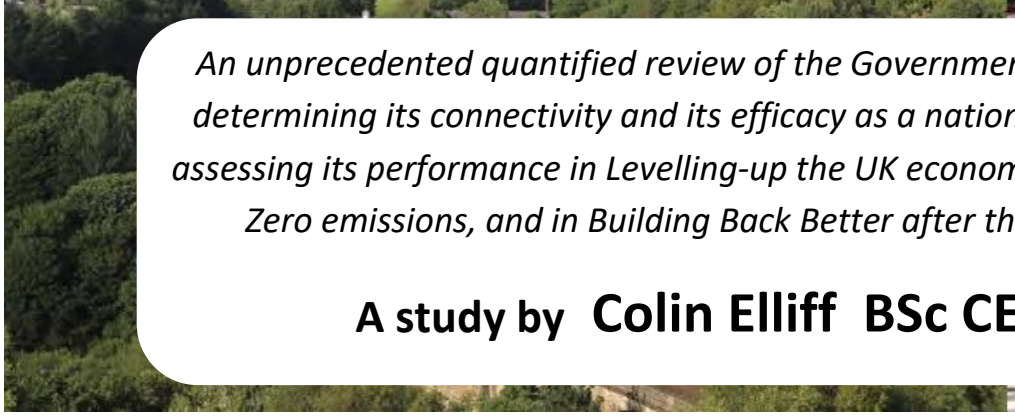
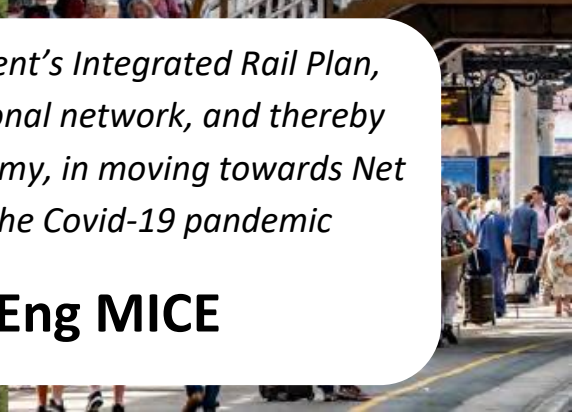
Dissecting the Integrated Rail Plan

A plan with little integration, less benefit and no levelling-up





An unprecedented quantified review of the Government's Integrated Rail Plan, determining its connectivity and its efficacy as a national network, and thereby assessing its performance in Levelling-up the UK economy, in moving towards Net Zero emissions, and in Building Back Better after the Covid-19 pandemic

A study by Colin Elliff BSc CEng MICE

Author's Foreword

The Great British public has sensed from the start that there was something very wrong with the HS2 project; a 'Y-network' of new high speed lines, starting in Yorkshire and the North-West, and funnelling through the West Midlands to London, always seemed a highly unlikely solution for the nation's transport problems. And many experienced professionals in the railway industry, myself included, have never understood how HS2's new high speed lines, built with minimal connection to the existing main line network, could ever form the backbone of the enhanced and integrated national rail network that the nation so clearly needs.

Yet HS2's supporters in Government, in the wider political and business establishment, and in the 'consultocracy' that has clustered around the HS2 honeypot, have been unwavering in insisting that HS2 was the right way forwards; and dissenting railway industry voices, such as my own, have been ruthlessly suppressed, with careers terminated, to maintain the illusion of unanimity. 13 years have now passed since the inception of the HS2 project; and in all that time, neither the Government, nor HS2 Ltd, nor any of its attendant cheerleaders have ever offered a remotely cogent explanation of how HS2 represents the right, and the best way forward for the UK railway network.

But with the publication of the Government's long-awaited Integrated Rail Plan (IRP) in November 2021, the chickens are finally coming home to roost. The Government has at last accepted that an integrated national railway network is what the nation needs, and moreover, it sees this integrated network as vital to delivering its key policy agendas, of Levelling-up the UK economy, achieving Net Zero greenhouse gas emissions, and Building Back Better after the Covid-19 pandemic.

It is crucial that the Integrated Rail Plan does deliver the step-change gains in railway network connectivity and capacity that the UK Government and the UK people expect, and – in the absence of any definitive studies from official quarters – I have compiled ***Dissecting the Integrated Rail Plan*** to present the rigorous and quantified assessments necessary to determine this critical issue.

Dissecting the Integrated Rail Plan is written from a unique perspective, not only my railway engineering experience of more than 4 decades, but also my 16 years' involvement in developing an alternative to HS2, that on any rational basis of comparison outperforms all official proposals (i.e. HS2 and its subsidiary IRP projects) by an order of magnitude. I offer my High Speed UK proposals (see www.highspeeduk.co.uk) not from any expectation of personal gain, but as the Exemplar Alternative to the Integrated Rail Plan, developed to radically different principles of network and integration, that is necessary to expose all of the IRP's massive deficiencies.

Dissecting the Integrated Rail Plan aims to make a definitive study of how the UK railway network will perform, with the Integrated Rail Plan in place. In a study of such scope, errors are inevitable, and I will of course take full responsibility. However, I am confident that any errors will only be small in scale, and highly unlikely to detract in any way from the basic finding of this study: the Integrated Rail Plan, and all of its component projects, in particular HS2, are unfit for their purpose as a national railway network, and utterly incapable of delivering on the Government's key policy agendas, for Levelling-up, for Net Zero and for Building Back Better post-pandemic. The transport 'professionals' in charge have failed, and the Government needs urgently to get a grip.

Colin Elliff BSc CEng MICE

Contents

***** Not included in printed document – only available online at www.highspeeduk.co.uk as documents D18 (A), W11 (B), A17 (C), A18 (D) and A19 (E).**

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Issue	Date	Purpose
2.0	06/07/2022	Web-published version

Executive Summary

The publication in November 2021 of the Government's long-awaited Integrated Rail Plan[1] (IRP) has provoked intense controversy. On the one hand, the detractors claim that the IRP's drastic cuts to both HS2 Phase 2b (east) and Northern Powerhouse Rail (NPR) constitute a betrayal of Midlands and Northern communities. On the other hand, the Government claims that its new strategy of upgrading existing main lines, combined with limited sections of new-build high speed line, will deliver greater connectivity and capacity; moreover, the Government also claims that its key policy agendas, for a 'Levelled-up' UK economy, for 'Net Zero' greenhouse gas emissions and for 'Building Back Better' after the Covid-19 pandemic, are still intact.

This study aims to look beyond the claims and counter-claims, to determine whether the strategy and the schemes set out in the Integrated Rail Plan will actually deliver – as the published IRP document strongly asserts – the step-change enhancements in national network connectivity and capacity that are necessary to Level-up the UK economy, deliver Net Zero and Build Back Better.

These are crucial issues of public and national interest, and it is clearly imperative that the Integrated Rail Plan delivers the greatest possible Levelling-up, and the greatest possible reduction in greenhouse gas emissions (in particular CO_2) in line with 'Net Zero' commitments. Yet close examination of the IRP reveals no indication of any sort of structured and quantified approach by which candidate schemes might be assessed, to determine how they will combine with the established HS2 scheme (i.e. Phases 1 and 2a) to bring about an optimised and integrated national rail network – which is what the Integrated Rail Plan, by its very definition, surely demands.

On the contrary, it appears simply to have been assumed, with no verification whatsoever (and with no recognition of the fully auditable fact[2], that HS2 was designed with no worthwhile consideration of national network) that an efficient national network will somehow result.

The future of the national rail network, and of all the Government's cherished policy agendas – for Levelling-up, for Net Zero and for Building Back Better – now hang on this extraordinarily dangerous assumption.

Direct Linkage between Connectivity Improvement and Levelling-up

The Integrated Rail Plan is predicated upon the core proposition, that improvement of connectivity between communities in the UK regions is vital to deliver the Government's flagship Levelling-up, Net Zero and Building Back Better agendas. It therefore follows logically that the Government should have undertaken a wide-ranging review of all available options, to ensure the selection of the railway scheme that would deliver the greatest quantified improvement in connectivity and capacity (in both absolute terms, and also relative to the higher standards of connectivity currently prevailing in London) and thereby also deliver the greatest Levelling-up, the greatest reductions in greenhouse gas emissions, and of course the greatest value for money.

However, if the Integrated Rail Plan does not deliver either an efficient or an optimised national railway network, then it cannot deliver the greatest possible Levelling-up of the UK economy, or the greatest possible reduction in CO_2 emissions, and it would therefore be unfit for purpose.

Key Conclusions

This study resolves this crucial issue, and reaches 3 key conclusions:

- The Integrated Rail Plan's inefficiency as either a regional or a national network is revealed by the vastly superior network performance of the High Speed UK Exemplar Alternative.
- The predication of the Integrated Rail Plan upon the established HS2 proposals appears to be the principal reason for the IRP's hugely suboptimal performance.
- The failure of the Integrated Rail Plan will lead directly to failure of the Government's flagship Levelling-up, Net Zero and Building Back Better agendas.

To arrive at these conclusions, it has been necessary for this study to do what the Government has never done – to examine the performance of the official high speed rail schemes in the context of the entire national network. It has also been necessary to test the core assumption that has bedevilled the HS2 project from the start – that building HS2 as a stand-alone super-fast railway, with minimal connection to the existing system, was the right way to bring about an improved national rail network that would best serve the people of the United Kingdom.

Assessing the Integrated Rail Plan and other Candidate Schemes

3 candidate schemes have been considered in the assessment of the Integrated Rail Plan:

- The Integrated Rail Plan as published in November 2021;
- The Predecessor Scheme i.e HS2 'Y-network', Northern Powerhouse Rail (NPR) and Midlands Rail Hub (MRH);
- The High Speed UK Exemplar Alternative.

High Speed UK[3] (HSUK) is a scheme for a national network of new high speed lines, upgraded existing routes and restored lines. It has been developed from the outset to radically different principles of full integration and optimised network performance, completely independent of the established HS2 scheme on which both the Integrated Rail Plan and its Predecessor Scheme are based. HSUK's inclusion in the assessments is necessary to gauge HS2's potentially huge adverse effect upon overall network performance. Further details of the HSUK proposals can be found in Section 5 of this study and on the HSUK website www.highspeeduk.co.uk.

To inform the assessments, a national network comprising 55 hubs (50 towns/cities and 5 airports) has been modelled. Journey times for all of the 1485 possible interconnections have been collated from multiple sources (National Rail website[4], official IRP/HS2/NPR reports, or HSUK data) and, where changes of trains are required, calculated by means of a standardised methodology. This methodology is documented in Section 6.2 of this study.

With no established science in analysing the performance of a national railway network, and no definitive metric by which connectivity can be measured in an absolute sense, it has been necessary to develop more empirical methodologies to define the connectivity improvements offered by a candidate scheme. These methodologies (see also Section 6.2) have been designed to take into account the key issues of journey time, the need to change trains and the quality of interchange; all this then provides for each town, city or airport a single Connectivity Improvement Score to allow simple and direct comparison between schemes.

Key Tests for the Integrated Rail Plan

The results of the study are best presented in the form of responses or 'findings' in respect of the 7 key Tests set out below:

1. Are the journey time and route capacity benefits predicted in the Integrated Rail Plan (IRP) feasible, achievable or optimal?
2. Will the IRP deliver significant connectivity benefits to major regional cities, and thereby support the Government's Levelling-up and Net Zero agendas?
3. Will the IRP meet the long-standing journey time targets for the Northern Powerhouse, and provide the necessary step-change in capacity on Transpennine routes?
4. Are the IRP's proposed main line upgrades compatible with emerging proposals for a West Yorkshire Mass Transit System?
5. Will the IRP deliver significant connectivity benefits to smaller regional communities, and thereby support the Government's Levelling-up and Net Zero agendas?
6. Can the IRP transform the railway network in the Midlands and the North, and provide the additional capacity to spur the development of regional 'powerhouse' economies?
7. Will the IRP maintain and enhance the integrity of the national railway network?

Key Findings

The findings of this study are as follows:

1. ***Many of the journey time and route capacity benefits predicted in the Integrated Rail Plan appear to be either unachievable or prejudicial to the development of efficient national and local networks.***
2. ***The Integrated Rail Plan's connectivity benefits are small, and for all major communities they are dwarfed by those of the High Speed UK Exemplar Alternative; hence it is certain that the IRP cannot deliver Levelling-up etc.***
3. ***The Integrated Rail Plan will fail to meet every single official target for improved intercity journey times across the Northern Powerhouse, and it will fail also to deliver the step-change capacity enhancement necessary for Levelling-up.***
4. ***The Integrated Rail Plan's proposed West Yorkshire main line upgrades, with faster and more frequent services on key Transpennine routes, are fundamentally incompatible with emerging proposals for a West Yorkshire Mass Transit System.***
5. ***The Integrated Rail Plan is incapable of delivering significant connectivity benefits to the 'Small Town' communities that it has pledged to protect; again, it is hugely outperformed by the High Speed UK Exemplar Alternative.***
6. ***The Integrated Rail Plan provides no evidence to demonstrate that it will deliver the transformation of the railway network and the 'local capacity dividend' necessary to drive regional 'powerhouse' economies in the Midlands and the North, and thereby support the Government's Levelling-up agenda.***
7. ***The Integrated Rail Plan will fail to improve Crossborder journeys to Scotland, and it will compel passengers on Crosscountry journeys to make a walking transfer between adjacent terminus stations in central Birmingham. This threatens the fundamental integrity of the national railway network.***

Finding 1

Many of the journey time and route capacity benefits predicted in the Integrated Rail Plan appear to be either unachievable or prejudicial to the development of efficient national and local networks.

Desk studies have been undertaken to determine feasible journey time and capacity improvements for all of the routes listed below.

Journey A : Upgrade of East Coast Main Line between London and Leeds

Journey Time (min)		Capacity Benefit?	Implementation Strategy
Existing	Predicted		
133	**113**	Not stated	Upgrade/accelerate existing line, with trains running at 225kph (140MPH) maximum speed.

Raising the linespeed from 125MPH to 140MPH will only deliver the predicted 20 minute journey time reduction with the elimination of all intermediate stops. Under more realistic operating conditions that respect the needs of major communities such as Peterborough, Doncaster and Wakefield, a London-Leeds journey time of circa 123 minutes might be achieved.

Journey B : Upgrade of Transpennine Route between Manchester and Leeds

Journey Time (min)		Capacity Benefit?	Implementation Strategy
Existing	Predicted		
51	**33**	Existing capacity doubled	New high speed line from Manchester to Marsden, remainder of route upgraded and electrified. 4-tracking presumed where vacant trackbeds exist, not possible on Dewsbury-Leeds section.

The predicted journey time and capacity improvements are technically feasible only if the key 2-track Dewsbury-Batley-Leeds section is devoted to intercity traffic, with no possibility of improving local services. This is incompatible with the ambition for a West Yorkshire Mass Transit System.

Journey C : Upgrade of Calder Valley Line between Bradford and Leeds

Journey Time (min)		Capacity Benefit?	Implementation Strategy
Existing	Predicted		
19	**12**	Not stated	Upgrade and electrify existing line from Bradford Interchange via New Pudsey to Leeds.

Again, the predicted 7 minute (37%) journey time reduction can only be achieved with huge impact upon available capacity for local services, and upon any future West Yorkshire Mass Transit System.

Journey D : Upgrade of Hope Valley Line between Manchester and Sheffield

Journey Time (min)		Capacity Benefit?	Implementation Strategy
Existing	Predicted		
50	**30-35**	3rd fast train/hour	Upgrade of existing route, no commitment either to electrification or diversion of existing freight traffic.

Detailed analysis of the Hope Valley Line indicates no potential to ease any of its many curves, and very little potential for significant journey time reductions. 40 minutes would be the best possible time, probably still unachievable due to the line's continued use by heavy railfreight traffic.

For further details see Section 6.1 of this study.

Finding 2

The Integrated Rail Plan's connectivity benefits are small, and for all major communities they are dwarfed by those of the High Speed UK Exemplar Alternative. Hence it is certain that the IRP cannot deliver either Levelling-up or Net Zero.

Figure X.2A below sets out Connectivity Improvement Scores for 18 principal communities of the Northern Powerhouse, and for 10 principal Midlands communities. Blue shows the connectivity offered by the Integrated Rail Plan, red shows the HS2/NPR Predecessor Scheme and green shows the High Speed UK Exemplar Alternative.

HSUK's comprehensive superiority for all communities is shown clearly, with HSUK outperforming the Integrated Rail Plan by a factor of 5 in the North, and by a factor of 9 in the Midlands. A similar superiority in Levelling-up and in progressing towards Net Zero can also be anticipated.

