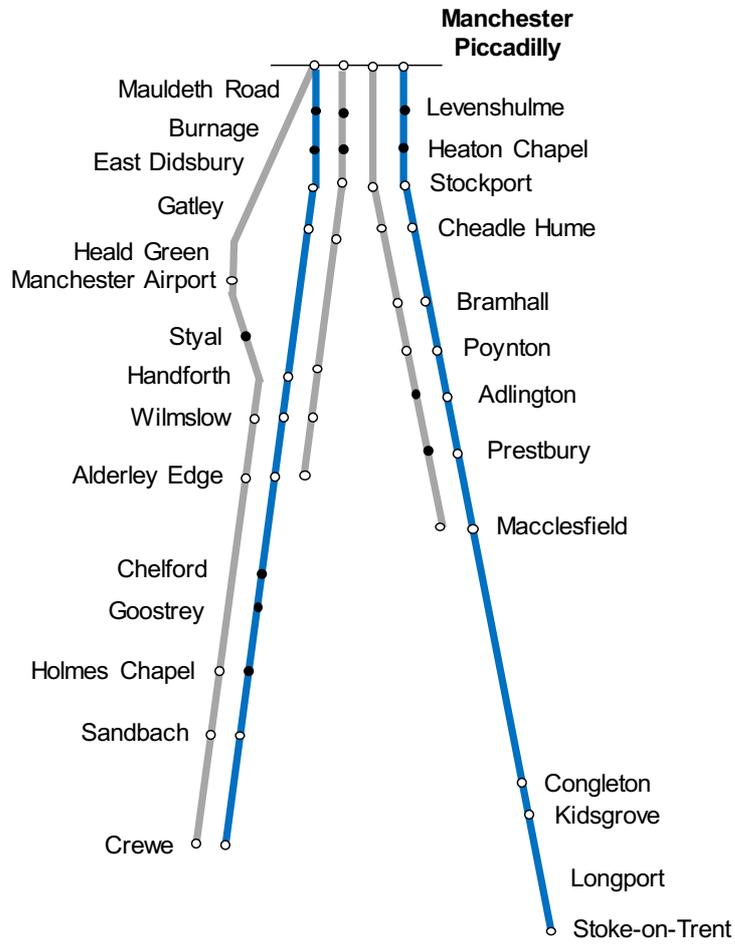
**Notes:**

- 1) Service specification is for modelling purposes only.
- 2) Diagram is a simplification of actual modelled services for presentation purposes.

Figure 6-g: Northern Railway Services- South Manchester Corridor Service Pattern used in PFMv7.1 – Phase 2b

**Key:**

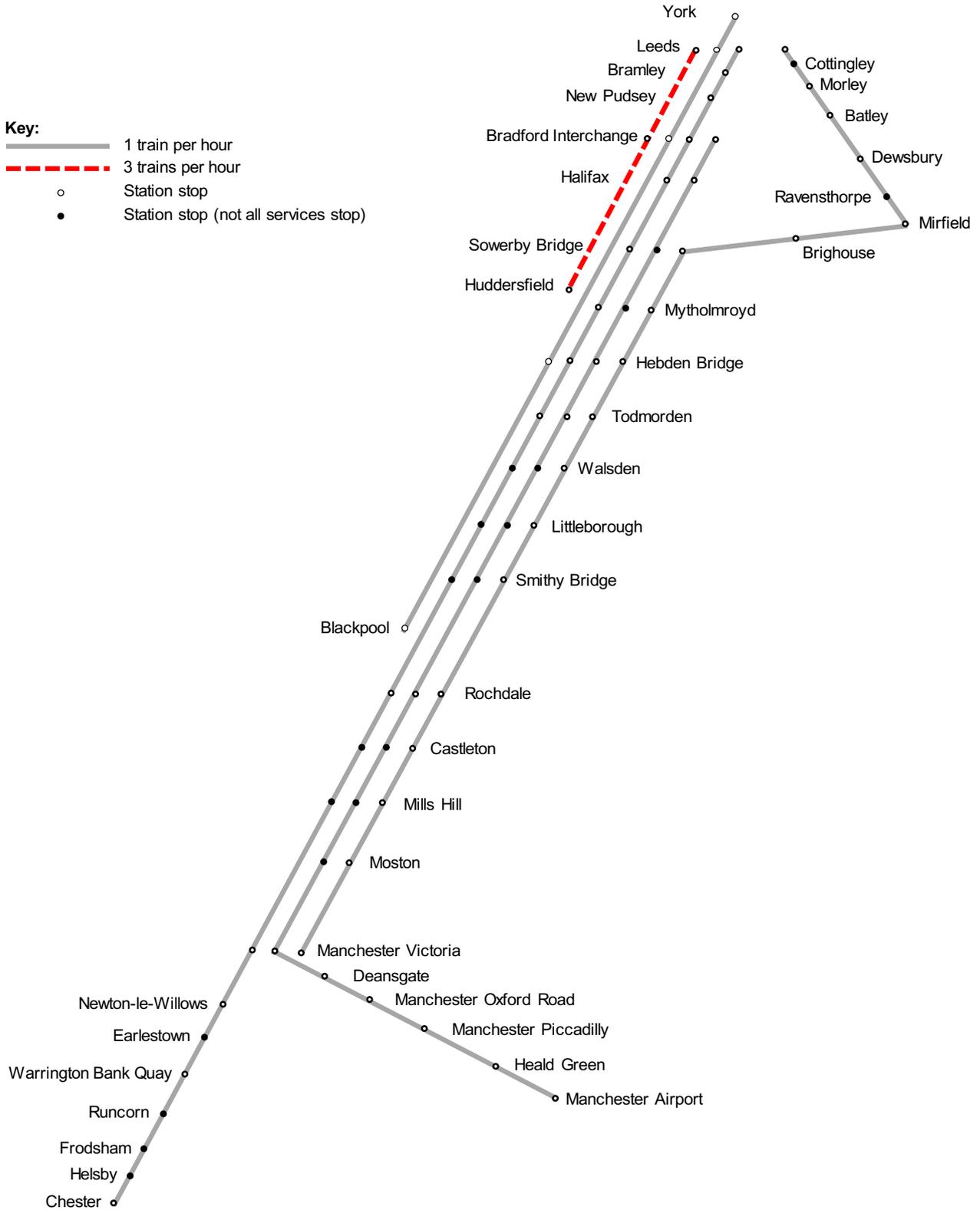
- 1 train per hour
- 2 trains per hour
- Station stop
- Station stop (not all services stop)



**Notes:**

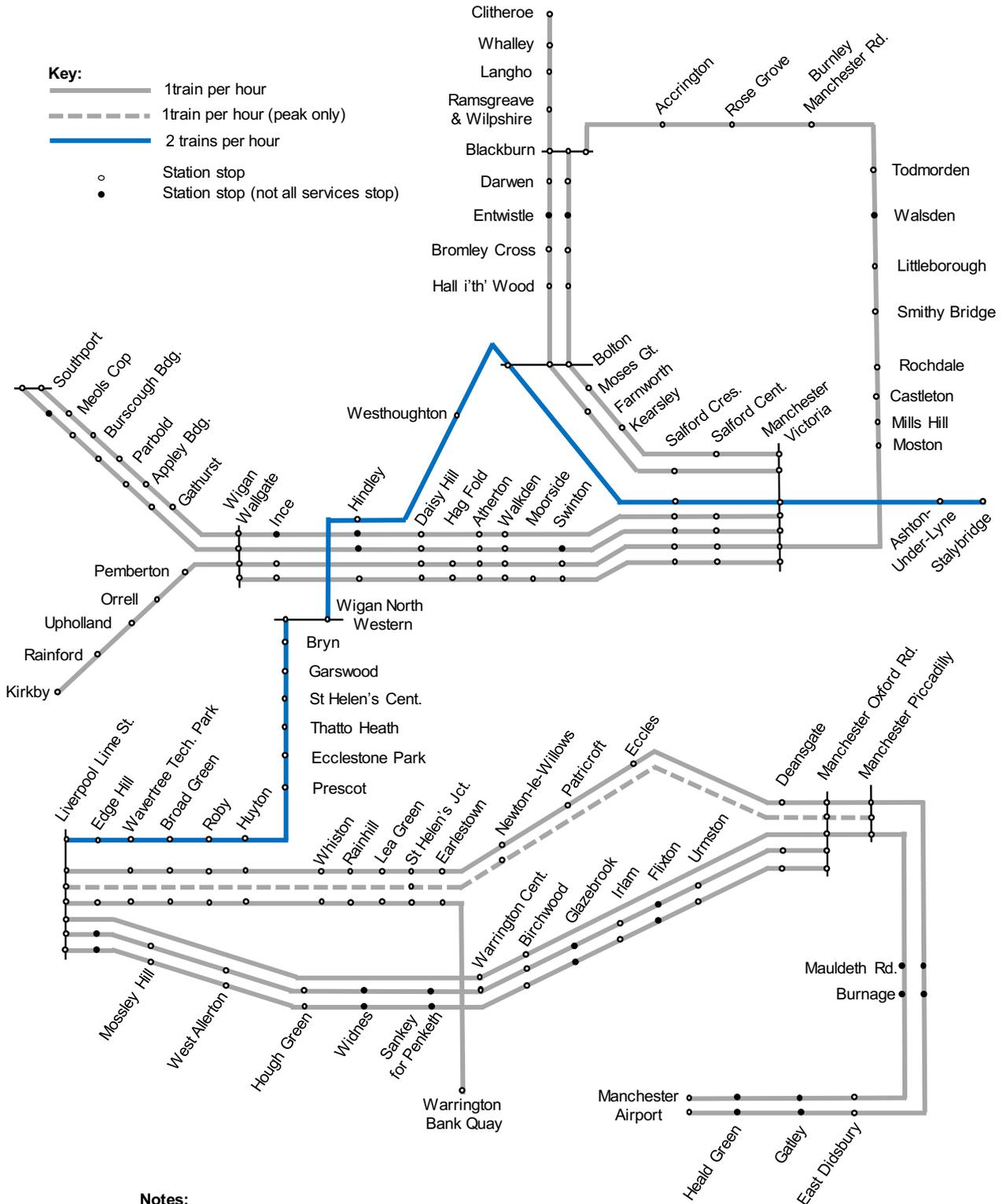
- 1) Service specification is for modelling purposes only.
- 2) Diagram is a simplification of actual modelled services for presentation purposes.

Figure 6-10: Northern Railway Services- Leeds-Sheffield & Doncaster Corridor Service Pattern used in PFMv7.1 – Phase 2b



- Notes:**
- 1) Service specification is for modelling purposes only.
  - 2) Diagram is a simplification of actual modelled services for presentation purposes.