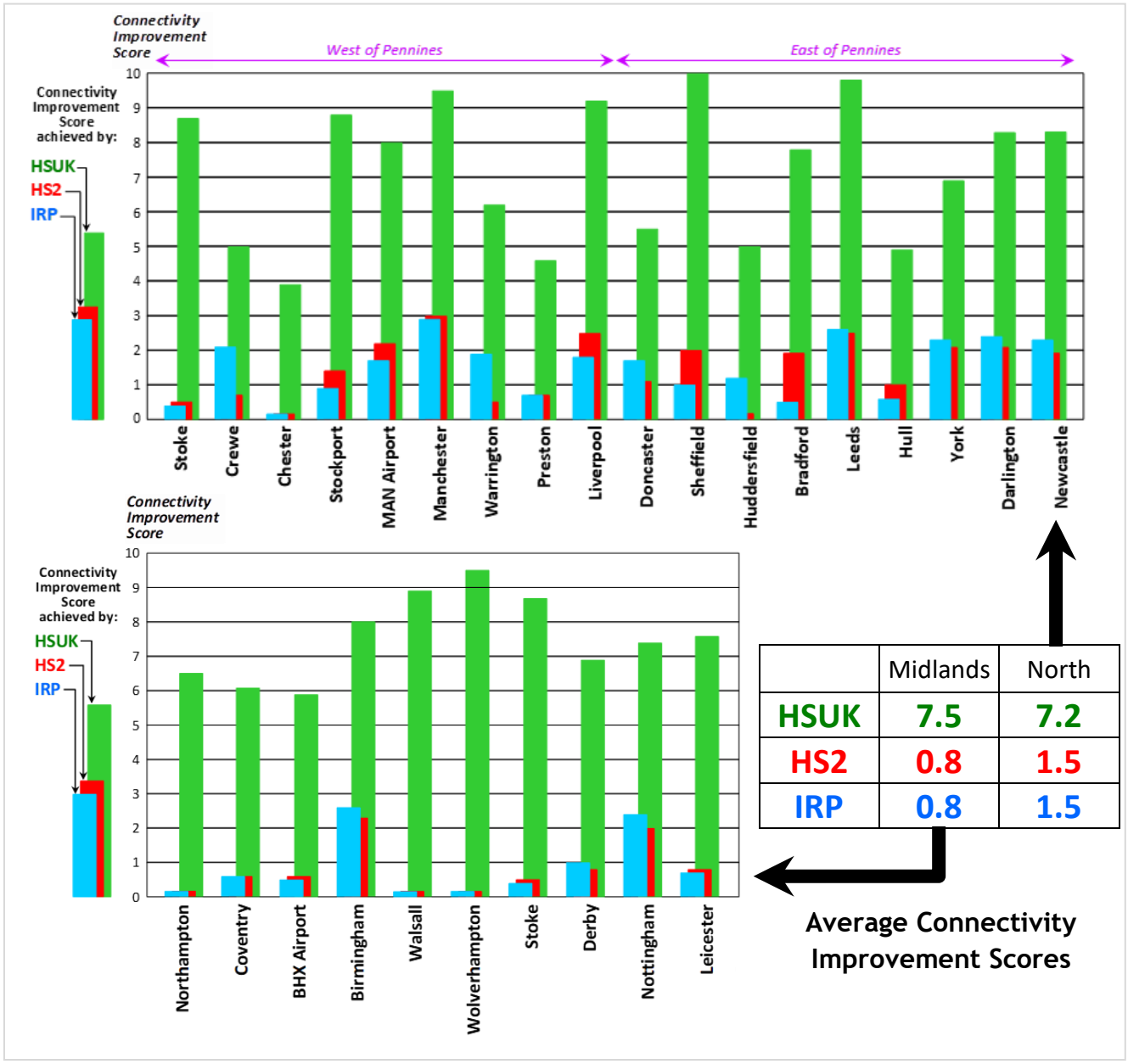


Figure X.2A: Connectivity Scores for Major Northern and Midlands Communities

For further details, including analysis of Levelling-up potential, see Section 6.2 of this study.

Finding 3

The Integrated Rail Plan will fail to meet every single official target for improved intercity journey times across the Northern Powerhouse, and it will fail also to deliver the step-change capacity enhancement necessary for Levelling-up.

The Northern Powerhouse initiative was launched in 2014 with the promise of major reductions in intercity journey times across the North, with headline timings of 30 minutes between the core cities of Leeds, Sheffield and Manchester. The HSUK Exemplar Alternative shows that the 'Northern Powerhouse Specification' set out in Figure X.3A below was perfectly achievable, with only minor exceptions; however, the Integrated Rail Plan now fails to meet every single journey time target.

Northern Powerhouse intercity journey	Existing journey time (mins)	Spec. journey time (mins)	IRP journey time (mins)	HSUK journey time (mins)
Liverpool - Manchester	32	20	35	20
Manchester - Sheffield	48	30	40	23
Manchester - Leeds	49	30	33	26
Sheffield - Leeds	40	30	41	19
Manchester - MAN Apt	13	10	13	13
Leeds - MAN Apt	62	40	58	37
Sheffield - MAN Apt	73	30	66	34
Liverpool - MAN Apt	65	30	41	26
Leeds - Newcastle	87	60	76	60
Leeds - Hull	55	45	55	38
Sheffield - Hull	86	60	76	59

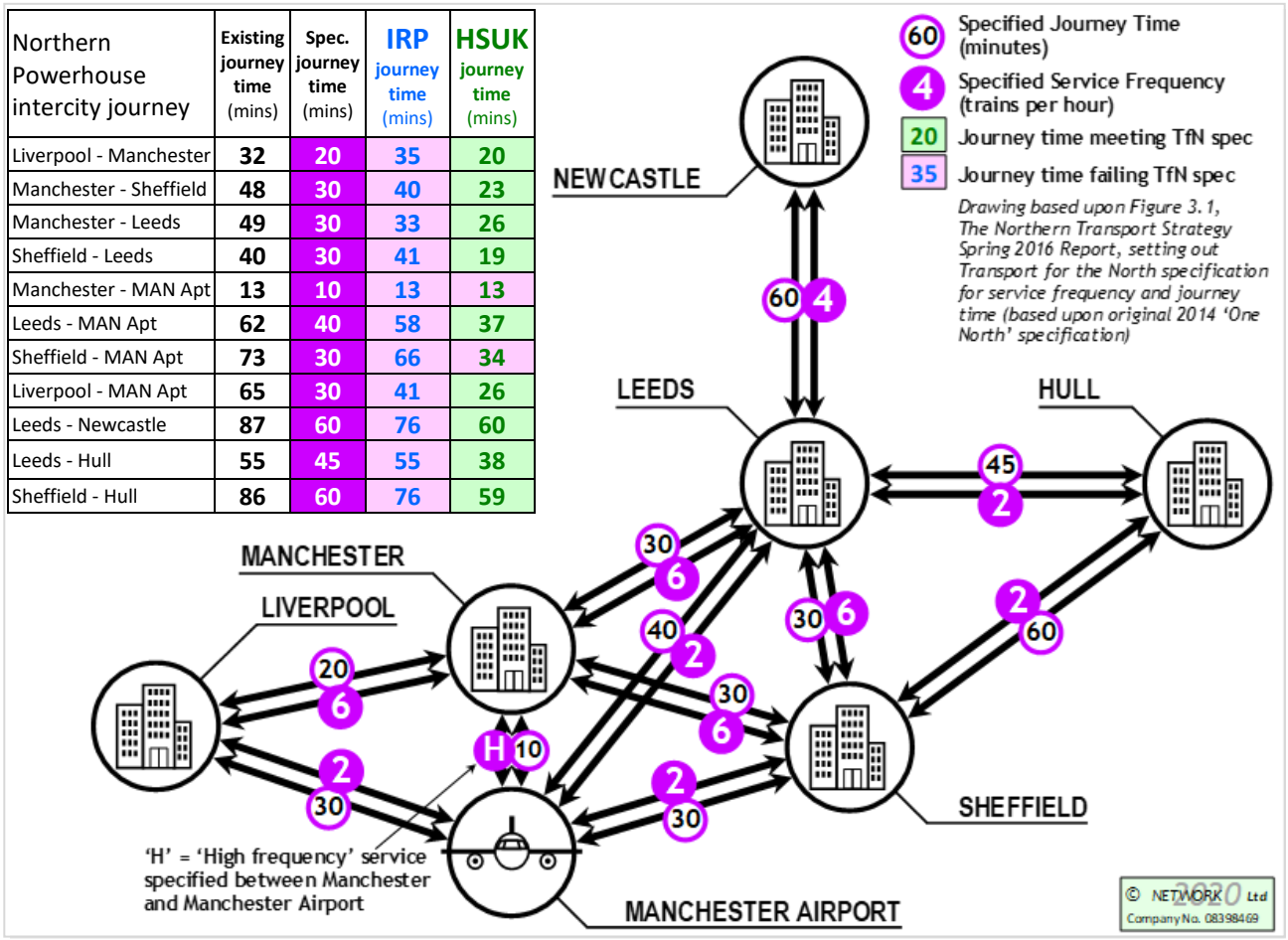


Figure X.3A : IRP & HSUK Performance against Northern Powerhouse Specification

This 'epic fail' can be explained by the huge and malign influence that HS2 has exerted upon the development of Northern Powerhouse Rail. Despite the fact that northern elements of HS2 were designed with no thought for Transpennine connectivity, these routes were still used as the basis for NPR's design, and the result was a deeply flawed and inefficient design (i.e. the Predecessor Scheme) which failed to meet many of its journey time targets.

With the Integrated Rail Plan's cancellation of all new-build routes east of the Pennines, this failure is now complete, and compounded by its failure to deliver the capacity necessary for Levelling-up.

For further details see Section 6.3 of this study.

Finding 4

The Integrated Rail Plan's proposed West Yorkshire main line upgrades, with faster and more frequent services on key Transpennine routes, are fundamentally incompatible with emerging proposals for a West Yorkshire Mass Transit System.

The Integrated Rail Plan's proposed introduction of faster and more frequent services on both the Huddersfield-Dewsbury-Leeds line (Transpennine Main Line) and the Bradford Interchange-New Pudsey-Leeds line (Calder Valley Line) will hugely compromise the capacity of these key corridors to accommodate enhanced local services. This will exacerbate current capacity pressures on these routes which have already greatly restricted the present service offer; this will in turn compromise development of the West Yorkshire Mass Transit System, which to date has been predicated upon a new-build Northern Powerhouse Rail main line via Bradford, clear of existing rail routes.

The potential for existing West Yorkshire rail routes to be developed for more intensive local services (Huddersfield-Leeds line) and additional local stations (Bradford-Leeds line) is demonstrated in the HSUK scheme for a heavy-rail-based Mass Transit System illustrated in Figure X.4A below. These enhancements are only possible through HSUK's fully integrated development of local, regional and national services, with primary Manchester-Leeds flows diverted to a new Transpennine line, and a new cross-city link in Bradford to enable accelerated Calder Valley flows to be diverted to the Aire Valley line.

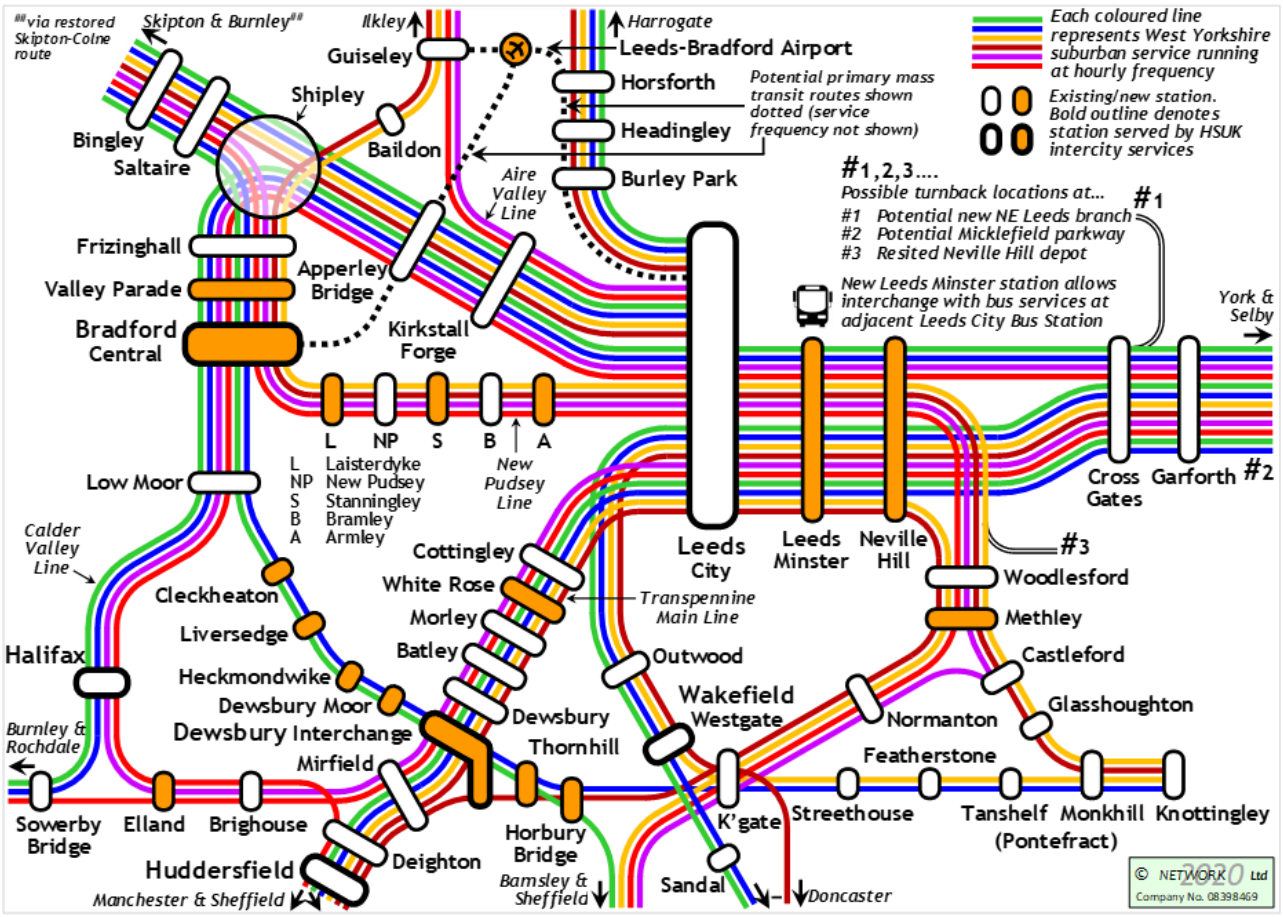


Figure X.4A : HSUK Scheme for 'Heavy Rail' West Yorkshire Mass Transit System

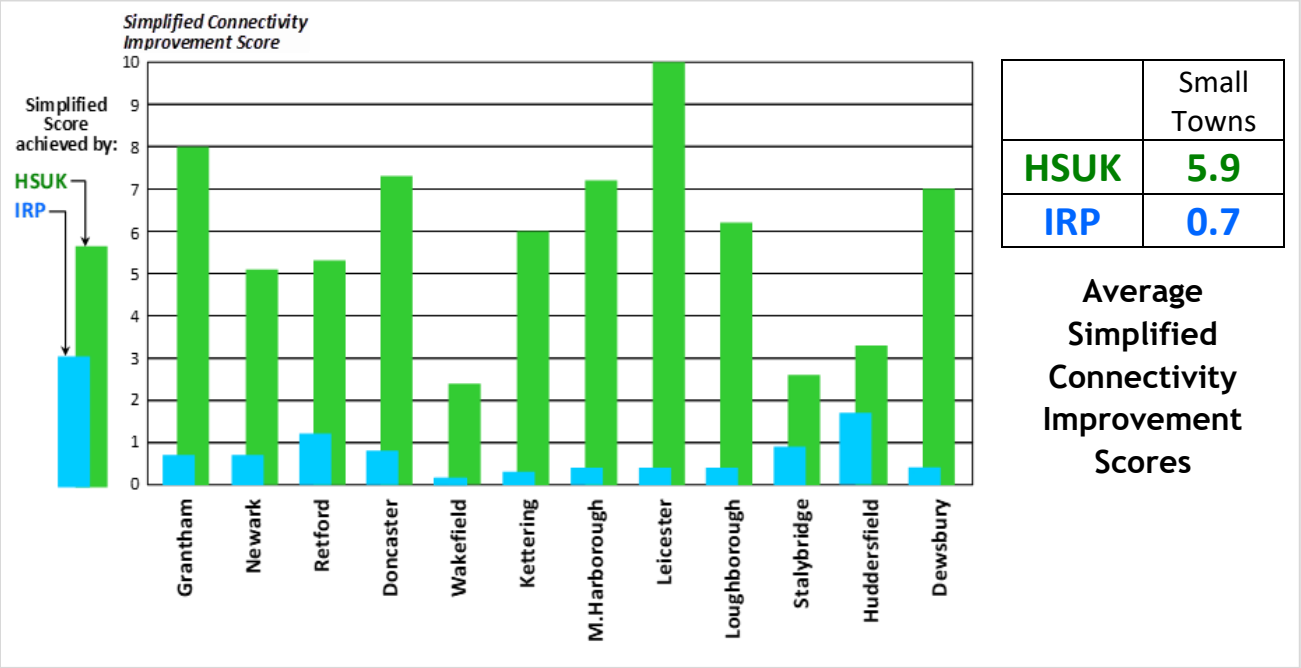
For further details see Section 6.4 of this study.

Finding 5

The Integrated Rail Plan is incapable of delivering significant connectivity benefits to the 'Small Town' communities that it has pledged to protect; again, it is hugely outperformed by the High Speed UK Exemplar Alternative.

The Integrated Rail Plan has, at least in part, justified its massive cuts to HS2 Phase 2b (east) and Northern Powerhouse Rail by highlighting the connectivity needs of 12 'Small Town' communities on existing main line routes which would have seen major reductions in services[5] if HS2 and NPR had been constructed in full.

The connectivity analysis set out in this study has been extended to cover these communities, and a Simplified Connectivity Improvement Score has been calculated for each 'small town'. Again, HSUK's far superior network performance allows it to deliver connectivity improvements that are an order of magnitude greater than what the Integrated Rail Plan can offer. See Figure X.5A below.



	Small Towns
HSUK	5.9
IRP	0.7

Average Simplified Connectivity Improvement Scores

Figure X.5A: Simplified Connectivity Scores for 'Small Town' Communities

The analysis set out in Figure X.5A refers specifically to the following 12 communities cited in the Integrated Rail Plan: **Grantham, Newark, Retford, Doncaster, Wakefield, Kettering, Market Harborough, Leicester, Loughborough, Stalybridge, Huddersfield** and **Dewsbury**.

1. However, there is no reason to suppose that HSUK would not show very similar massive superiority if the same analysis were applied to a different group of 12 communities, for instance: **Durham, Sunderland, Middlesbrough, Harrogate, Halifax, Barnsley, Chesterfield, Altrincham, Bolton, Blackpool, Burnley** and **Carlisle**. Connectivity results will shortly be published for these communities.

For further details see Section 6.5 of this study.

Finding 6

The Integrated Rail Plan provides no evidence to demonstrate that it will deliver the transformation of the railway and the 'local capacity dividend' network necessary to drive regional 'powerhouse' economies in the Midlands and the North, and thereby support the Government's Levelling-up agenda.

There are no maps in the Integrated Rail Plan to show how its proposed interventions will deliver a transformed network in any UK region. There is no ambition demonstrated for such a network, that might see all principal centres within a UK region directly interconnected with high quality, high speed and high frequency intercity services – and with massively increased capacity for local services. There is no concept that such a network, capable of supporting Government's Levelling-up agenda, and capable of bringing about the desired regional 'powerhouse' economies, might even be possible.

The opportunity for network transformation in the Midlands and the North is best demonstrated in 'Tube Map' format in Figures X.6A and X.6B. These show the near-complete interconnectivity that High Speed UK would deliver in both regions – a level of connectivity that the Integrated Rail Plan cannot even remotely match.

For further details, including HSUK schemes for local network transformation in the principal conurbations of the Midlands and the North, see Section 6.6 of this study.