Figure 6-11: Northern Railway Services- South Manchester Corridor Service Pattern used in PFMv7.1 – Phase 2b

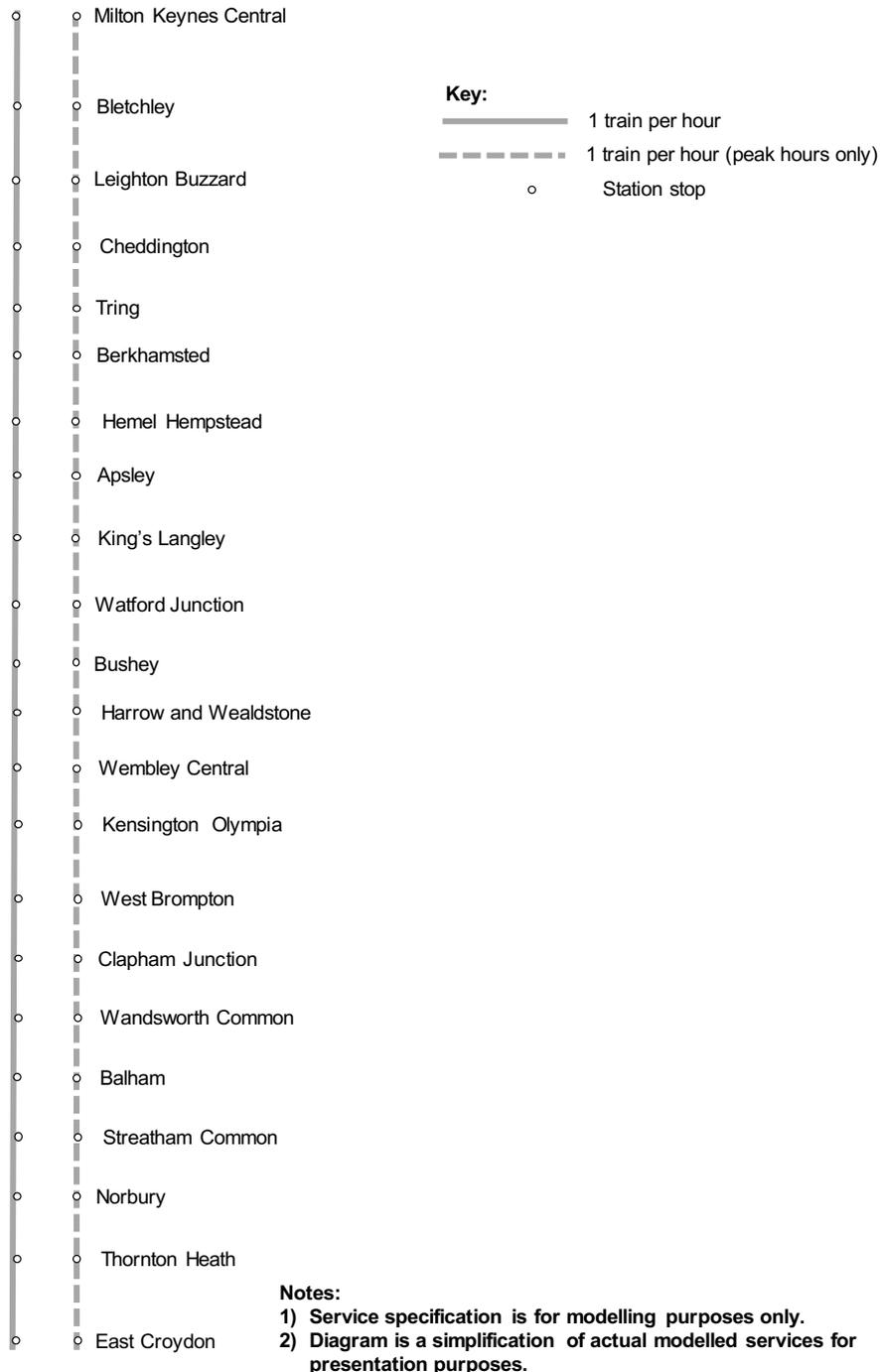


## 6.9 Southern

6.9.1 The service pattern assumptions for Southern relate to the service operating to Milton Keynes. In Phase 1, Phase 2a, and Phase 2b an hourly service is assumed, with a second train per hour in peak times, between East Croydon and Milton Keynes Central.

6.9.2 A summary of services and stopping patterns for Southern Trains in Phase 1, Phase 2a, and Phase 2b is included in Figure 6-12.

Figure 6-12: Southern Train Service Pattern used in PFMv7.1 – Phase 1, Phase 2a, and Phase 2b



## 6.10 TransPennine Trains

- 6.10.1 Released capacity assumptions for TransPennine changes to the 'Do Minimum' timetables are applied initially in Phase 1 and Phase 2a with the introduction of an additional peak hour service (2 tpd) between Manchester Piccadilly and Manchester Airport.
- 6.10.2 The majority of released capacity assumptions for TransPennine are applied in Phase 2b with the extension of Liverpool – Newcastle services to Edinburgh.
- 6.10.3 The Phase 2b timetable for TransPennine Trains assumes the following enhancements compared to the DM service pattern:
- 2tph between Manchester and Hull via Leeds (increase from 1tph);
  - 1tpd between Manchester Airport and Doncaster via Sheffield;
  - 1tpd from York to Middlesbrough;
  - 5tpd between Liverpool and Newcastle (via Manchester, Leeds and York);
  - 1tph between Liverpool and Scarborough (via Manchester, Leeds and York);
  - To / from Manchester Airport:
    - 4tpd to York; and,
    - 1tph to Cleethorpes via Sheffield.
- 6.10.4 A summary of services and stopping patterns for TransPennine Train services is included in Figure 6-13 for Phase 2b. Phase 1 and Phase 2a services for TransPennine are not shown as they are as per the 'Do Minimum'.