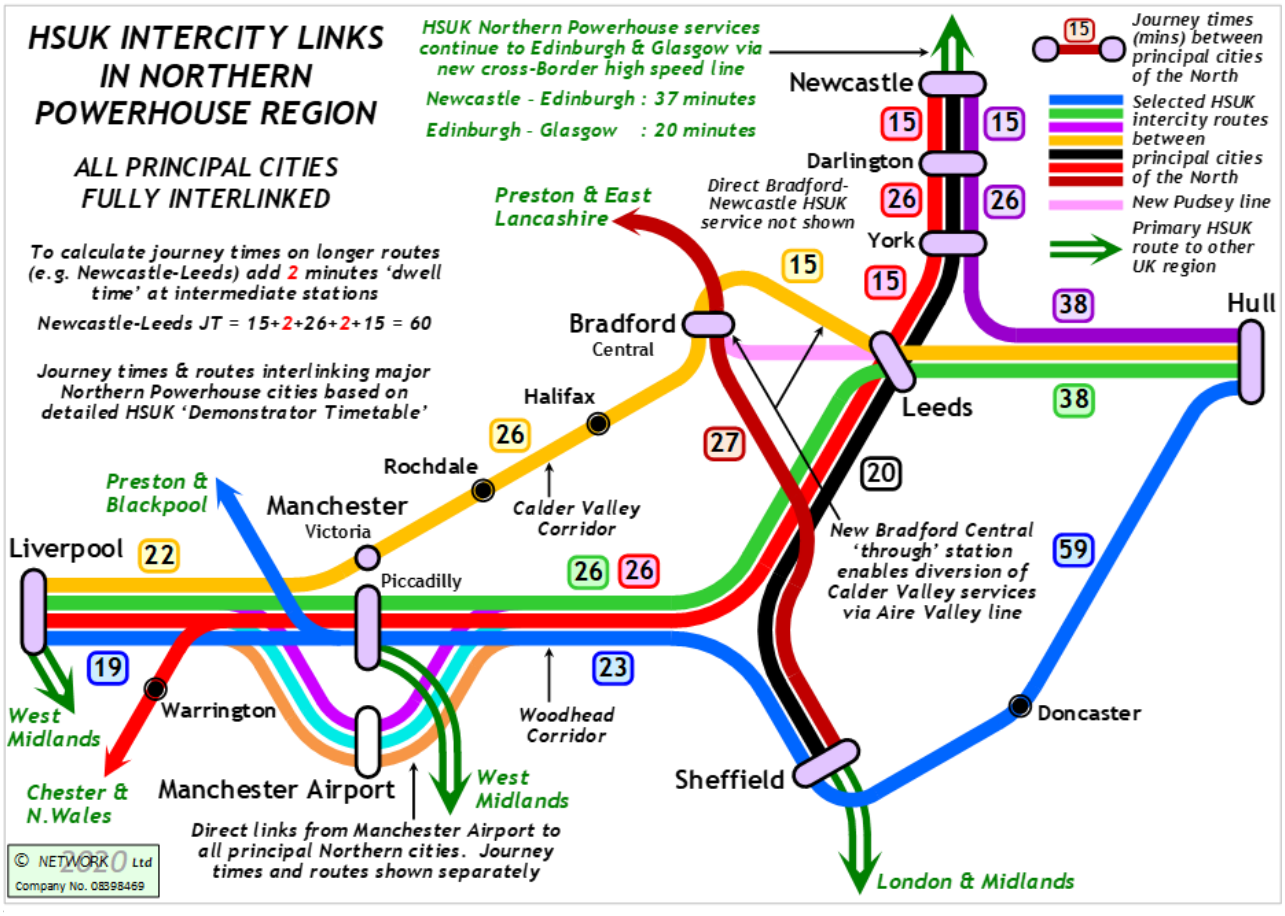


Figure X.6A : Northern Powerhouse 'Tube Map' illustrating principal HSUK services

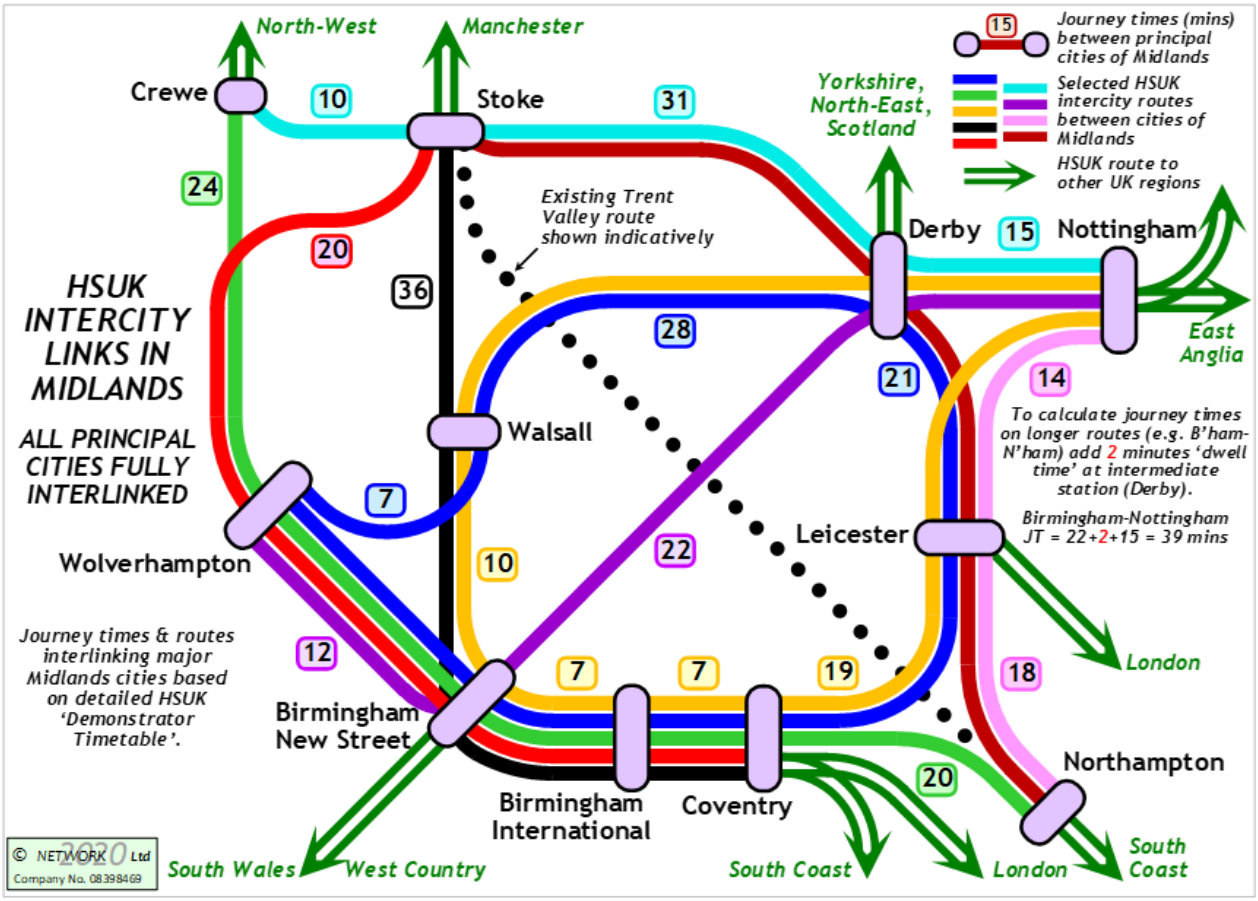


Figure X.6B : Midlands 'Tube Map' illustrating principal HSUK services

Finding 7

The Integrated Rail Plan will fail to improve Crossborder journeys to Scotland, and it will compel passengers on Crosscountry journeys to make a walking transfer between adjacent terminus stations in central Birmingham. This threatens the fundamental integrity of the national railway network.

The Integrated Rail Plan has endorsed the established proposals for HS2/IRP high speed services from Manchester, Leeds and other Northern cities to serve a new terminus station at Birmingham Curzon Street, while Midland Rail Hub services from the adjacent Moor Street terminus will continue south-west to Bristol and Cardiff. The enforced walking transfer between the two stations will effectively sever the Crosscountry rail corridor that is most critical to connecting the nation.

The IRP's fragmented station strategy in Birmingham represents a catastrophic failure of integrated railway design. As set out in Figures X.7A and X.7B, it will fail to offer any improved intercity links from Scotland and the North to South Wales, the South-West and the South Coast, and it will also fail to deliver significantly improved local rail links in the West Midlands. By contrast, High Speed UK's radically different strategy, of upgrading the existing approach routes to Birmingham New Street, will allow the capacity of the existing station to be massively increased. This will enable a huge enhancement of local, regional and national Crosscountry services.

For further details see Sections 6.6.8 and 6.7 of this study. Section 6.7 also covers the issue of Crossborder links to Scotland.

			Glasgow
			Edinburgh
			Newcastle
			Leeds
			Liverpool
			Manchester
			Sheffield
Cardiff	Bristol	South'ton	Direct IRP intercity link No direct intercity link

Figure X.7A : Integrated Rail Plan – No Crosscountry Links through Birmingham

0
Direct Links

Figure X.7B: HS2/IRP/MRH Crosscountry Links to north from South Wales, South-West & South Coast

Conclusions

There are many possible reasons that might account for the Government's development of an Integrated Rail Plan that fails so spectacularly to meet the needs of the people of the United Kingdom in any region. But they all revolve around the failure to recognise the central illogicality of the HS2 project – its design as superfast, stand-alone high speed lines between arbitrary fixed points, a concept totally at odds with the basic need for a national network that efficiently connects all regions of the nation, a need that is now explicitly expressed in the Government's own Integrated Rail Plan. This failure is perfectly summed up in the IRP's severance of the critical Crosscountry rail corridor, as illustrated in Figures X.7A and X.7B above.

A very simple lesson emerges from the failure of HS2 and the Integrated Rail Plan: if an integrated and efficient national network was always the fundamental requirement (as the IRP initiative now confirms), then all its elements (HS2, Northern Powerhouse Rail et al) should have been designed from the start to fulfil this purpose. This is the philosophy that has driven the design of High Speed UK from the outset, and the catastrophic extent of the Government's failure is demonstrated by every aspect of HSUK's comprehensively superior network performance.

1 Introduction

On 18th November 2021, the Government published its long-awaited Integrated Rail Plan.

The purpose of the Integrated Rail Plan (IRP) is to set out a strategy to develop the national rail network over the coming decades, and to identify the key schemes that will be at the heart of this development. It also seeks to explain how flagship projects such as High Speed 2 (HS2) and Northern Powerhouse Rail (NPR) will be integrated with the existing 'classic' rail network, with the presumed intention of developing an optimised national network best capable of connecting the nation. Effectively, it represents the culmination of the UK high speed rail project.

The logic path of the Integrated Rail Plan is clear:

- The development of new, upgraded and restored railways is the principal lever in the Government's strategy to deliver step-change improvements in the connectivity and capacity of national, regional and local transport networks.
- These transformations are in turn vital to delivering key aspects of the Government's policy programme, namely:
  - **Levelling-up** the UK economy;
  - Achieving **Net Zero** greenhouse gas (i.e. CO_2) emissions in transport;
  - **Building Back Better** after the Covid-19 pandemic.

While the present Government has identified strongly with all of the policies listed above, it must be recognised that these all comprise core aspects of the 'public policy' that is supported by all mainstream political parties. Essentially, Levelling-up, Net Zero and Building Back Better all constitute fundamental issues of national interest.

It is therefore indisputable that the Government's Integrated Rail Plan can only be dedicated to creating a national network that will deliver the greatest possible improvements in connectivity and capacity, and thereby bring about the greatest possible benefits to society. With issues as critical as Levelling-up, achieving Net Zero CO_2 emissions and Building Back Better at stake, second-best cannot be an option.

Yet nowhere in the Government's Integrated Rail Plan (or indeed, in any of its predecessor documents covering HS2, Northern Powerhouse Rail, et al) is there any indication of a structured process to bring about the optimised national network that the nation so clearly needs. No fundamental principles are established for how this network should perform in connecting the UK's many towns and cities, and no worthwhile attempt is made to measure, and hence optimise, the connectivity that any particular scheme will deliver. Instead, the Government seems simply to have assumed that this optimised network will come about as a natural consequence of building their preferred configuration of new and upgraded railways, as set out in the Integrated Rail Plan.

This study seeks to identify the consequences of this dangerous, unfounded assumption, and to demonstrate the huge benefits of adopting a different strategy for railway network development. It is concerned primarily with establishing the core engineering principles by which the UK's railway network should be designed and optimised. The question of cost is subsidiary, and it will be addressed in a subsequent study – however, it can still be confidently stated at this stage that good engineering always offers far better value for money than bad engineering.

2 Levelling-up – Engineering the New Transport Solution

2.1 Origins of the Government's Levelling-up Agenda

The present Government's oft-stated commitment to 'Level-up' the UK economy is unquestionably welcome, but it must be recognised that this is nothing new. Every Government in the post-war era has attempted to grapple with the problems of an unbalanced economy in which London and the South-East have prospered while the outlying regions of England, and all of Wales, Scotland and Northern Ireland, have suffered relative economic decline.

The issue has been crudely characterised as the 'North-South Divide', and regrettably, the response of Government at times has been equally crude, throwing money at the problem in a series of uncoordinated public infrastructure projects which have ultimately proved largely fruitless.

2.2 Components of the Levelling-up Agenda

The present Government does deserve credit for attempting to solve the problem of an unbalanced UK economy in a more structured manner. It has understood that there are multiple facets to the problem, ranging from education and training, to health and life opportunities, to jobs and incomes, and it has understood also that these interdependent issues must be solved in a holistic and coordinated manner.

Most importantly, the Government has recognised that Levelling-up can only happen with transformational improvements to existing transport networks, to eliminate the congestion and other constraints that have prevented people and goods from moving freely between, and within, the UK regions. Accordingly the Government has supported many initiatives to improve transport connectivity across the UK, for instance Northern Powerhouse Rail[6], Midlands Rail Hub[7] and a variety of smaller-scale 'Beeching Reversal' aka 'Restoring Your Railway' rail restoration projects.

2.3 Appropriate Scale and Scope of Transport Intervention

The Government's Levelling-up ambitions represent a desire for step-change improvement in the economic performance of the UK regions. Logically, this requires that major Government-led initiatives such as the Integrated Rail Plan and the Union Connectivity Review *inter alia* deliver a similar transformational enhancement, with the scale and scope necessary to deliver the desired benefits, to improve connectivity in the UK regions towards the level currently enjoyed by London.

Other transformational changes, in education, health and employment, are of course also required – but if the necessary transformation of the transport network, and in particular the railway network (national, regional and local), does not happen, then Levelling-up cannot happen either.

2.4 Potential Conflict between Levelling-up and Net Zero Ambitions

There are clear environmental implications in the step-change increase in transport connectivity necessary to 'Level-up' the UK economy.

Under present 'business as usual' circumstances, increased economic activity invariably leads to increased movement of both people and goods, and therefore (with UK transport currently

dominated by petrol- and diesel-powered road vehicles) to increased CO_2 emissions and increased congestion/demand for road space. It is generally accepted that there is only one practicable means of avoiding these adverse consequences – a coordinated programme of infrastructure development to allow a major proportion of both existing and projected traffic flows to be transferred to a much lower-emitting and more space-efficient electrified rail network.

It could be argued that if ongoing Government initiatives were to succeed in their aim of decarbonising both the energy and transport sectors, 'Net Zero' road transport might become a reality; this could then eliminate the imperative for rail development, at least from the perspective of reducing CO_2 emissions.

However, the congestion and road space issues outlined above would remain, and therefore – given the huge and intractable environmental issues surrounding the development of new motorways – transformational development of the national rail network still appears by far the best option to deliver on the Government's agenda for a Levelled-up, Net Zero United Kingdom.

2.5 Transpennine Capacity and Connectivity Issues

The scale of railway intervention necessary to deliver the Government's Levelling-up agenda is revealed in the data for road traffic flows (Annual Average Daily Traffic or AADT) between the major conurbations of the Northern Powerhouse, as set out in Figure 2A.

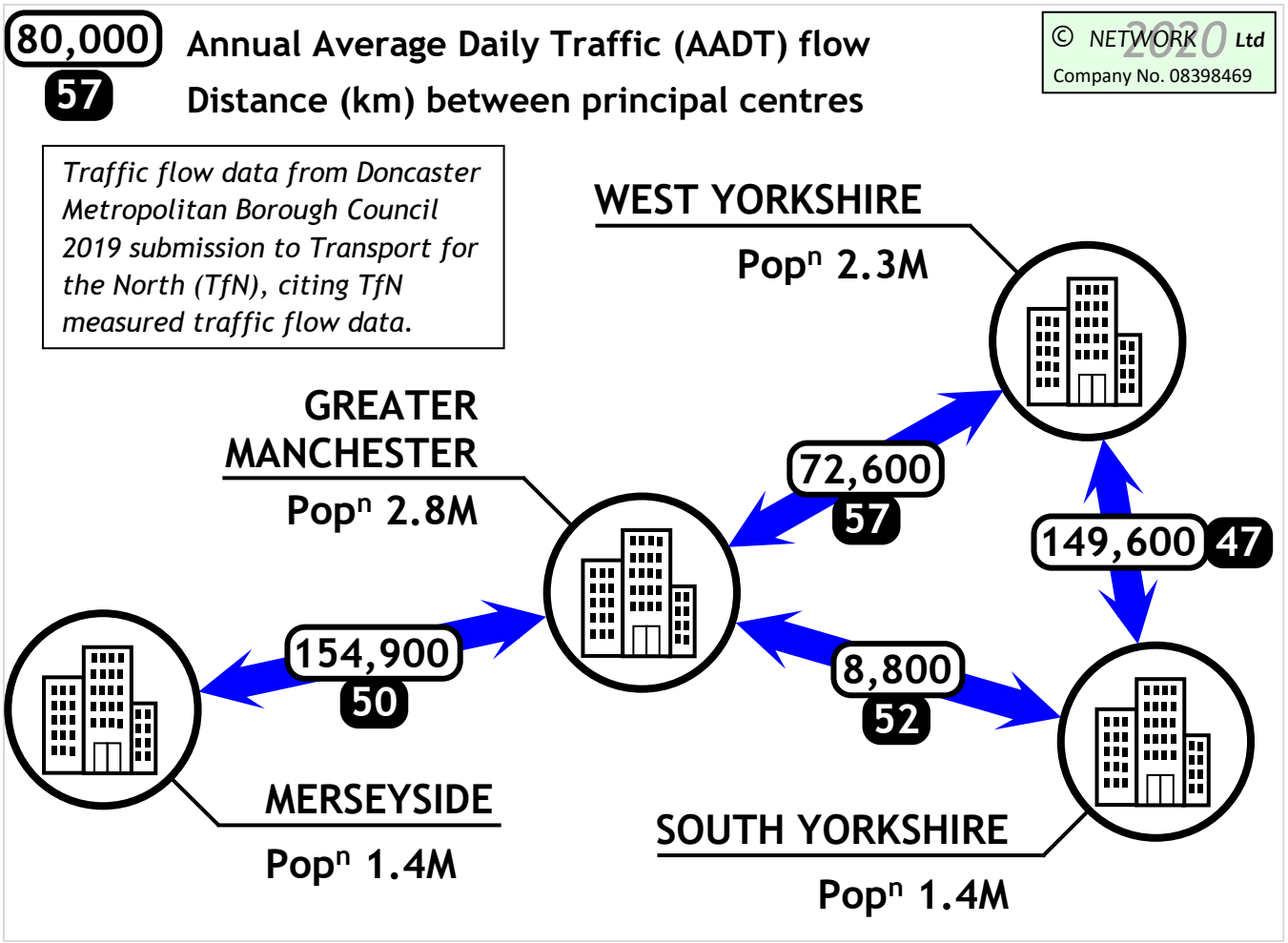


Figure 2A : Annual Average Daily Traffic flows between Northern Conurbations

The traffic flow data set out in Figure 2A is taken from Doncaster Metropolitan Borough Council's April 2018 consultation response[8] to Transport for the North's Draft Strategic Transport Plan, citing measured traffic flow data published by Transport for the North (TfN).