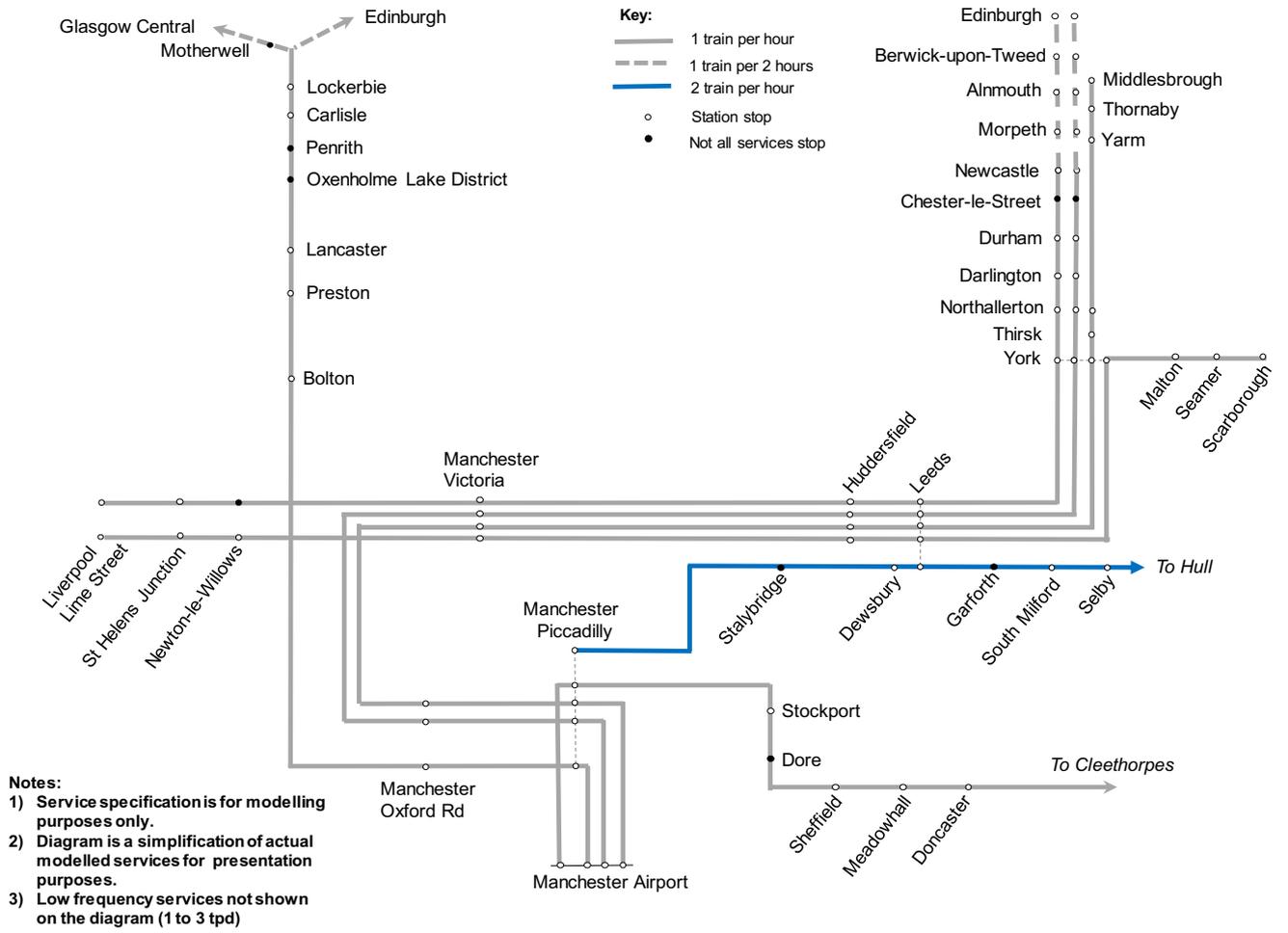
### Released Capacity Summary – TransPennine

- 6.10.5 This section summaries the difference in service patterns between the Do Minimum, and the Do Something service patterns for TransPennine. The table shows a summary of the released capacity changes incorporated into each modelled phase.
- 6.10.6 In developing service specifications, we have sought to maintain or improve the overall level of service across all TOCs. Where the level of service on a particular TOC has decreased, it will usually be compensated by enhancements to another TOC's services or by the new HS2 service.

Differences in Service Pattern between Do Minimum and Do Something	Phase 1 & Phase 2A	Phase 2b
<b>Manchester Airport – Manchester Piccadilly</b> an additional 1tpd in each direction is introduced in the Phase 1 and Phase 2a modelling.	√	√
<b>Liverpool – Newcastle</b> (5tpd) services extended to Edinburgh in the Phase 2b.		√
<b>Manchester Airport – Newcastle</b> (gtpd) services extended to Edinburgh in Phase 2b.		√

**Newcastle – Manchester Airport (11tpd) services reduced to 2tpd in Phase 2b.**

Figure 6-13: Trans Pennine Service Pattern used in PFMv7.1 – Phase 2b



## 6.11 Thameslink and Great Northern Trains

- 6.11.1 The Thameslink specification presented here relates to selected Thameslink services in the corridors impacted by the released capacity specification, that is, the Midland route to Bedford and the Great Northern route to Peterborough. Services south of London are assumed unchanged.
- 6.11.2 Phase 1 is unchanged from the 'Do Minimum' and assumes the following:
- On the Thameslink Midland corridor:
    - 5.5tph between Bedford and Brighton via central London;
  - And on the Great Northern Peterborough corridor:
    - 1tph peak only between King's Cross and Peterborough;
    - 2tph between Three Bridges and Peterborough via central London.
- 6.11.3 Phase 2b assumes the following:
- On the Thameslink Midlands corridor:
    - 5.5tph between Bedford and Brighton via central London;
    - 1tph between Bedford and London St Pancras semi-fast.
  - And on the Great Northern Peterborough corridor:
    - 1tph peak only between King's Cross and Peterborough semi fast;
    - 1tph peak only between King's Cross and Peterborough stopping service;
    - 2tph between Three Bridges and Peterborough via central London;
    - 1tph between King's Cross and Peterborough semi-fast.
- 6.11.4 A summary of services and stopping patterns for Thameslink Midland and Thameslink Great Northern services is presented in Figure 6-14 for Phase 1 and Phase 2a, and Figure 6-15 for Phase 2b.

Figure 6-14: Thameslink- Midlands and Great Northern Service Pattern used in PFMv7.1 – Phase 1

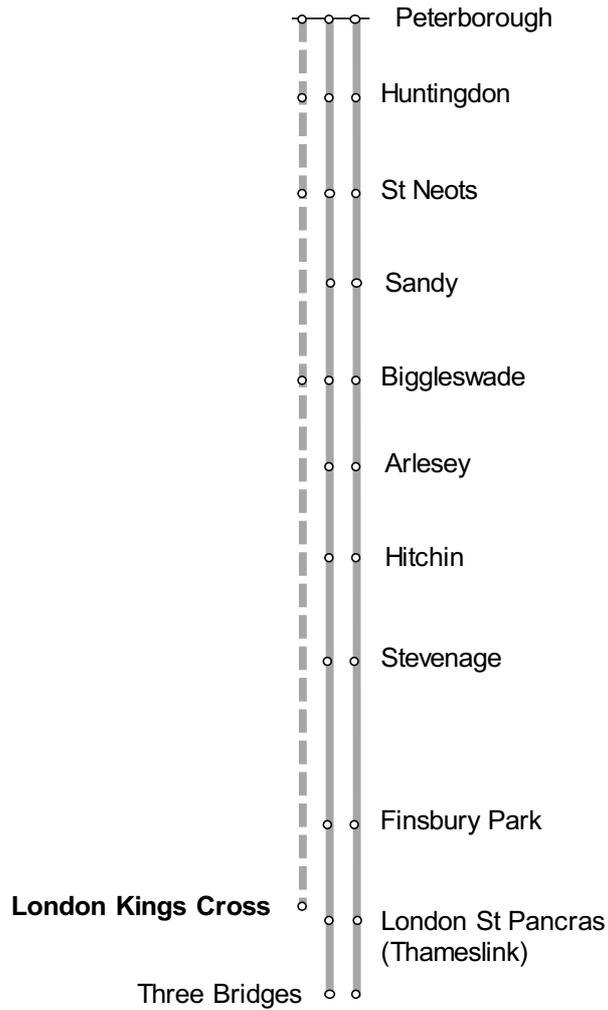


**Notes:**

- 1) Service specification is for modelling purposes only.
- 2) Diagram is a simplification of actual modelled services for presentation purposes.
- 3) Only shows trains starting at Bedford, plus any released capacity services

**Key:**

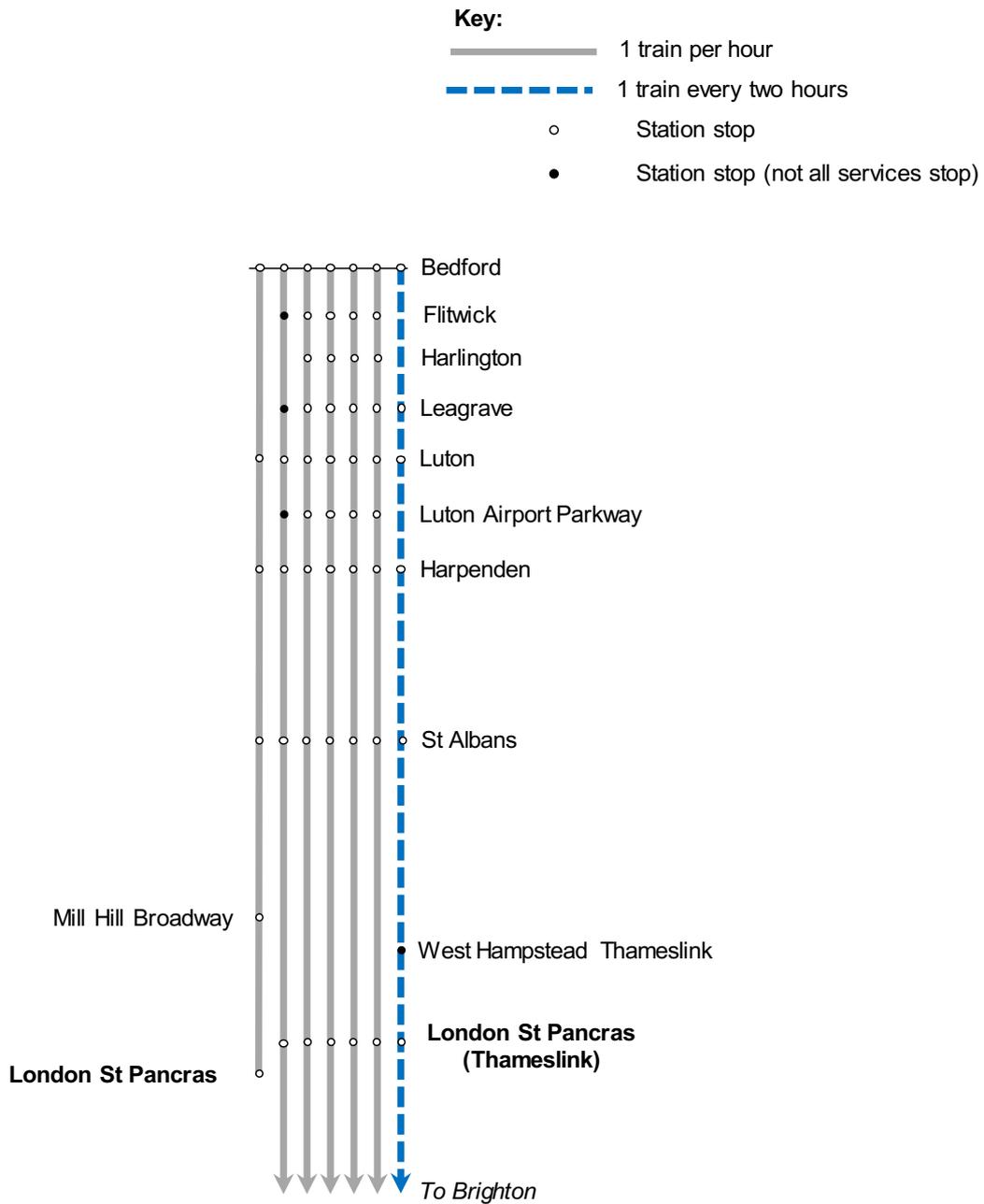
- 1 train per hour
- - - - - 1 train per hour (peak hours only)
- o Station stop