It would be reasonable to expect interconurbation flows across the North to conform to a 'gravity' model i.e. proportional to the populations connected, but inversely proportional to the distance between. These calculated gravitational flows, normalised against the measured West Yorkshire - South Yorkshire flow (149,600 AADT), are set out in Table 2B. With the key cities (i.e. Liverpool, Manchester, Leeds and Sheffield) all separated by a similar distance of circa 50km, the gravitational flows are broadly proportional to the populations connected, and the greatest flow should therefore be between the two most populous conurbations i.e. Greater Manchester and West Yorkshire.

Route A-B	Distance A-B	Population A	Population B	Gravity Model Flow (AADT) ##	Measured Flow (AADT)	Suppressed Demand (AADT)
Merseyside-Manchester	50km	1.4M	2.8M	169,600	154,900	14,700
Manchester-South Yorks	52km	2.8M	1.4M	163,600	8,800	154,800
Manchester-West Yorks	57km	2.8M	2.3M	244,600	72,600	172,000
West Yorks-South Yorks	47km	1.4M	2.3M	149,600	149,600	0

Gravity Model Flow normalised against West Yorks - South Yorks Measured Flow.

Gravity Model Flow = (Population A x Population B) / (Distance A-B) x Constant

Table 2B : Suppressed Demand for Transpennine Traffic

However, this gravitational model is not supported by the measured traffic flow data set out in Table 2B. The greatest flows (around 150,000 vehicles per day) are between the conurbation pairs on either side of the Pennines (i.e Merseyside and (Greater) Manchester to the west, West Yorkshire and South Yorkshire to the east), while Transpennine flows are an order of magnitude lower (72,600 measured between Manchester and West Yorkshire vs 244,600 gravitational, 8,800 measured between Manchester and South Yorkshire vs 163,600 gravitational).

The measured flows indicate an entirely different correlation, not with the populations connected, but with the quality and capacity of the roads that connect the populations. Whereas at least 2 motorways or dual carriageways interlink the conurbations to the west and to the east of the Pennines, only a single motorway (the M62) links Manchester and West Yorkshire, and only a single trunk road (the inadequate, congested and highly dangerous A628T Woodhead Road) links Manchester and South Yorkshire.

The disparity between the calculated gravitational flows and the actual measured flows (in both cases over 150,000 vehicles per day) demonstrate the huge impediment that the hills of the Pennines present to road connectivity, a huge suppression of demand that must act as a massive brake upon economic development across the North.

And should this impediment ever be removed, the figures demonstrate a further, more startling truth. If the Northern Powerhouse were to deliver all the Levelling-up benefits of a single agglomerated economy in which traffic from Leeds or Sheffield to Manchester were to flow as freely as traffic from Leeds to Sheffield or from Liverpool to Manchester, then an increase of over 150,000 vehicles per day on both Transpennine routes could be anticipated. This implies a requirement for 2 new motorways between Manchester and West Yorkshire, and 2 new motorways between Manchester and South Yorkshire, the latter routed through the Peak District National Park.

This is an impossible proposition from any perspective; not only would the environmental impact be unacceptable and wholly inappropriate in the current climate emergency, there would simply not be the available space to build 2 new M62s.

With new road construction plainly impracticable, the only remaining option to deliver the necessary step-change in Transpennine capacity would appear to be the construction of new electrified railways.

2.6 The 2014 'One North' Initiative

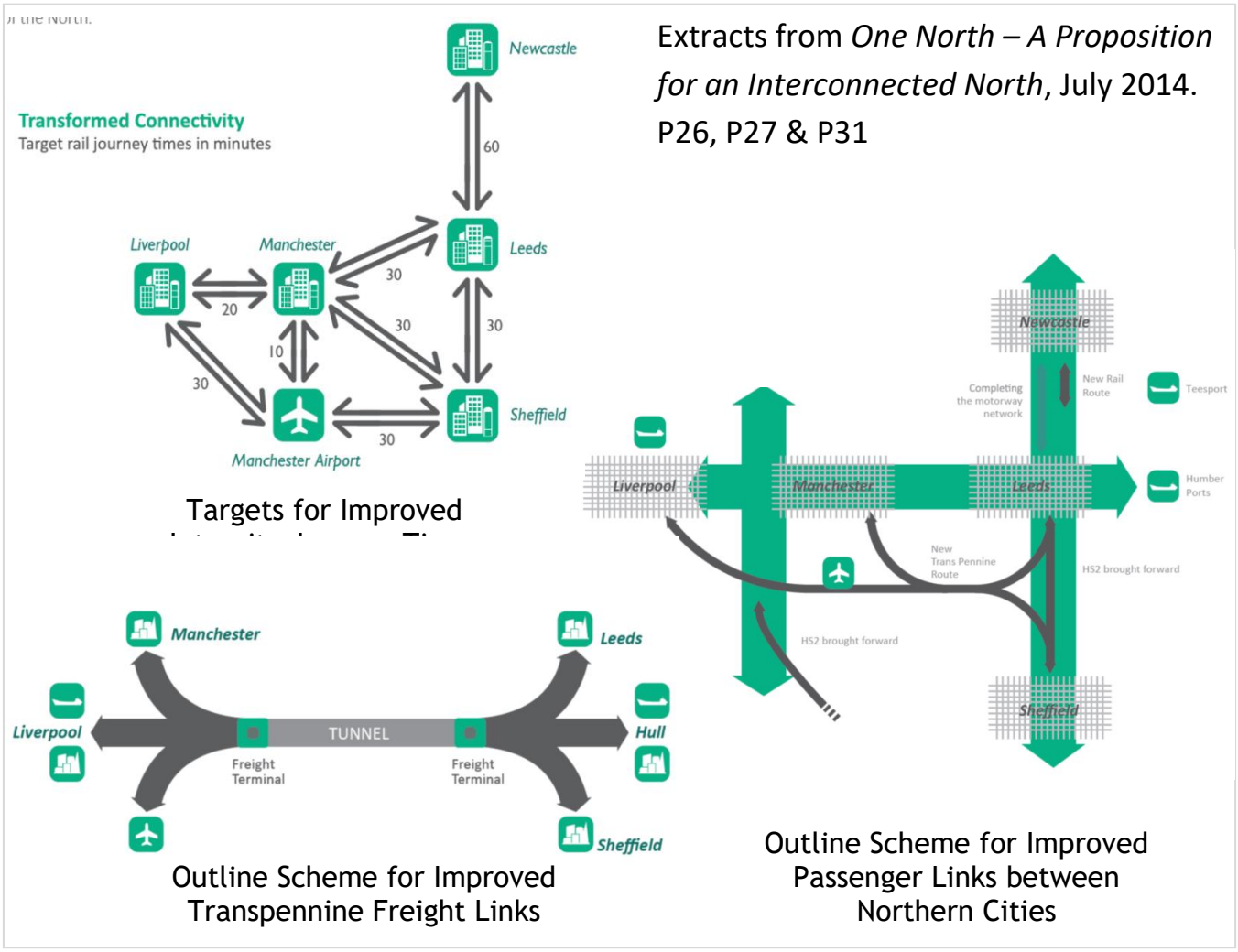


Figure 2C : 'One North' Journey Time Targets and Routeing Concepts (2014)

The imperative for new railway construction, as the only realistic option to deliver the required step-change in Transpennine capacity and connectivity, was anticipated in the 2014 'One North' initiative[9].

The launch of 'One North' – originated by the City Councils of Liverpool, Manchester, Sheffield, Leeds and Newcastle – was timed to complement then-Chancellor George Osborne's own Northern Powerhouse initiative. 'One North' called for a new Transpennine west-to-east high speed line to run from Liverpool and Manchester, and cross the Pennines to connect to a new high speed line in Yorkshire, running south to north, and thus interlink all 5 cities with direct services. The 'One North' initiative was supported by a demanding specification for reduced intercity timings, as shown in Figure 2C.

The One North initiative was adopted by Transport for the North (TfN) to form its core specification for Northern Powerhouse Rail, and it was subsequently amplified[10] to cover journeys to Hull, and also to stipulate service frequencies between all key centres. See Figure 2D.

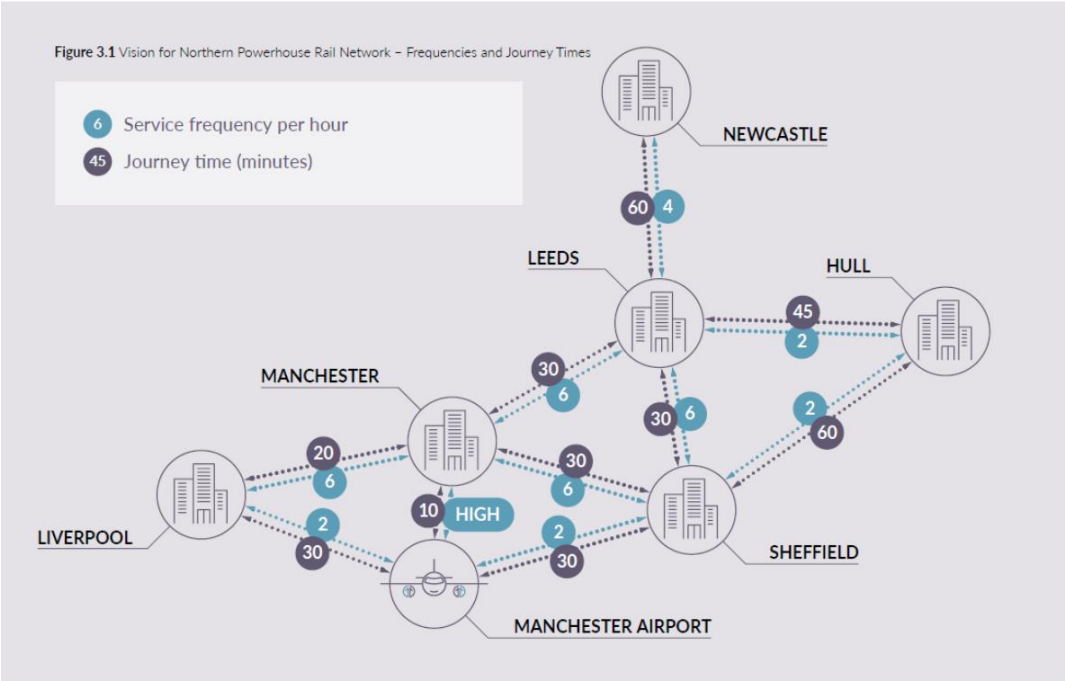


Figure 2D : TfN Journey Time/Service Frequency Targets between Northern Cities

Extract from The Northern Transport Strategy : Spring 2016 Report, TfN, March 2016

The specification was designed to enhance and 'agglomerate' the economy of the Northern Powerhouse by drawing its principal cities and principal airport closer together with faster and more frequent rail services. For instance, rail journeys in the 'Transpennine Triangle' of Manchester, Sheffield and Leeds would be cut from circa 50 minutes to 30 minutes, and enhanced to 6 trains per hour.

In proportional terms, the reduction in journey time would be similar in scale to that claimed for the HS2 project; however, just as importantly, the specification for enhanced speed and frequency could only be met by network designs which offered new construction and/or elimination of conflict with local passenger and freight traffic for most if not all of the route length. This would leave existing main lines largely free of express passenger traffic, and thus also allow step-change improvements in local services and also freight.

2.7 The Priority for Connectivity

The relationship and relative priority between connectivity and capacity must be understood.

Connectivity – which is defined in the dictionary[11] as 'the state of being connected or inter-connected' – is a fundamental attribute of any transport network, that defines how the communities that rely on the network are connected. To ensure a prosperous and Levelled-up. United Kingdom, it is vital that the connectivity of all parts of the UK transport network is enhanced to the same high level, and the connectivity of the national rail network is central to this consideration.

Improved connectivity of a railway network can be measured in several ways, for instance:

- Reduction of journey times;
- Reduction (or preferably elimination) of the need to change trains;
- More efficient interchange between local and national rail networks;
- More efficient interchange with other transport modes;
- Maximised segregation between different types of rail traffic i.e. intercity passenger, local passenger and freight, to ensure smooth, conflict-free and high-capacity operation.

Once the required connectivity of the network is agreed and defined, the individual elements of the network – the lines, the junctions and the stations – can then be engineered to provide the necessary local capacity, and thus enable the network to deliver the required connectivity.

2.8 A GB-wide Scope for the Integrated Rail Plan??

With regional/national network connectivity clearly taking precedence over the more local issue of line capacity, it must be questioned whether the regionalised focus of the 'Integrated Rail Plan for the North and the Midlands' is appropriate (and it must be remembered that an 'Integrated Rail Plan for the Whole GB Network' was the original recommendation of the Oakervee Review – see Section 4.1). The Government's policy goals of Levelling-up, of Net Zero greenhouse gas emissions, and of Building Back Better are all national priorities, and it would seem vital that a similarly national approach is taken to a) developing the national rail network in an optimal manner, and b) ensuring that projects such as HS2 are compatible with this development.

However, this has not happened. There is no indication, either in the Integrated Rail Plan or in any official document pertaining to HS2, Northern Powerhouse Rail or any other subsidiary initiative, of any network-wide assessment; instead, the analysis that has been undertaken is largely corridor-specific, with no holistic network overview.

It is not necessary speculate upon the precise combination of organisational, budgetary and competence issues that might account for this glaring omission. However, there should be no doubting the extent and potential technical complexity of the analysis, that might have deterred officialdom from troubling itself to make the necessary study of the national railway network.

This analysis has of course been essential in the compilation of this study, and Figure 2E sets out an indicative scope:

- 55 primary hubs of the national network, including all principal centres of the Northern Powerhouse and the Midlands Engine;
- 1485 possible journeys between these 55 primary network hubs;
- Assessment of these 1485 journeys for 3 different 'Candidate Schemes':
  - Integrated Rail Plan as published (2021) – see Figure 4B;
  - Predecessor Scheme (2020 and previously) including HS2 'Y-network', Northern Powerhouse Rail and Midlands Rail Hub – see Figure 4A;
  - High Speed UK Exemplar Alternative (assessed as an integrated national network, in its full designed form – see Section 5);
- 9 additional 'sample' locations to test IRP performance for 'Small Town' communities, with 162 possible journeys to 18 principal network hubs, again for the scenarios listed above.

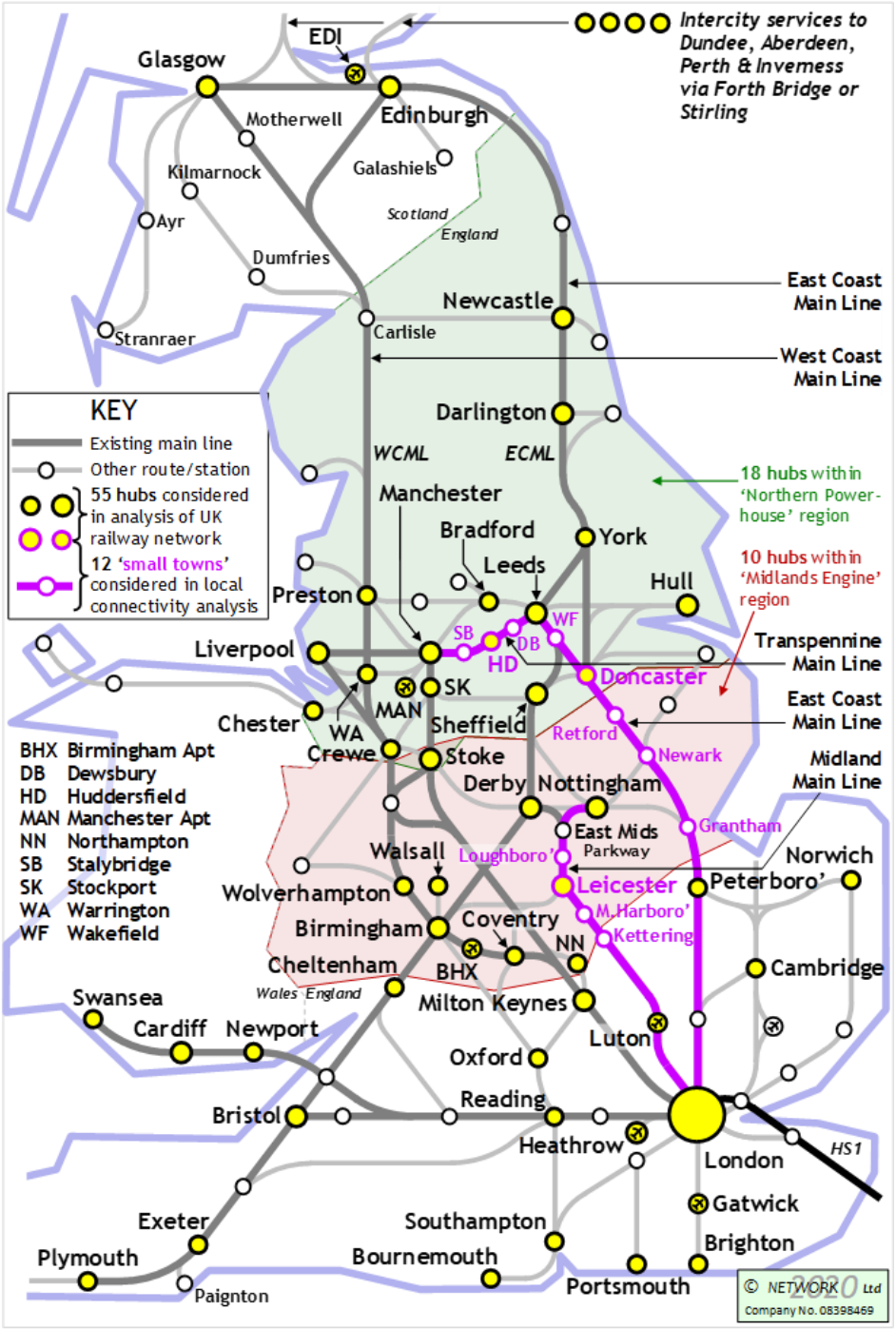


Figure 2E : 55 Primary Network Hubs and 9 Additional 'Small Town' Communities

3 A Performance Specification for the Integrated Rail Plan

3.1 An Engineered, Quantified and Optimised Approach

If the Integrated Rail Plan is to deliver the greatest possible benefits, be they Levelling-up, Net Zero greenhouse gas emissions, Building Back Better, or simple good transport, then a structured, quantified and engineered approach is vital to ensure the greatest possible benefits. In such a structured approach, it is first necessary to establish the fundamental connectivity principles to which the IRP should be developed. Noting the need for efficient national, regional and local transport, these principles are best articulated from the perspective of a UK region.