**Notes:**

- 1) Service specification is for modelling purposes only.
- 2) Diagram is a simplification of actual modelled services for presentation purposes.
- 3) Only shows trains starting at Peterborough, plus any released capacity services

Figure 6-15: Thameslink – Midlands and Great Northern Service Pattern used in PFMv7.1 – Phase 2b



**Notes:**

- 1) Service specification is for modelling purposes only.
- 2) Diagram is a simplification of actual modelled services for presentation purposes.
- 3) Only shows trains starting at Bedford, plus any released capacity services

**Key:**

- 1 train per hour
- - - - - 1 train per hour (peak hours only)
- o Station stop



**Notes:**

- 1) Service specification is for modelling purposes only.
- 2) Diagram is a simplification of actual modelled services for presentation purposes.
- 3) Only shows trains starting at Peterborough, plus any released capacity services

## 6.12 West Coast Main Line

- 6.12.1 A summary of services and stopping patterns for the West Coast Main Line is included in Figure 6-16 for Phase 1. The service pattern for Phase 2b is shown in Figure 6-17.
- 6.12.2 The Phase 1 timetable assumes the following services to/from London Euston:
- 1tph to Wolverhampton (2 trains per day extension to Shrewsbury);
  - 1tph to Scotland via Birmingham (alternating between Glasgow and Edinburgh);
  - 1tph peak shuttle service between Preston and Blackpool North;
  - 1tph to Chester (7-8 trains per day extension to North Wales) with a regularised stopping pattern compared to the do-minimum along the Trent Valley;
  - one train per peak hour in the peak direction from/to Crewe;
  - 1tph to Northampton (in addition to LM services); and,
  - 1tph and one train per peak hour in the peak direction London Euston to Manchester.
- 6.12.3 Train types used are similar to those by service in the new 'Do Minimum', but with all Pendolino trains being of 11-car train sets, and the same mix of Voyagers on those services worked by diesel trains.
- 6.12.4 There is no change to the West Coast Main Line Open Access services under the released capacity assumptions.
- 6.12.5 Phase 2b service pattern is identical to the Phase 1 specification, with the exception being that the hourly service from Euston to Scotland via the West Midlands (alternating between Glasgow and Edinburgh) only runs to Preston in the Phase 2b specification. Train types adopted are as used in Phase 1.

## Released Capacity Summary – WCML

6.12.6 This section summaries the difference in service patterns between the Do Minimum, and the Do Something service patterns for West Coast Main Line. The table shows a summary of the released capacity changes incorporated into each modelled phase.

6.12.7 In developing service specifications, we have sought to maintain or improve the overall level of service across all TOCs. Where the level of service on a particular TOC has decreased, it will usually be compensated by enhancements to another TOC’s services or by the new HS2 service.

Differences in Service Pattern between Do Minimum and Do Something	Phase 1 & Phase 2A	Phase 2b
<b>London Euston-Birmingham</b> corridor has 33tpd (24tpd to Birmingham New Street, 9 tpd to Wolverhampton/Shrewsbury) in the Do Minimum with a variety of stopping patterns. The released capacity assumptions reduce this to 16tpd (14tpd to Wolverhampton, 2tpd to Shrewsbury) with consistent stopping pattern making overall service slightly slower.	√	√
<b>London Euston-Manchester Piccadilly</b> corridor has some London-Manchester services removed in the Do Something except for 3 peak services to maintain peak services from Stoke, Stockport and Macclesfield.	√	√
<b>London Euston-Chester/North Wales</b> services increased from 7/8tpd in the Do Minimum to 10tpd with additional calling points resulting in slower journey time but greater accessibility to services.	√	√
<b>Preston-Blackpool</b> has an additional 1tpd added in the Do Something scenario.	√	√
<b>London Euston-Scotland via Birmingham</b> has a service of 10tpd in the Do Minimum. In Phase 2b, this service is truncated at Preston and increased to 16tpd. All services have an additional calling point at Watford Junction.		√