Within any UK region, the Integrated Rail Plan should be developed to offer the best possible performance against the following ideals:

A) Full compliance with any core specification for intercity journey times, train frequencies etc *(note the One North/Northern Powerhouse specification detailed in Section 2.6)*;
B) Comprehensive direct links by frequent 'intercity-quality' services between all principal population centres within the region;
C) Achievement of maximised journey time reductions;
D) Full integration with local networks at city centre stations;
E) Achievement of step-change capacity gains for local services;
F) Full compatibility with parallel ambitions for improved railfreight services *(note Transport for the North's ambition[12] for a "freight superhighway connecting Liverpool and the Humber")*;
G) Optimised direct links to principal population centres across the national network (as per Item B above);
H) Optimised reductions in journey time to principal population centres across the national network (as per Item C above).

3.2 Measuring Performance and Developing a Scoring System

There is no single measure of connectivity against which performance can be assessed; instead, the performance of the candidate schemes under consideration must be measured, quantified and scored against each of the ideals listed above. These individual scores represent the various components of connectivity which an ideal UK railway network should offer.

Any scoring of candidate schemes is only meaningful if it can be baselined against the performance of the existing network. This is necessary to ensure that the scoring system represents the improvement in connectivity that each scheme will deliver; this relates much more closely to potential economic and environmental gains, than any attempt at an absolute measure.

With the individual scores aggregated into a single combined score, the candidate scheme attaining the highest overall score against all of these criteria can be justifiably proclaimed as the best scheme. This study sets out provisional scoring systems in Sections 6.2 and 6.5, and these are used in all quantified assessments of connectivity improvements.

3.3 Baselining of all Comparisons against pre-Covid Network

In the immediate aftermath of Covid-19 (i.e. June 2022), many interregional services are still significantly reduced (for example Manchester-Birmingham-Bristol direct Crosscountry service suspended, Transpennine services reduced in frequency with more stops added). There is a major risk that these depressed service levels will be taken as the baseline for any claim of improvement under the Integrated Rail Plan, particularly in relation to the Government's aspiration to 'Build Back Better' after the Covid-19 pandemic.

'Building Back Better' must mean that rail services will be improved to a standard higher than before the pandemic. It is therefore important that all comparisons between candidate schemes should be baselined upon the existing network, as it stood prior to the Covid-19 pandemic.

3.4 Direct Linkage between Improved Connectivity and Levelling-up

The criteria set out in Section 3.1 would appear to be totally uncontroversial, and they all relate to the improvement of connectivity, which is a fundamental requirement for the Government's 'Levelling-up' agenda. Moreover, all of these connectivity criteria are quantifiable, measurable and capable of optimisation to deliver the greatest possible economic benefit and hence the greatest possible Levelling-up – so long as the candidate scheme delivers significantly greater benefits for regional cities than for London, elevating regional connectivity towards levels enjoyed by London.

It therefore follows logically that if one candidate scheme can be shown to deliver a quantified improvement in connectivity which is twice that of another candidate scheme, it is likely (given the above proviso) to be twice as effective in delivering 'Levelling-up'.

3.5 Direct Linkage between Improved Connectivity and Net Zero

A very similar direct linkage exists between the improvement of connectivity and the achievement of Net Zero greenhouse gas emissions, in particular carbon dioxide (CO_2). Improved connectivity in a railway network is a crucial determining factor in attracting road users to rail and thereby reducing transport CO_2 emissions. The candidate scheme offering the greatest improvement in connectivity would therefore seem to be the scheme most capable of delivering step-change CO_2 reductions, and thus achieving the closest possible approach to Net Zero.

3.6 The Imperative for Optimised Outcomes

The arguments set out in Sections 3.4 and 3.5 carry a stark message for Government and the wider transport establishment. The Government can only pursue its Integrated Rail Plan if it can demonstrate that it will deliver the best possible outcomes in terms of enhanced network connectivity and capacity, and therefore deliver the greatest possible Levelling-up and the greatest possible reductions in greenhouse gas emissions towards its Net Zero target.

If, however, the Integrated Rail Plan can be shown by quantified comparative analysis to be hugely inferior to an alternative scheme, then the Government cannot responsibly press on with either the Integrated Rail Plan or any of its component projects. To do so would be to fail the nation, and to fail every region of the nation.

4 The Integrated Rail Plan – Remit, Input & Output

4.1 Origins of the Integrated Rail Plan

The 2019/20 Oakervee Review[13] of the HS2 project was commissioned by Prime Minister Boris Johnson with the purpose of informing his Government's decision on whether or not HS2 should go ahead, and it now stands as the primary justification for the 'Notice to Proceed' issued on 18th April 2020.

Notwithstanding its broad approval of the HS2 project, the Oakervee Review expressed serious concern at HS2's failure to integrate with the existing railway network, and it made a strong recommendation for the development of an 'Integrated Rail Plan for the Whole GB Network'.

The Government's commissioning of an 'Integrated Rail Plan for the North and Midlands', along with the more UK-wide transport improvements envisaged in the Union Connectivity Review[14] (also commissioned in 2020), represents broad acceptance of Oakervee's recommendation.

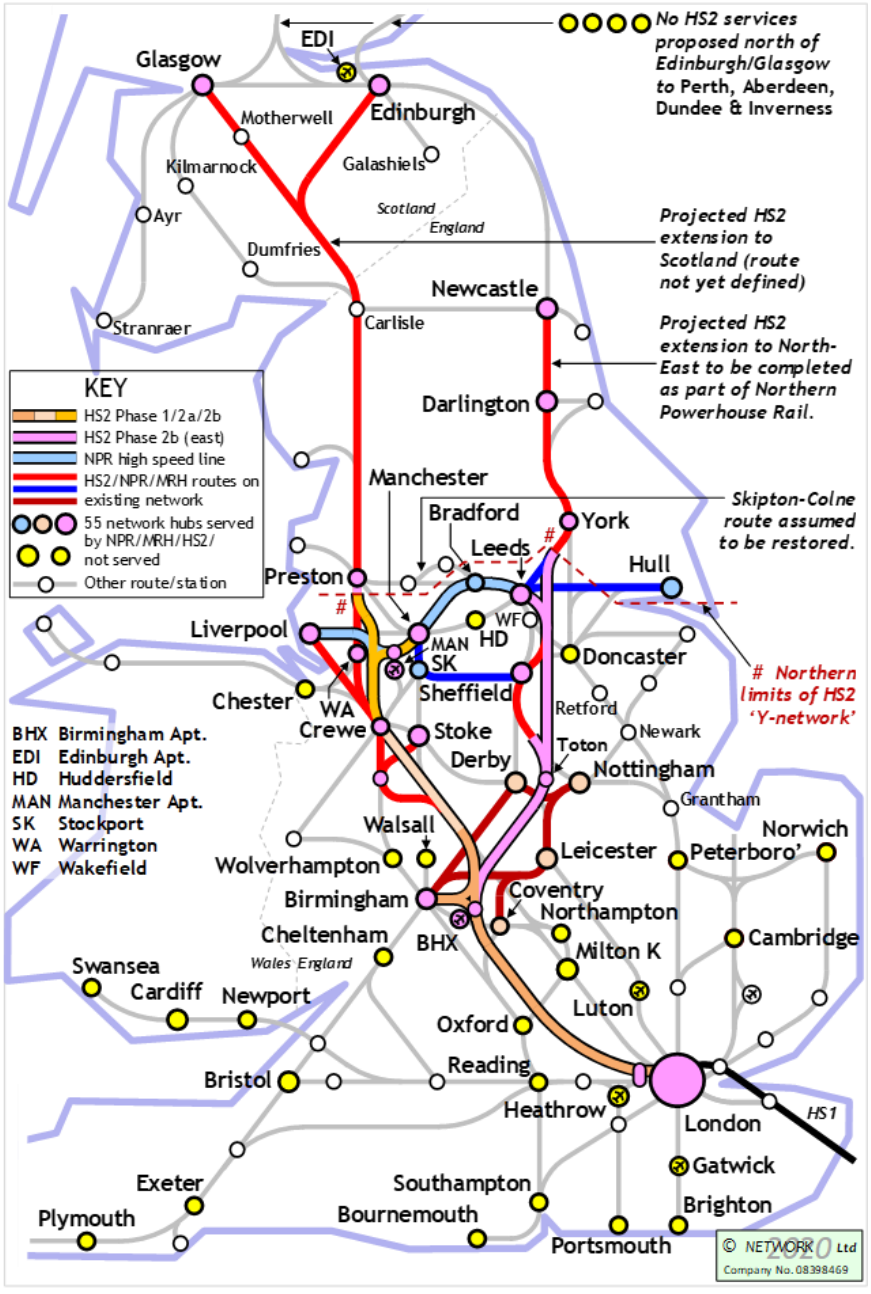


Figure 4A : Predecessor Scheme comprising HS2 Y-network, Northern Powerhouse Rail and Midlands Rail Hub

4.2 Remit for the Integrated Rail Plan

The Government's Terms of Reference for the Integrated Rail Plan are set out in Appendix A.

These Terms of Reference placed no overarching requirement for how a national network comprising HS2, Northern Powerhouse Rail, Midlands Rail Hub and the existing 'classic' system should perform, in terms of either cities directly interlinked, reduced intercity/interurban journey times or any specification for efficient interchange between local and national rail networks.

Instead, its primary requirement was for the IRP to be built around the existing established schemes i.e. HS2 Phases 1 and 2a), plus Northern Powerhouse Rail and Midlands Rail Hub. These were the 'givens' – only HS2 Phase 2b (east) was to be taken as any sort of variable.

Put simply, the Integrated Rail Plan's remit was all about conformance, rather than performance.

The configuration of the established 'Predecessor Scheme' – comprising the full HS2 'Y-network', Northern Powerhouse Rail and Midlands Rail Hub – is shown in Figure 4A.

4.3 IRP critical to Levelling-up, Net Zero and Building Back Better

The 'Integrated Rail Plan for the North and the Midlands' was published on 18th November 2021.

The critical role that the Integrated Rail Plan will play in delivering the Government's Levelling-up, Net Zero and Building Back Better agendas is confirmed[15] in the published IRP (Item 1.8 p30):

> *"(The Integrated Rail Plan)… sits at the heart of the Government's plans to level up the whole country, Build Back Better, and move to net zero greenhouse gas emissions."*

4.4 Committed Projects detailed in Integrated Rail Plan

The Integrated Rail Plan sets out[16] the Government's commitment to 12 major projects, as follows:

a) Complete HS2 Phase 2b (west) from Crewe to Manchester Piccadilly and Wigan;
b) Build a truncated HS2 Phase 2b (east) only from Birmingham to East Midlands Parkway;
c) Build a new Warrington-Marsden high speed line via Manchester Piccadilly, incorporating the Manchester Spur element of HS2 Phase 2b, as per Item a) above;
d) Upgrade and Electrify the Transpennine Main Line between Manchester and York;
e) Upgrade and Electrify the Midland Main Line northwards to Sheffield;
f) Upgrade and Accelerate the East Coast Main Line to Leeds and Newcastle;
g) Start work on a West Yorkshire Mass Transit System;
h) Introduce 'London-style' contactless ticketing;
i) Develop the Midlands Rail Hub scheme in the West Midlands;
j) Develop the Midlands Rail Hub scheme in the East Midlands;
k) Protect and Improve Services on the Existing Network;
l) Complete planned upgrades on the Manchester-Sheffield 'Hope Valley' route.

These projects are additional to HS2 Phases 1 and 2a i.e. the London-Birmingham-Crewe high speed line currently in progress, and collectively they define the present scope of the Government's UK high speed rail project.

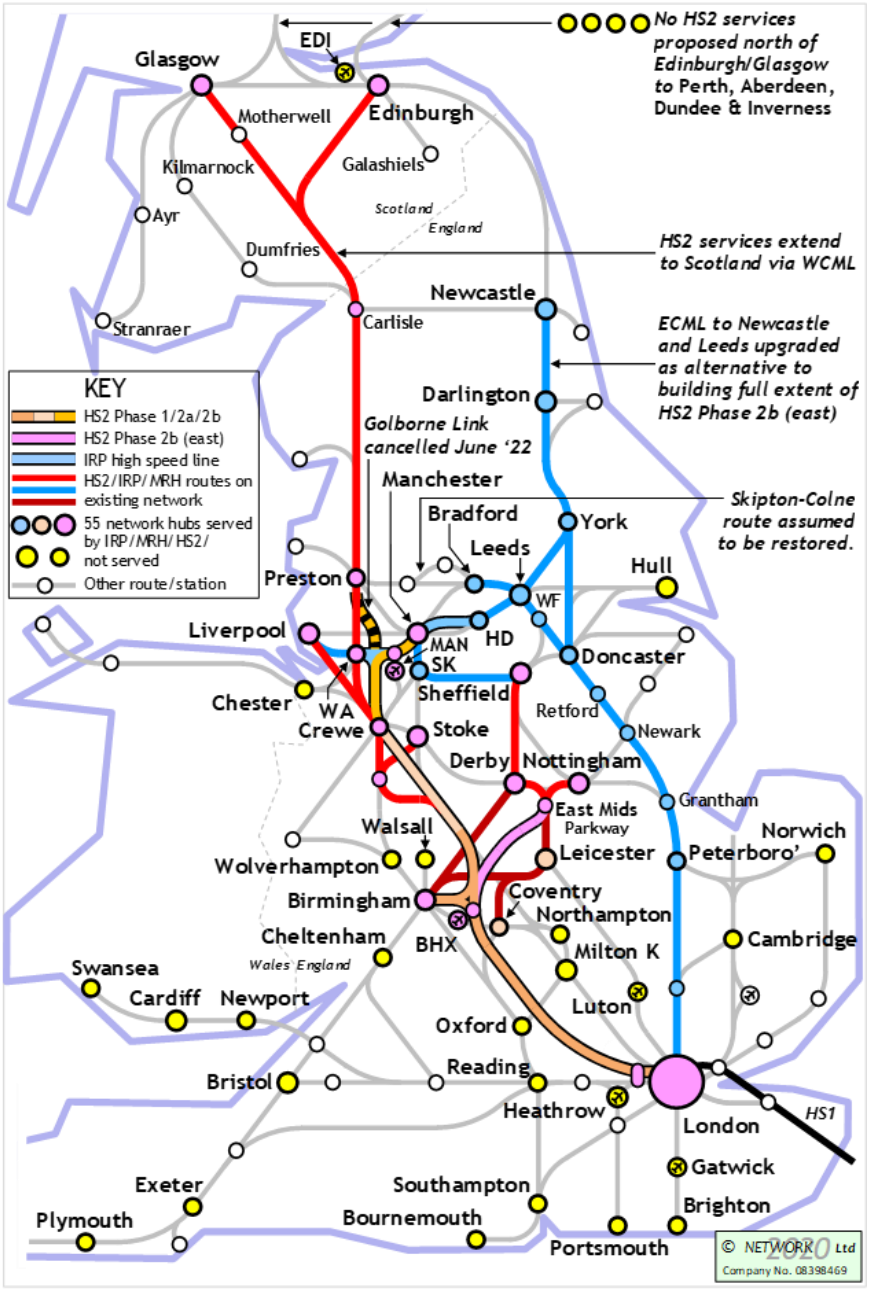


Figure 4B : Principal Schemes detailed in 2021 Integrated Rail Plan

4.4.1 Reduction in Scope of New-build High Speed Lines

Commitments **a)**, **b)** and **c)** set out the new-build railway projects envisaged under the Integrated Rail Plan, to supplement Phases 1 and 2a of HS2:

- Only the western arm of HS2 Phase 2b will be built in full, extending northwards to a junction with the West Coast Main Line near Wigan (i.e. the 'Golborne Link'), with a spur to central Manchester. *(Note the cancellation of the Golborne Link on 7th June 2022, leaving only the spur to central Manchester as 'HS2 Phase 2b (west)' – discussed in Section 4.8).*
- The eastern arm of HS2 Phase 2b, originally intended to extend from the West Midlands to West Yorkshire, will be truncated to a short spur to East Midlands Parkway.
- Northern Powerhouse Rail, originally intended to comprise a new-build railway from Liverpool via Manchester and Bradford to Leeds, will be curtailed to a Warrington-Manchester-Marsden high speed line, with upgraded sections of existing route at either end, and Bradford left completely bypassed.

All this effectively constitutes a massive retrenchment of the UK high speed rail project, with the much-vaunted HS2 'Y-network' now reduced to 'Telegraph Pole' format – a single trunk route with 2 short stubs on either side. With both HS2 Phase 2b (east) and Northern Powerhouse Rail massively curtailed, communities in Yorkshire and the North-East – collectively comprising over 7 million population – will be left primarily reliant upon upgrades of the existing main line network.

4.4.2 Main Line Upgrades instead of New High Speed Lines

Commitments **d)**, **e)**, **f)** and **l)** set out the Integrated Rail Plan vision for upgrading/electrifying/ accelerating key main line routes in the Midlands and the North, in lieu of the previous schemes (i.e. the full HS2 'Y-network' and Northern Powerhouse Rail) for new high speed lines. The IRP seeks to justify this retrenchment by claiming variously that:

- The achieved journey time reductions should either match those of the previous scheme, or be only marginally inferior.
- The proposed upgrade strategy should still be capable of delivering the required step-change increase in capacity.

Certain of the Government's assertions in support of their upgrading strategy appear surprising, to put it mildly. For instance:

- The proposed upgrade of the East Coast Main Line is predicted to shave 20 minutes (or 15%) off the existing 133 minute (2h13m) London-Leeds journey time, while top speeds will only increase by 12% (125MPH to 140MPH).
- With a strategy to build new tracks for only 40% of the route length between Manchester and Leeds, a doubling of capacity on this line is still predicted.
- The proposed upgrade of the Manchester-Sheffield 'Hope Valley' route is claimed to deliver the same circa 33% journey time reduction that is claimed for the IRP's Manchester-Leeds route, where 40% or the route will be new-build high speed line.

The Government's main line upgrade strategy has been met with considerable scepticism and outright hostility. The reaction from the many Northern communities now denied the prospect of high speed services has only been muted by the fact that no definitive independent study has yet emerged to directly contradict any of the Government's claims.

Accordingly, the above claims (and others) are tested in Section 6.1 of this study.

4.4.3 Commitment to West Yorkshire Mass Transit System

The Government's commitment **g)** to the development of a Mass Transit System in West Yorkshire (the only UK Metropolitan county without a tramway, light rail or comprehensively electrified suburban rail system) is certainly welcome. However, there are obvious tensions and potential conflicts with the ambition for accelerated and more intensive long-distance services along the Manchester-Huddersfield-Leeds line (as documented in Section 6.1), and very similar issues apply along the Bradford-New Pudsey-Leeds line.

These matters are addressed in Section 6.4 of this study.

4.4.4 Commitment to 'London-style Contactless Ticketing'

The Government's commitment **h)** to a network-wide ticketing system, to match the Oyster Card system that operates on London's rail, Tube and bus networks, is again welcome. However, it is fair to state that such a 21st Century system is the least that public transport users in the Midlands and the North should expect, and this issue does not require further discussion in this study.

4.4.5 IRP Initiatives in West and East Midlands

Commitments **i)** and **j)** offer a lukewarm endorsement of the existing Midlands Rail Hub (MRH) programme of upgrades[17] to the existing network in the West and East Midlands, but they offer no other schemes that might provide the step-change enhancement of connectivity and capacity necessary to deliver the Government's ambitions for Levelling-up etc.

However, Commitment **i)** does provide an interesting insight into the disjointed thinking behind the ongoing HS2 scheme. It states: *"New high-speed line from Birmingham to Manchester will enable improved onward connectivity to the South West and Wales."* As the IRP notes, this 'improved onward connectivity' requires passengers from Manchester arriving at the new HS2 Birmingham Curzon Street terminus to walk with their luggage to the nearby Moor Street terminus to catch another train to Bristol, and change there for destinations further south and west.

It would seem mystifying, how the IRP service offer between Manchester and Bristol can be represented as 'improved… connectivity'. One possibility is that the Government has failed to understand that prior to the pandemic, there was an hourly direct service from Manchester via Birmingham New Street to Bristol, with certain services extending further south-west to Paignton or Plymouth; this oversight may have led to the IRP's promotion of the retrograde 'walking change' between Curzon Street and Moor Street stations as some sort of improvement.

This issue, and the wider issue of IRP network performance in the West and East Midlands, is addressed in Sections 6.1, 6.6 and 6.7.

4.4.6 Commitment to Bypassed Communities

The Government's commitment **k)** to "*protect and improve services on the existing main lines*" acknowledges the well-recognised problem of the new HS2 high speed line bypassing smaller towns and cities, and leaving these communities with significantly reduced intercity services on the existing main lines.

12 specific towns – Kettering, Market Harborough, Leicester, Loughborough, Grantham, Newark, Retford, Doncaster, Wakefield, Dewsbury, Huddersfield and Stalybridge – are cited as benefitting (or at least suffering no harm) from the revised strategy to upgrade existing main lines, as set out in the Integrated Rail Plan.

The IRP claim of "*improved services in terms of destinations served, electrified trains, higher frequencies, more seats and/or faster services*" to these 12 communities is tested in Section 6.5.

4.5 Linkage to other primary Government Policy Initiatives

4.5.1 Union Connectivity Review (2021)

The Integrated Rail Plan states (Item 2.19, p44) that connectivity issues outside the Midlands and the North, and particularly on routes from these regions to Scotland, are to be encompassed within the Union Connectivity Review (UCR). The UCR is a wider Government initiative aimed at strengthening links between all UK nations, and it has declared a specific ambition to establish 'UKNET', a 'strategic transport network for the whole United Kingdom'.

It not necessarily the case that rail will offer the optimum solution for every inter-conurbation/ inter-region/inter-nation link, and this is particularly true for any link to Northern Ireland with the very obvious intervening obstacle of the Irish Sea. But for the vast majority of links between the UK's principal population centres, a rail-based solution is undoubtedly the best way forward, whether viewed from an economic or environmental perspective.

It would therefore seem imperative that the railway development proposals contained within the 'Integrated Rail Plan for the North and the Midlands' are fully co-ordinated with UKNET and other UK-wide initiatives that should spring from the Union Connectivity Review, to bring about an optimised railway network extending across the entire island of Great Britain. This of course was the original intention of the Oakervee Review's recommendation for an 'Integrated Rail Plan for the Whole GB Network'.

Bullet Point	Value (£bn)	Project
1	5.0	Project Gigabit
	1.0	Shared Rural Network
2	5.7	Consolidated Transport
	5.0	Buses & Active Travel
	96.0	Integrated Rail Plan
3	8.7	Schools
4	3.8	Skills
5	23.3	NHS money
6	---	Universal Credit
7	0.1	Safer Streets
8	---	Immigration
9	1.5	Scotland
	0.8	Wales
	0.6	Northern Ireland
10	---	Freeports
11	2.4	Towns Fund
12	2.0	Culture Recovery
13	4.8	Levelling Up Fund
14	0.2	Pubs & Playing Fields
15	26.0	Green Industrial/Net Zero
16	---	Decentralisation
	186.8	**Total**
	51.4%	%age Integrated Rail Plan

Mission	Value (£bn)	Project
3	96.0	Integrated Rail Plan
3	24.0	Roads & Motorways
3	5.7	City Region Sust Transport
3	5.0	Buses & Cycling & Walking
	130.7	**Total**
	73.5%	%age Integrated Rail Plan

'Mission 3' Levelling-up transport Projects listed on p11

Projects Listed by HMG Levelling-up White Paper (Executive Summary, 2022)

Levelling-up Projects listed on pp1-2

Table 4C : Levelling-up Projects & Values Listed in HMG Levelling-up White Paper

4.5.2 Levelling-up White Paper (2022)

The importance that the Government appears to be placing upon the Integrated Rail Plan can be judged from listings of costs of Levelling-up projects set out in the recently published Levelling-up White Paper[18], as set out in Table 4C on the previous page.

It is freely acknowledged that the above listing of the projects and the associated public expenditure is neither comprehensive nor consistent in terms of the timescales over which the money will be spent. However, it still gives a fair impression of the magnitude of the Integrated Rail Plan, relative to other public projects; its quoted £96 billion cost is:

- around half the total cost of the listed projects;
- around three-quarters of the total cost of 'Mission 3' transport projects;
- almost 4 times the cost of the next most expensive project.

This only serves to emphasise the importance of rail in general, and the Integrated Rail Plan in particular, in providing the essential trunk travel component of the Government's Levelling-up agenda.

The Levelling-up White Paper also makes the key statement[19]: *"Levelling up can only succeed as a shared national project"*. This reinforces the imperative for the Integrated Rail Plan (and/or UKNET) to comprise an optimised solution, a fully integrated national network capable of delivering the greatest possible improvement in capacity and connectivity between all of the UK regions. A second-best solution, especially one that purports only to consider the needs of the Midlands and the North, cannot be an option.

4.5.3 National Policy Statement for National Networks

The Government has published a series of National Policy Statements to define the 'public policy' guiding the development of major infrastructure. The 'National Policy Statement for National Networks'[20], published in 2014, is the relevant document in respect of national rail network development.

The National Networks National Policy Statement (NNNPS) defines[21] the Government's vision and strategic objectives for the national networks as follows:

> *"The Government will deliver national networks that meet the country's longterm needs; supporting a prosperous and competitive economy and improving overall quality of life, as part of a wider transport system. This means:*
>
> - *Networks with the capacity and connectivity and resilience to support national and local economic activity and facilitate growth and create jobs.*
> - *Networks which support and improve journey quality, reliability and safety.*
> - *Networks which support the delivery of environmental goals and the move to a low carbon economy.*
> - *Networks which join up our communities and link effectively to each other."*

The National Networks National Policy Statement also makes the following key statements:

> *"There is… …a need for development on the national networks to support national and local economic growth and regeneration, particularly in the most disadvantaged areas. Improved and new transport links can facilitate economic growth by bringing businesses closer to their workers, their markets and each other. This can help rebalance the economy." (NNNPS Section 2.6)*
>
> *"The Government has therefore concluded that at a strategic level there is a compelling need for development of the national networks – both as individual networks and as an integrated system. The Examining Authority and the Secretary of State should therefore start their assessment of applications for infrastructure covered by this NPS on that basis." (NNNPS Section 2.10)*

These statements establish beyond any reasonable doubt the public policy linkage between economic rebalancing (i.e. 'Levelling-up' in contemporary parlance) and railway network development to achieve the "*capacity and connectivity and resilience to support national and local economic activity and facilitate growth and create jobs*". This must dictate the development not of any railway network, but the railway network capable of delivering the greatest possible capacity and connectivity in order to achieve optimum outcomes.

It would be reasonable to expect the Integrated Rail Plan and the Levelling-up White Paper to be co-ordinated with the National Policy Statement for National Networks. Strangely, however, no reference to any National Policy Statement can be found in either the Integrated Rail Plan or the Levelling-up White Paper.

Whatever the case, the public policy imperative for optimised railway network development, as set out in the National Policy Statement for National Networks, must logically still apply.

4.5.4 2021 Budget Speech by Chancellor Rt Hon Rishi Sunak MP

The Budget speech delivered on 27th October 2021 by the Chancellor of the Exchequer provides a valuable insight into Government thinking on national infrastructure development. From a railway perspective, one short excerpt[22] is crucial:

> *"Infrastructure connects our country, drives productivity and levels up. That is why our national infrastructure strategy invests in economic infrastructure such as roads, railways, broadband and mobile – over £130 billion. To connect our towns and cities, we are investing £21 billion on roads and £46 billion on railways. Our Integrated Rail Plan will be published soon, dramatically improving journey times between our towns and cities. Today, we are providing £5.7 billion for London-style transport settlements in Greater Manchester, the Liverpool city region, the Tees Valley, South Yorkshire, West Yorkshire, the West Midlands and the West of England…*
>
> *…The Prime Minister promised an infrastructure revolution. This Budget delivers an infrastructure revolution."*

The Chancellor's words establish a clear logic path:

- Levelling-up depends on improved infrastructure to *"connect our country"*.
- The Integrated Rail Plan is a crucial element in developing this improved infrastructure.
- *"Dramatically improving journey times"* is seen (at least by the Chancellor of the Exchequer) as a key indicator of good Integrated Rail Plan performance.
- Clearly, the greatest Levelling-up will happen with the best possible Integrated Rail Plan delivering (along with other quantified connectivity and capacity benefits) the greatest possible journey time reductions.

Given the Government's clear (and justified) enthusiasm for the development of national infrastructure, the Integrated Rail Plan's cancellation of major elements of its UK high speed rail project seems highly surprising.

4.5.5 Transport Select Committee Inquiry into Integrated Rail Plan

The House of Commons Transport Select Committee has launched an Inquiry into the Government's Integrated Rail Plan (IRP), requesting specific responses on the following issues:

- The contribution that the IRP will make to rail capacity and connectivity for (a) passengers and (b) freight in (i) the Midlands and the North and (ii) the UK;
- Whether and how the IRP will 'Level up' communities in the Midlands and the North;
- How the IRP will affect rail infrastructure and services outside the Midlands and the North;
- The challenges to central Government, Great British Railways, regional and local authorities, transport bodies and other stakeholders in delivering the IRP;
- How the rail schemes in the IRP will integrate and interact with HS2;
- How the rail improvement schemes in the IRP were selected, and whether those selections represent equity between and within regions;
- Whether the IRP represents value for money for UK taxpayers.

The High Speed UK response to the Transport Select Committee's Inquiry is set out in Appendix B.

4.6 Overview of Integrated Rail Plan

4.6.1 Retrenchment of UK High Speed Rail Project

It seems plain that the Integrated Rail Plan represents a massive retrenchment in the scope and ambition of the UK high speed rail project. As noted previously, the HS2 'Y-network' (which with the addition of Northern Powerhouse Rail might be represented as an 'Inverse A') is now effectively reduced to a largely linear 'Telegraph Pole' configuration, and this would seem to destroy any legitimacy that HS2 might claim as a national system.

It is reasonable to speculate as to the Government's motivation in promoting an Integrated Rail Plan that is at such odds with its previous strategy (i.e. the 'Predecessor Scheme') of comprehensive high speed line construction to interlink the UK's principal cities. Many regional politicians and business leaders have accused the Government of a savage cost-cutting agenda, and there is no doubting the political imperative to slash double-digit billions from the burgeoning budget of the HS2 project.

However, this would seem to fly in the face of the Government's own pledges to invest in infrastructure (see Section 4.5.4) and promote regional 'powerhouse' economies. Moreover – with Northern Powerhouse Rail effectively cancelled in addition to HS2 Phase 2b (east) – it might seem that the Integrated Rail Plan has exceeded its own terms of reference, which were primarily focussed upon a review of HS2 Phase 2b (east). It would therefore seem prudent to investigate other possible explanations.

4.6.2 Alternative Explanation for Reduced IRP Scope

The primary alternative explanation lies with the fundamental lack of integration between HS2, Northern Powerhouse Rail and the existing network.

It is quite possible that when viewed from the perspective of an 'Integrated Rail Plan', with a presumed priority to create an enhanced national network offering optimised integration and connectivity between all communities large and small, the new-build routes of HS2 and Northern Powerhouse Rail, plainly lacking any integration, were deemed to make no sense at all. In the absence of detailed quantitative analysis (as presented in this study), this would have been a largely qualitative judgment, but still with plentiful evidence of the established schemes' broad failure to perform as a network.

Hence the Government's only practicable option to attain improved network performance would be to cancel the majority of proposed new-build high speed lines, with only the core stem of HS2 (i.e. Phases 1, 2a and 2b (west)) surviving as the residual spine of the new IRP national 'network'.

4.6.3 'Logic Gap' at heart of Integrated Rail Plan

This exposes the fundamental 'logic gap' at the heart of the Integrated Rail Plan. To deliver the step-change connectivity improvement for all communities, and hence deliver on the Government's ambitions for Levelling-up, Net Zero greenhouse gas emissions, Building Back Better etc, the IRP must perform as an optimised network offering the greatest possible connectivity between UK communities. Yet the IRP national network will be based upon HS2, which – as described in Section 6.7.9 – was designed with no thought for an optimised national network.

None of this precludes the possibility, that an optimised national network might somehow result from an Integrated Rail Plan that is based upon HS2. But this would be a highly fortuitous outcome representing an almost infinitesimally small statistical possibility. A far more likely outcome is that failure to plan HS2 as the core element of an optimised national network will in turn massively impair the performance of every scheme that is based upon HS2.

4.6.4 No Structured Process in Development of Integrated Rail Plan

With an efficient and successful Integrated Rail Plan key to realising the Government's ambitions for Levelling-up, for achieving Net Zero greenhouse gas emissions and for Building Back Better after the Covid-19 pandemic, there would seem to be a clear imperative for a structured process to maximise the IRP's efficiency and success.

Moreover, given the fact that all of the schemes envisaged even in the IRP's reduced scope will consume of the order of £100 billion of public money (and in doing so, consume all and more of the budget available for new railway construction), there is an equal imperative for a similar process of optimisation to minimise costs and maximise value.

However, it is plain from even the briefest examination of the Integrated Rail Plan that no such process exists. There is:

- No definition of the IRP's fundamental connectivity and capacity goals;
- No definition of the design principles to which the IRP should be developed;
- No measurement of any proposal's performance against any principles and goals;
- No comparison with or 'market testing' against alternative proposals;
- No apparent recognition that predication upon established schemes (in particular HS2) may fatally compromise IRP performance.

4.7 The Imperative for an 'Exemplar Alternative' Project

With crucial issues of national and public interest at stake, not to mention around £100 billion pounds of public money, there would seem to be an unarguable imperative to formulate a logical, scientific and structured approach for the development of an efficient, successful and fully optimised Integrated Rail Plan.

Yet there is no evidence of any such approach in the Integrated Rail Plan.

This makes it imperative that the performances of both the Integrated Rail Plan and its Predecessor Scheme are rigorously benchmarked against that of an 'Exemplar Alternative' scheme, developed to a radically different philosophy in which optimised network performance has been the overriding priority from the outset.

The High Speed UK Exemplar Alternative is described in Section 5 of this study.

4.8 Cancellation of HS2 Golborne Link to WCML (June 2022)

The cancellation of the 'Golborne Link' was announced by the Government on 7th June 2022. The Golborne Link was intended to comprise a connection from the HS2 (Phase 2b (west)) trunk route to the West Coast Main Line at Bamfurlong, south of Wigan, and it was to be used by HS2 services from London and Birmingham to Edinburgh and Glasgow. With the cancellation of the Golborne Link, HS2 Phase 2b (west) will comprise just the trunk HS2 route north of Crewe and the spur to Manchester Piccadilly, and HS2's link to the WCML is assumed to be located at Crewe.

The impact of the Golborne Link's cancellation is discussed in Sections 6.2.7 and 6.7.6.