Figure 6-16: West Coast Long Distance Services assumed in PFMv7.1 – Phase 1

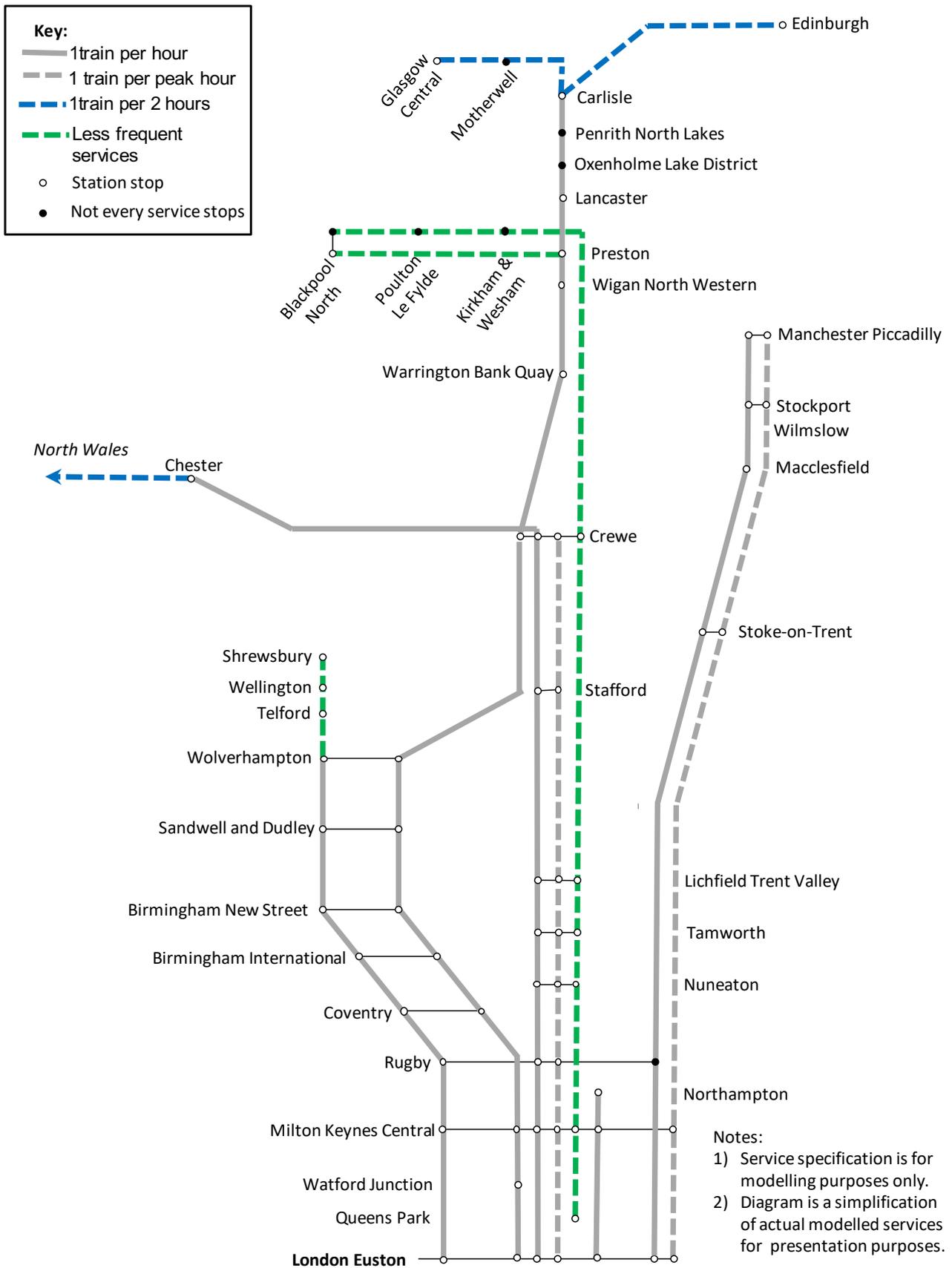
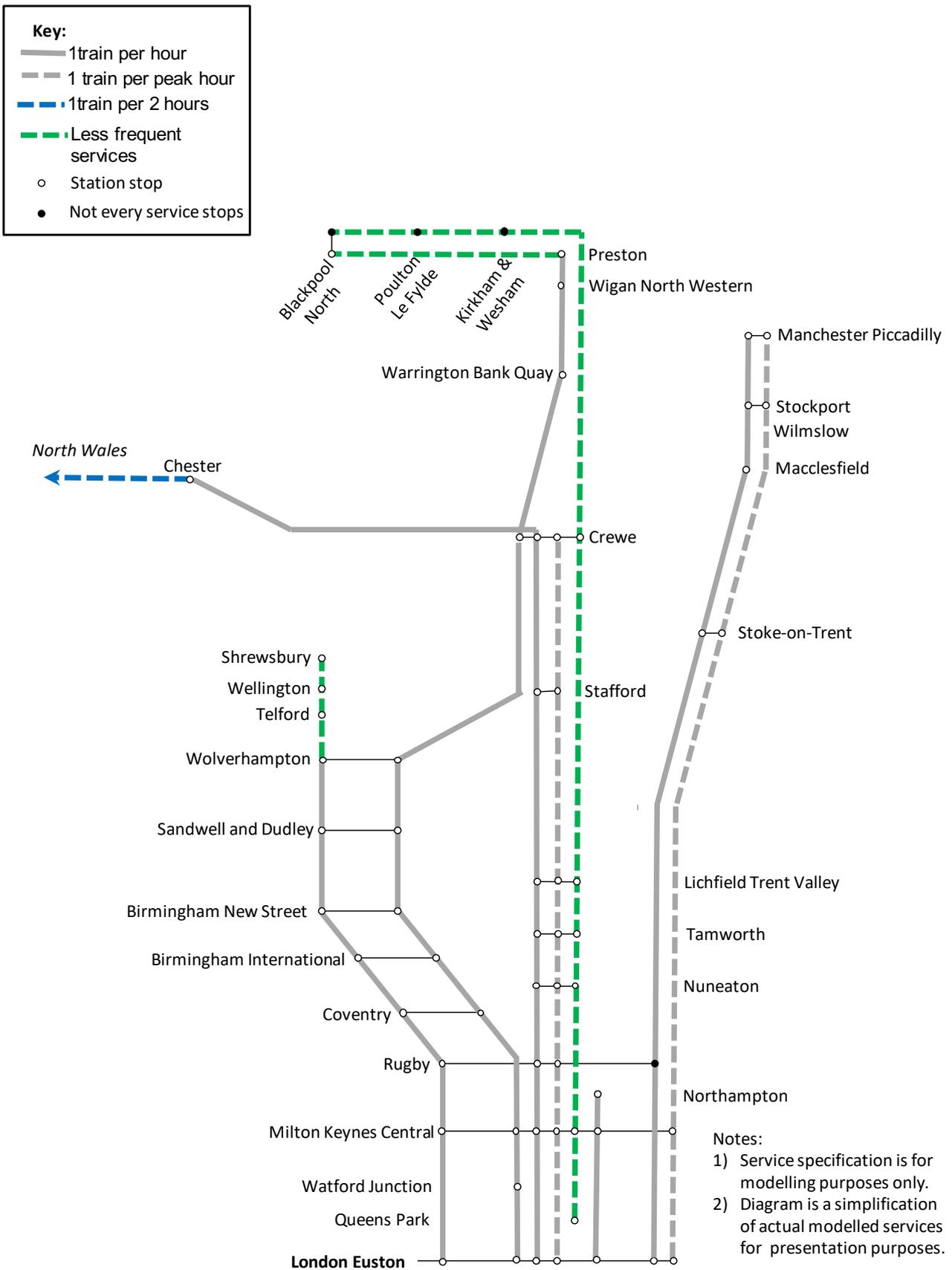


Figure 6-17: West Coast Long Distance Services assumed in PFMv7.1 – Phase 2b



## **6.13 Old Oak Common - Great Western and Heathrow Express**

6.13.1 All Great Western and Heathrow Express services between Paddington and the West call at Old Oak Common in Phase 1, Phase 2a and Phase 2b. The journey time impact of the additional stop at Old Oak Common is an increase in journey time of between two and four minutes.

## **6.14 Old Oak Common - CrossRail**

6.14.1 All CrossRail trains that travel the western section towards Heathrow and West Drayton/Maidenhead/Reading in the Do Minimum additionally call at Old Oak common in the Do Something scenario

6.14.2 In addition, services that start/end at Paddington are extended to serve Old Oak Common. The maximum capacity for turnaround at Old Oak Common is 12 trains per hour; therefore 12 trains per hour are extended in the morning and evening peaks, and 8 trains per hour have been extended in the off-peak. This extension is split equally between the Paddington to Shenfield, and Paddington to Abbey Wood<sup>24</sup> services.

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<sup>24</sup> In practise these services are modelled to start/terminate at Liverpool Street as Abbey Wood is not represented in the PFM.

## 7 High-Speed Rail Reliability

- 7.1.1 The approach to modelling reliability in PFMv7.1 involves adjusting the journey times for HS2 rail services as a proxy for the greater reliability of HS2 over conventional rail services. The approach considers the potential improvement in reliability that HS2 can deliver by examining one measure of reliability – Average Minutes Lateness (AML).
- 7.1.2 Improvements in AML as a result of HS2 are converted into an equivalent journey time saving based on evidence in PDFH and WebTAG<sup>25</sup>. The PFM assumes that all passengers value one AML as equivalent to three minutes of journey time<sup>26</sup>. This perceived reduction in journey time is then input into the model to forecast the change in demand due to reliability improvements.
- 7.1.3 PFM uses HS2 Ltd.'s design assumption that on dedicated HS2 track the average delay will be 0.003 minutes/km; this is equivalent to an average delay of 30 seconds delay between Old Oak Common and Birmingham Curzon Street. For Do Minimum services running on classic lines an average delay of 0.014 minutes/km delay is assumed (taken from PEARS data 2012).

Table 7-1: Reliability Benefits of HS2 in Phase 1, selected services

HS2 Service Group	Conventional Rail AML	HS2 Forecast AML	Difference in AML	Equivalent Journey Time Reduction (i.e., 3 times AML)
London - Birmingham	2.6	0.5	2.0	6
London – Phase 1 connection to WCML	2.9	0.5	2.3	7

Table 7-2: Reliability Benefits of HS2, Phase 2b, selected services

HS2 Service Group	Conventional Rail AML	HS2 Forecast AML	Difference in AML	Equivalent Journey Time Reduction (i.e., 3 times AML)
London - Birmingham	2.6	0.5	2.0	6
London – Liverpool via Crewe	3.5	0.7	2.8	9
London - Sheffield	3.8	0.8	3.0	9
London - Manchester	4.1	0.9	3.3	10
London - Leeds	4.7	0.9	3.7	11
Birmingham - Manchester	1.9	0.5	1.4	4
London – Phase 2 connection to WCML	4.4	0.9	3.5	11

<sup>25</sup> WebTAG unit 3.15.4

<sup>26</sup> PDFH5.1 recommends a weighting of 3.0 for London-Inter Urban non-commuting trips.

# Glossary

AML	Average minutes lateness
AP	Attraction to production
ATOC	Association of Train Operating Companies
CA	Car available
CAA	Civil Aviation Authority
CEBR	Centre for Economics and Business Research
CPI	Consumer Price Index
DECC	Department of Energy & Climate Change
DfT	Department for Transport
DM	Do Minimum
DS	Do Something
EDGE	Endogenous Demand Growth Estimator – forecasting framework for rail demand growth in Great Britain (DfT)
GDP	Gross domestic product
HSR	High Speed Rail
HS2	High Speed Two (the project)
HS2 Ltd	HS2 project promoter
IEP	Intercity express programme
IVT	In vehicle time
LUL	London Underground Limited
MOIRA	Rail forecasting software and database. Maintained on behalf of ATOC members for rail demand and revenue forecasting.
NCA	Non-car available
NTEM	National Trip End Model (DfT)
NTM	National Transport Model (DfT)
OBR	Office for Budget Responsibility
ONS	Office of National Statistics
ORR	Office of Rail and Road

PA	Production to Attraction
PDFH	Passenger Demand Forecasting Handbook
PFM	PLANET Framework Model
PLD	PLANET Long Distance
PM	PLANET Midlands
PN	PLANET North
PS	PLANET South
PT	Public transport
RIFF	Rail Industry Forecasting Framework
RPI	Retail Price Index
RTF	Road Traffic Forecasts (DfT)
SCM	Station Choice Model
TEMPro	Trip End Model presentation Program (DfT)
TfL	Transport for London
TOC	Train Operating Company
WebTAG	DfT's web-based Transport Appraisal Guidance

High Speed Two (HS2) Limited  
Two Snowhill  
Snow Hill Queensway  
Birmingham B4 6GA

[www.hs2.org.uk](http://www.hs2.org.uk)