5 The High Speed UK Exemplar Alternative

5.1 High Speed UK Design Philosophy

High Speed UK (HSUK) has been designed to a radically alternative philosophy to that which has driven the development of HS2 and hence the Integrated Rail Plan. Whereas HS2 was remitted as a stand-alone high speed line, with no stated requirement either for integration or network performance, HSUK has been designed from the outset as a fully integrated national network, with the aim of directly interconnecting all of the UK's many regional centres.

At the core of the HSUK scheme (see Figure 5A) is a new Anglo-Scottish high speed line (following the corridors of the M1, and of the East Coast Main Line northwards from Yorkshire) and a new Transpennine route extending west (via the abandoned Woodhead corridor) from Sheffield and Leeds to Manchester and Liverpool. Further details of proposed HSUK infrastructure can be found on www.highspeeduk.co.uk.

The HSUK proposals have been designed to achieve full integration between new high speed line and existing national rail network. Close-spaced links to the existing network will be provided, to serve communities that would otherwise be bypassed, and upgrades of existing main lines and restorations of abandoned routes have been designed to complement HSUK's new-build lines. In particular, extensive 4-tracking is proposed on all principal intercity routes radiating from Birmingham New Street, towards Coventry, Derby and Wolverhampton. See Figure 5B.

HSUK's full integration with the existing network allows it to be developed in a modular 'city to city' fashion, with sections completed on a localised basis, and no imperative to construct the entire proposed system (although the greatest benefits would accrue with the complete national system). Outline regional modules are illustrated in Figure 5D.

High Speed UK has been launched under the brand of 'Network North' as a network for the Northern Powerhouse region, and it is similarly being promoted in the Midlands under the 'Midlands Ring' brand.

HSUK's strategy of constructing new lines, upgrading existing lines and limited restoration of abandoned routes will combine to transform the national railway network. This will for the first time achieve full direct interconnection between all of the UK's primary cities, and almost complete interconnection between its principal regional conurbations. HSUK's vast superiority as a national network can be fully appreciated from Figure 5C. Out of a possible 153 connections, HSUK will offer improved direct (i.e. no change of trains) high speed services for 141 – an overall network efficiency of 92% (=141/153).

(Considered on the same basis, the Integrated Rail Plan together with the existing intercity network can offer just 93 direct journeys out of 153 – an overall network efficiency of 61%. See Figure 6.2H.)

Figure 5A : Nationwide Extent of High Speed UK routes and new high speed lines

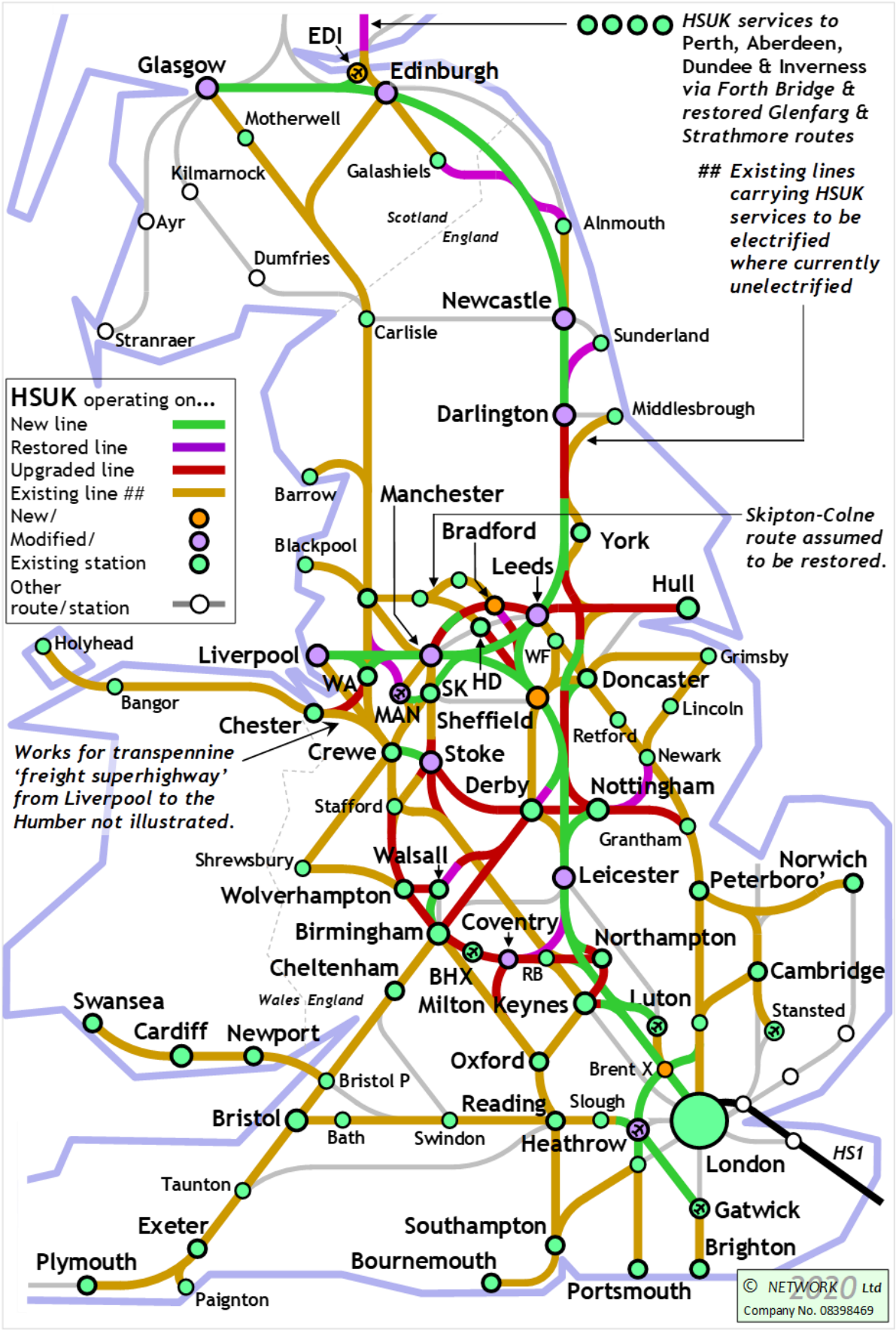


Figure 5.B : Proposed High Speed UK New-build, Upgrade & Restoration Works

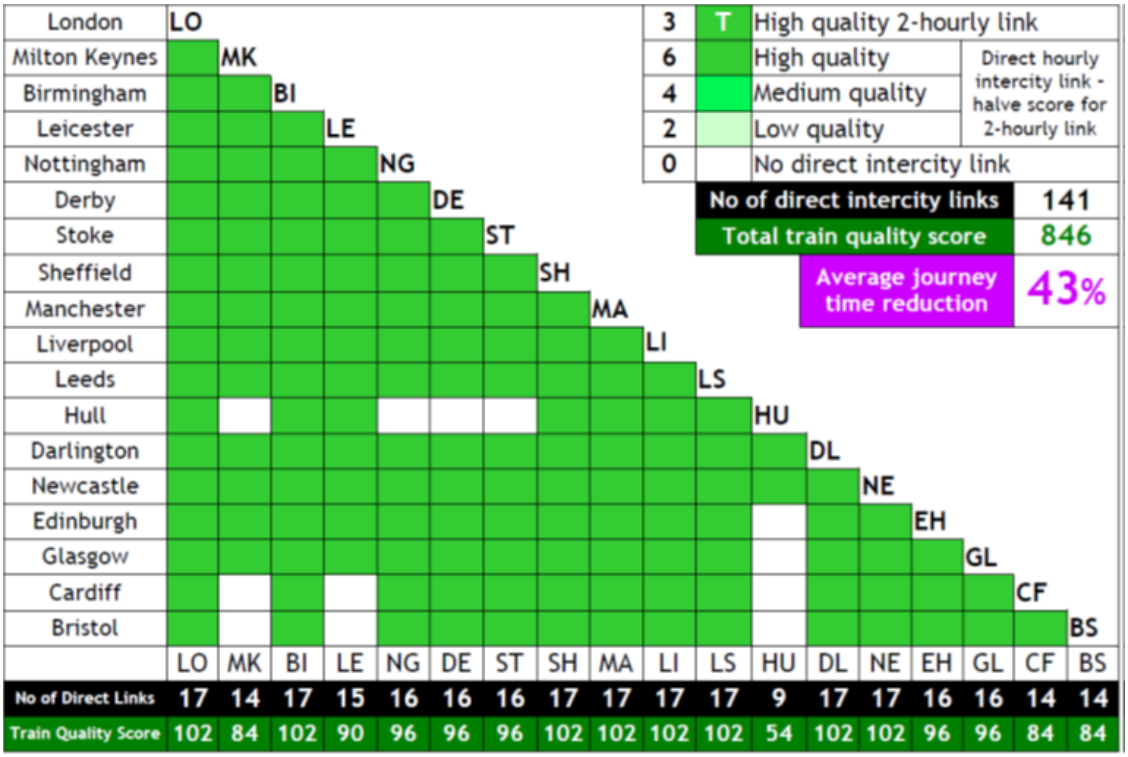


Figure 5C : High Speed UK – Direct Connectivity between Principal UK Cities

5.2 High Speed UK – Extent of Technical Development

It must be recognised that the design effort underpinning the HSUK proposals goes far beyond that of HS2 and the Integrated Rail Plan, including:

- Over 1,000 kilometres of proposed routes – new-build, upgraded and restored – have been designed to 1:25,000 scale – *straights, transitions and circular curves all designed, and complementary vertical alignments also developed*.
- Development of a 'Demonstrator Timetable' to illustrate the vast improvement in national intercity services that will be possible, with HSUK in place.
- Development of Regional Integration Strategies to demonstrate HSUK's full integration with local rail networks in all regions served by HS2/HSUK – *including bespoke proposals for central 'hub' stations in all major cities*.

Further detail of HSUK's design work can be found on www.highspeeduk.co.uk.

5.3 Detailed Technical Comparisons between HS2 and HSUK

HSUK's comprehensive route design has allowed the development of rigorous technical comparisons against the Government's high speed rail proposals.

5.3.1 Calculation of Journey Times and Development of Timetable

HSUK's detailed route design has made it possible to assess its speed capability at all points along each planned route. This in turn has allowed the calculation of point-to-point journey times along all of HSUK's routes, all validated against the journey times claimed for key elements of the HS2 'Y-network'.

And by using these journey times as the base data, it has been possible to design a nationwide service pattern (i.e. the HSUK Demonstrator Timetable) from which intercity journey times across the national network (i.e. both direct journeys and journeys requiring one or more changes of train) can be calculated.

This has allowed HSUK's network performance to be rigorously assessed against that of both the 2020 Predecessor Scheme (i.e. HS2 'Y-network', Northern Powerhouse Rail and Midlands Rail Hub) and the 2021 Integrated Rail Plan. Comparisons between the network performances of the candidate schemes are set out in Sections 6.2 and 6.5.

5.3.2 Detailed comparative costings

With HSUK's new-build lines (and upgraded/restored routes) defined in terms of both horizontal and vertical alignment, it has been possible to identify (to the nearest 100 metres) the lengths of the various structure types – tunnel, viaduct, cutting, embankment etc – that will be needed in the construction works.

With an equivalent classification exercise undertaken upon the published HS2 proposals, and with due allowance made for access and sensitivity issues, it has then been possible to scale HSUK's construction costs against those of the HS2 'Y-network'. Comparative costings undertaken for the Predecessor Scheme have shown the cost of the HS2 'Y-network' on its own to exceed that of the entire HSUK Exemplar Alternative.

However, a true comparison can of course only be undertaken with the costs of other elements of the Predecessor Scheme (i.e. Northern Powerhouse Rail and Midlands Rail Hub) also taken into account, and in the absence of a definitive detailed NPR (or MRH) scheme, it has been necessary to 'reverse-engineer' from the published journey times a representative NPR route from which a comparative cost estimate can then be made.

Significant work is now required to update the comparative costings so far undertaken to reflect:

- Recent increases in the basic HS2 cost model;
- The amended proposals set out in the Integrated Rail Plan.

Accordingly, it is not possible at this juncture to publish comparative costings between HSUK and the Integrated Rail Plan.

However it is hoped that it will shortly be possible to release definitive costing data for HSUK that will establish both its capital cost profile and also its benefit-cost ratio relative to the current Integrated Rail Plan proposals.

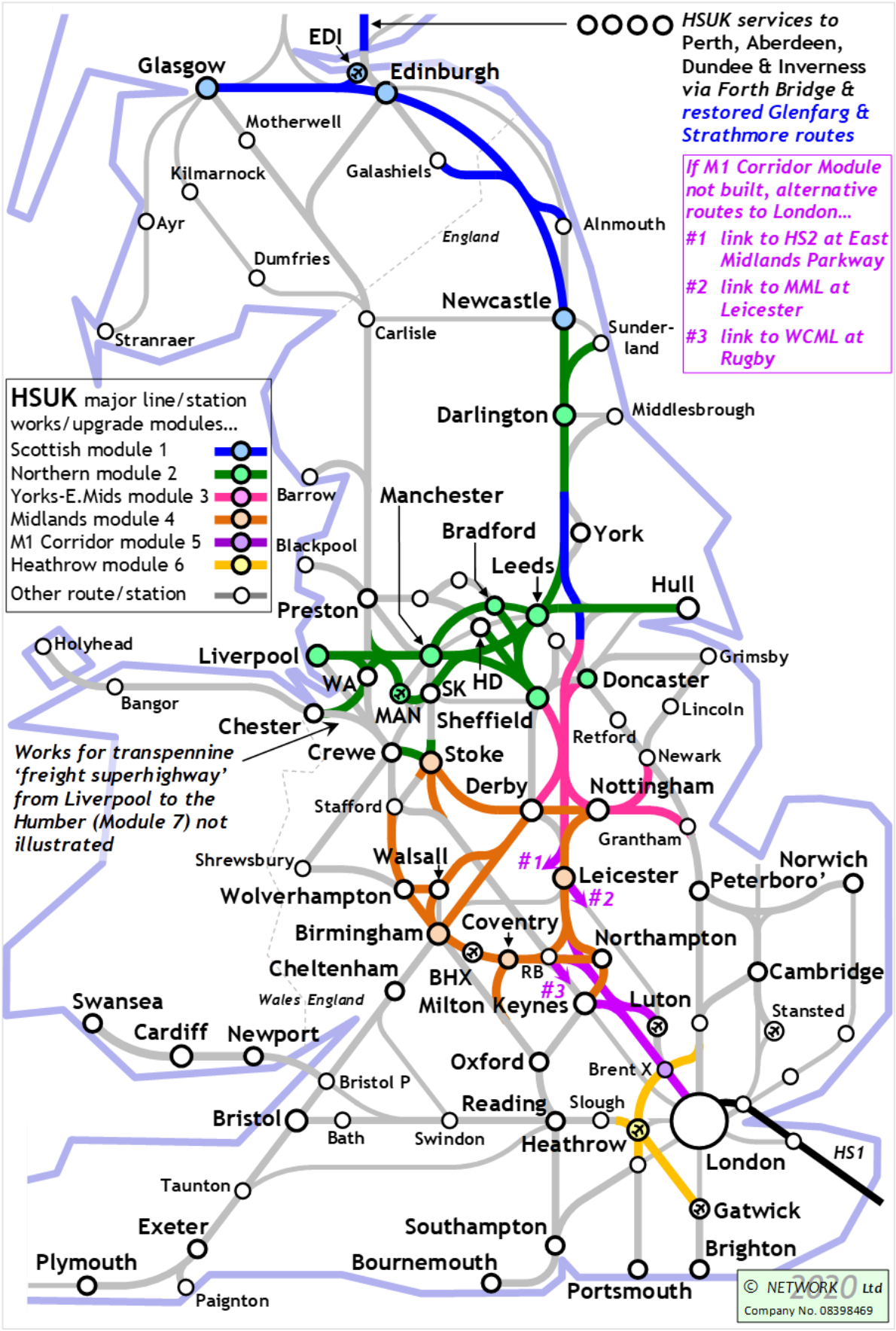


Figure 5D : High Speed UK Regional Modules

5.4 Compatibility of HSUK with Ongoing HS2 Construction

With the Integrated Rail Plan based around the established HS2 scheme, it must be a matter of deep concern that the Government has chosen to proceed with constructing Phases 1 and 2a of HS2, without first checking whether an IRP based upon HS2 will bring about the best possible national network, with the greatest possible connectivity and capacity. In proceeding this way, the Government seems blind to the obvious risk; if HS2 and the Integrated Rail Plan fail to deliver the outcome of an optimised network, then the Government's Levelling-up, Net Zero and Building Back Better agendas must also fail.

This is of course the whole point of this study, and its introduction of the High Speed UK Exemplar Alternative is intended to highlight the scale of the Integrated Rail Plan's failure to deliver the required step-change improvements in network connectivity.

However, there is a danger that the ongoing progress of HS2 will tend to prejudice the comparisons set out in this study. Critics may argue that HS2 is a *fait-accompli*, and that HSUK must conform with the sections of HS2 already under construction, regardless of how poorly they have been designed in the wider context of a national network. It might also be argued that with HS2 already in progress, HSUK has no validity as a national scheme.

These arguments (if they were to be advanced) would be deeply fallacious, and the underlying motives would possibly be questionable. However, arguments of this nature are inevitable, and they need to be addressed in a rigorous and professional manner.

5.4.1 Argument A – HSUK invalidated by HS2??

This argument is easily countered by HSUK's fundamentally modular nature. Although conceived as a national scheme, its fully integrated design is capable of division into self-standing independent units or 'modules', and 6 possible modules are illustrated in Figure 5D. Listed from north to south, these would be as follows:

1. Crossborder to Scotland;
2. Northern Powerhouse;
3. Yorkshire to East Midlands;
4. Midlands Engine;
5. M1 Corridor;
6. Heathrow Connections.

Any of these modules can be assembled from the individual elements detailed in Figure 5B, as a stand-alone project independent of the other modules, and their performance as local (or national) networks can be tested against the corresponding elements of the Integrated Rail Plan. This is the essential purpose of this study, to quantify and compare network performance within the Northern Powerhouse, and within the Midlands Engine, as a primary indicator of the potential to Level-up.

It is deeply regrettable that the Government has followed the advice of its experts, and has chosen an environmentally destructive and network-inefficient route for its flagship HS2 project; but this has no direct relevance to the Northern Powerhouse. Regardless of whatever the future might hold for the HS2 project, the railway network in the Northern Powerhouse must perform to the greatest

possible efficiency to deliver a Levelled-up economy for the people of the North; mistakes made elsewhere cannot be allowed to damage the railway system in the North.

Exactly the same argument applies in the Midlands, and indeed in any other UK region.

5.4.2 Argument B – HSUK forced to conform with HS2 Phases 1 & 2a??

This study makes an overwhelming case (see Sections 6.2 and 6.6) for the development of railway networks in the Northern Powerhouse and the Midlands Engine regions broadly in accordance with Modules 2 and 4, as listed in Section 5.4.1. There is an equally strong case for developing the railway system between the North and the Midlands, to agglomerate the economies of the two regions, and this is the logic for Module 3, to better connect the East Midlands and Yorkshire. (Note that on the west side of the Pennines, Modules 2 and 4 meet at Stoke on Trent.)

However, ongoing construction of Phase 1 of HS2 may imperil the case for constructing HSUK's proposed high speed line following the M1 Corridor from the Midlands to London (i.e. Module 5). It may instead be necessary for HSUK services originating in Scotland, the North and the Midlands to make the final part of the journey to London along either HS2 or existing main lines (i.e. Midland and West Coast).

Figure 5D identifies 3 locations where HSUK national services might transfer either to HS2 or to the existing main line network:

- **#1** – joining HS2's residual Phase 2b (east) stub near East Midlands Parkway. This would necessitate a very short spur from the designed HSUK new-build high speed line.
- **#2** – joining the Midland Main Line at Leicester. With HSUK planned to serve the existing Leicester (London Road) station, no modifications to existing designs are required.
- **#3** – joining the West Coast Main Line near Rugby. A connection from the HSUK trunk route/Midland Ring route to the WCML at Rugby is already designed.

Although these changes would have the effect of adding 15-20 minutes to journey times from regional cities to London, they would appear to have very little effect on HSUK's fundamental national connectivity offer. More importantly, however, they would have virtually no effect upon HSUK's ability to interconnect the UK's regions, and therefore its ability to Level-up the UK economy. It could even be argued that adding time to London-bound journeys (which are always far faster than interregional journeys) might have the unintended and beneficial consequence of promoting Levelling-up.

The impact upon HSUK's quantified connectivity, of forced conformance with established HS2 routes, is assessed in Section 6.2.6.

6 Outcomes of Assessment of Integrated Rail Plan

The outcomes of this study's technical assessment of the Integrated Rail Plan are presented as responses or 'Findings' in respect of 7 specific performance tests which – where relevant – have also been applied to the other candidate schemes described in Sections 4 and 5.

These 7 tests are listed as follows:

1. Are the journey time and route capacity benefits predicted in the Integrated Rail Plan (IRP) feasible, achievable or optimal?
2. Will the IRP deliver significant connectivity benefits to major regional cities, and thereby support the Government's Levelling-up and Net Zero agendas?
3. Will the Integrated Rail Plan meet the long-standing journey time targets for the Northern Powerhouse, and provide the necessary step-change in capacity on transpennine routes??
4. Are the IRP's proposed main line upgrades compatible with emerging proposals for a West Yorkshire Mass Transit System?
5. Will the IRP deliver significant connectivity benefits to smaller regional communities, and thereby support the Government's Levelling-up and Net Zero agendas?
6. Can the IRP transform the railway network in the Midlands and the North, and provide the additional capacity to spur the development of regional 'powerhouse' economies?
7. Will the IRP maintain and enhance the integrity of the national railway network?

The 'Findings' are presented in the subsequent Sections 6.1 – 6.7.

Further detailed comparisons, of journey times from principal cities of the Midlands Engine, the Northern Powerhouse, and from Edinburgh, Glasgow and London, are set out in Appendices C, D and E (only available on-line[23], not included in the printed version of this study).

6.1 Verifying IRP Claims for Journey Time & Capacity Improvements

Test 1 poses the question: ***"Are the journey time and route capacity benefits predicted in the Integrated Rail Plan feasible, achievable or optimal?"***

6.1.1 Test 1 – Assessment Rationale and Methodology

Test 1 aims to verify the Integrated Rail Plan's predictions for improved intercity journey times and route capacity, as tabulated in IRP Pages 18-19 and associated text.

16 primary intercity journeys have been selected from the routes highlighted in the Integrated Rail Plan. The respective journey times for the 3 candidate schemes – the Integrated Rail Plan, the Predecessor Scheme and the High Speed UK Exemplar Alternative – have been taken from publicly available official sources, or from data developed for the HSUK 'Demonstrator Timetable', and compiled into Table 6.1A.

Journey		Journey Time (minutes)				IRP/ HSUK Winner
		Existing	Predecessor Scheme	Integrated Rail Plan	High Speed UK	
01	London-Leeds	133	81	113	77	HSUK
02	London-Newcastle	169	137	148	125	HSUK
03	Manchester-Liverpool	33#	29*	35*	18	HSUK
04	Manchester-Leeds	51#	29	33*	26	HSUK
05	Leeds-Bradford	19#	8	12	15	IRP
06	Bradford-Manchester	59#	22	59	30	HSUK
07	Manchester-Sheffield	50#	30-35*	30-35*	23	HSUK
08	London-Nottingham	92	97$	57	47	HSUK
09	Birmingham-Nottingham	74	59	26	40	IRP
10	London-Sheffield	118	87	87	55	HSUK
11	Birmingham-Sheffield	75	65	62	44	HSUK
12	London-Manchester	126	71	71	76	IRP
13	Birmingham-Manchester	86	41	41-51	57	IRP
14	London-Liverpool	132	94	92	96	IRP
15	Birmingham-Leeds	118	49	89	65	HSUK
16	Birmingham-Newcastle	206	117	167	110	HSUK
	Average Journey Time Reduction		34.4%	27.8%	43.2%	HSUK

 # Pre-Covid journey times.

$ Journey time increased to allow for change of trains at Toton/East Midlands Parkway – see Section 6.2.

** Journey time failing Northern Powerhouse specification – see Section 6.3.*

Table 6.1A : Selected Intercity Journey Times for Candidate Schemes

All journey time data has been independently verified by a wide-ranging review of publicly-available information including:

- HS2 Ltd mapping of proposed new-build lines, including permitted speeds;
- Network Rail 'Sectional Appendix' data[24] for existing lines, again providing distance and speed profiles;
- Examination of on-line mapping information to determine potential for increased speed at curves.

Where appropriate, additional short sections of new-build high speed line (for instance in the Greater Manchester area, necessary for the revised IRP schemes) have been modelled to similar speed/curvature standards as the established HS2 proposals.

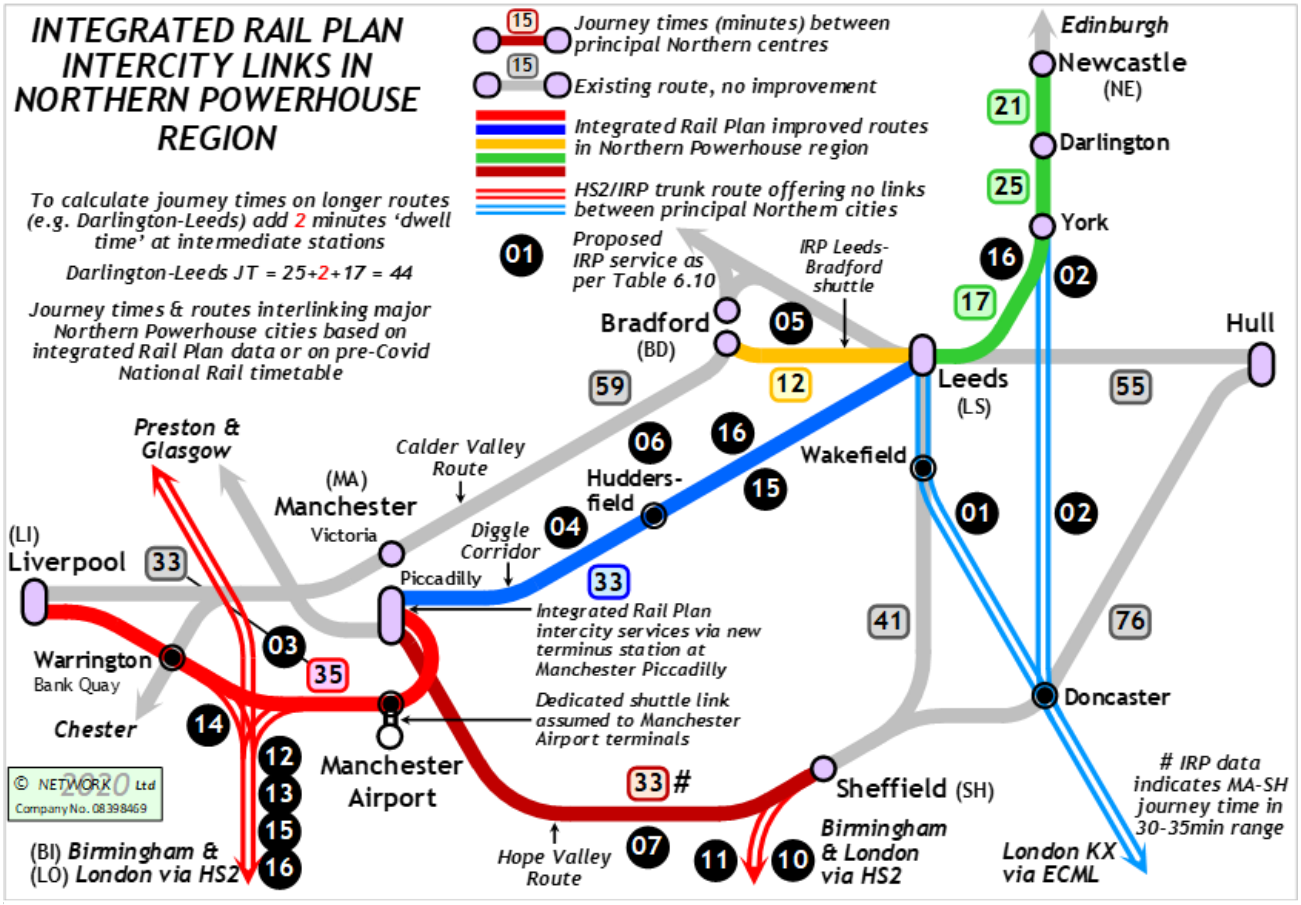


Figure 6.1B : Journeys in Northern Powerhouse Region listed in Table 6.1A

Using bespoke software developed by HSUK (and already validated against journey times claimed for primary HS2 routes), journey times have been calculated for all routes proposed under the Integrated Rail Plan. Exactly the same methodology has been employed in the calculation of journey times for the different route designs of the HSUK Exemplar Alternative.

6.1.2 Test 1A – Comparisons of Journey Times on 16 Selected Routes

The predicted journey times for the 3 candidate schemes are presented in Figure 6.1C as percentages of the existing journey time.

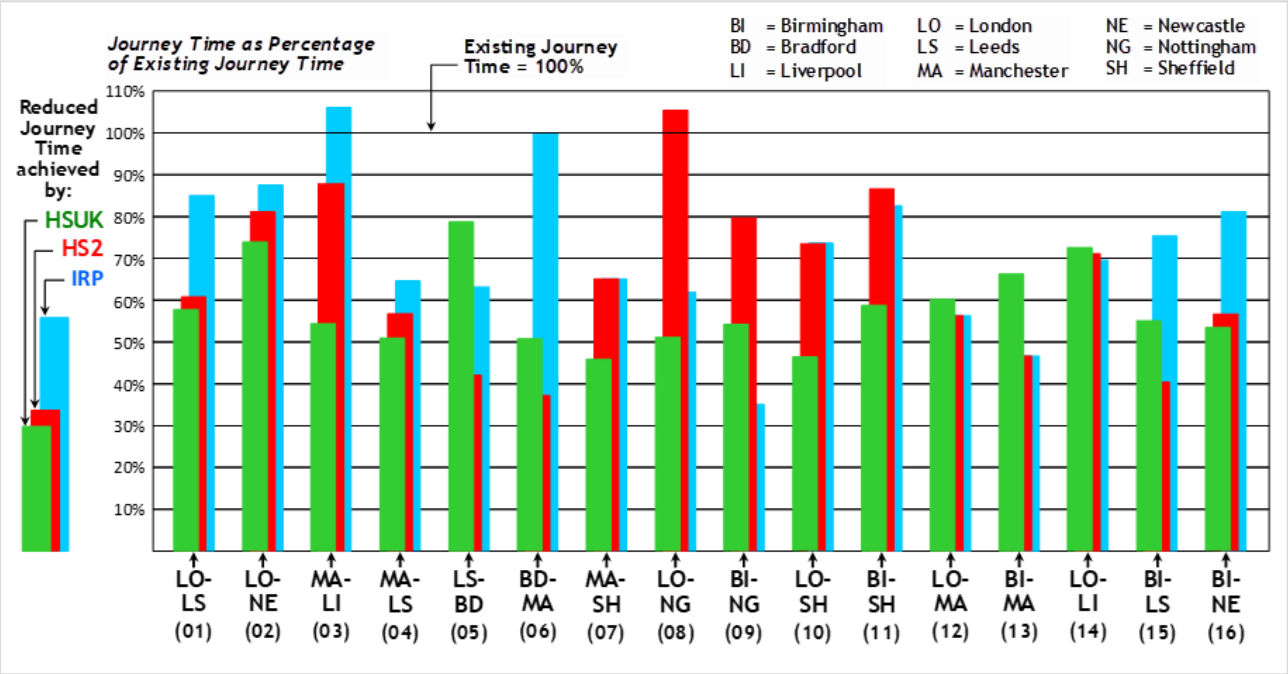


Figure 6.1C : Graphical Plot of Table 6.1A Journey Times as Percentage of Existing

Two journeys above the 100% baseline i.e. taking longer than the existing journey time, and therefore of highly questionable purpose and value, are immediately apparent:

- IRP Manchester-Liverpool journey via Manchester Airport and Warrington;
- HS2/NPR Predecessor Scheme London-Nottingham journey, including change of trains at the now-abandoned East Midlands Interchange at Toton.

Table 6.1D below allows a more structured consideration of the relative overall performance of the 3 candidate schemes on the 16 selected journeys. It is immediately apparent that while both the HS2/NPR Predecessor Scheme and the Integrated Rail Plan offer superior journey times on the routes on which they have specifically focussed (e.g. HS2/NPR Bradford-Manchester, IRP Birmingham-Nottingham), their overall performance is compromised by the routes that they either neglect or offer negative performance (e.g. HS2/MRH London-Nottingham, IRP Manchester-Liverpool).

Candidate Scheme	Performance as Percentage of Existing Journey Time				Average Journey Time Reduction
	Best	Worst	Variance	Average	
Predecessor Scheme	**37.3%**	**105.4%**	**68.1%**	**65.6%**	**34.4%**
Integrated Rail Plan	**35.1%**	**106.1%**	**70.9%**	**72.2%**	**27.8%**
High Speed UK	**46.0%**	**74.0%**	**28.0%**	**56.8%**	**43.2%**

Table 6.1D : Summary of Candidate Scheme Performance

By contrast, the HSUK Exemplar Alternative offers a much more consistent performance, with a much smaller variance between 'Best' and 'Worst', and a significantly superior overall performance in reducing journey times. This would appear to be in much better accord with the Government's aspiration for a Levelled-up nation.

Desk studies have been undertaken to test the Integrated Rail Plan's claims for journey time and capacity improvements for all of the journeys listed in Table 6.1A.

6.1.3 Test 1B – Detailed Assessment of IRP Predicted Journey Times

Journey 01 (A) : London to Leeds via Upgraded East Coast Main Line

No	Journey Time (min)		Capacity Benefit?	Implementation Strategy
	Existing	Predicted		
01	**133**	**113**	Not stated	Upgrade/accelerate existing line, with trains running at 225kph (140MPH) maximum speed.

The East Coast Main Line from London to Leeds has been modelled, using base geographic and linespeed data from Network Rail's Sectional Appendix. This has been supplemented by a detailed measurement of radius of curvature at all of the many critical curves along the route, and this has enabled the calculation of possible journey time reductions.

With a long history of upgrading work along the length of the East Coast Main Line, all viable options for local curve realignment have already been exhausted. It has been assumed that critical curves (at Peterborough, Grantham, Newark, Retford and Doncaster *inter alia*) are retained in fundamental alignment but reengineered where necessary to maximum cant and cant deficiency.

Raising the linespeed from 125MPH to 140MPH as proposed under the Integrated Rail Plan would only deliver the predicted 20 minute journey time reduction if all intermediate stops were to be eliminated. Under more realistic operating conditions, with the existing stopping pattern (i.e. intermediate stops at Peterborough, Doncaster and Wakefield) maintained, a reduced journey time of 123 minutes might be attained.

Journey 02 : London to Newcastle via Upgraded East Coast Main Line

No	Journey Time (min)		Capacity Benefit?	Implementation Strategy
	Existing	Predicted		
02	**169**	**148**	Not stated	Upgrade/accelerate existing line, with trains running at 225kph (140MPH) maximum speed.

As per Journey **01** above, similar considerations dictate that a maximum journey time reduction of circa 10 minutes might be achievable for the London-Newcastle route.

Journey 03 : Manchester to Liverpool via Warrington & upgraded Fiddlers Ferry line

No	Journey Time (min)		Capacity Benefit?	Implementation Strategy
	Existing	Predicted		
03	**33$**	**35**	Not stated	Extend HS2 Phase 2b (west) to link to upgraded Fiddlers Ferry line (aka 'Garston/Timperley') with services passing through Warrington Bank Quay en route to Liverpool.

$ *Promoted in Integrated Rail Plan as 50 minutes for Manchester-Liverpool journey via Warrington Central*

The IRP route from Manchester Piccadilly to Liverpool Lime Street is proposed to include intermediate stops at Manchester Airport and Warrington Bank Quay. It will utilise the full length of the planned HS2 Phase 2b (west) Manchester Spur, and, by means of a short additional section of new high speed line, it will follow the route of the abandoned Garston-Timperley line to a new station at Warrington Bank Quay (Low Level). It will then continue westwards along the freight line that previously served the now-decommissioned Fiddlers Ferry power station, and along existing passenger routes into Liverpool Lime Street.

Calculations demonstrate that, with suitable upgrades of existing lines, the claimed 35 minute journey time from Manchester to Liverpool is achievable. However, 3 points must be emphasised:

- A 35 minute journey time delivered by the IRP would miss the 20 minute target of the Northern Powerhouse specification by 15 minutes, or 75%.
- This would be 2 minutes slower than the existing (pre-Covid) 33 minute journey time along the much more direct Chat Moss Line (the original 1830 'Liverpool & Manchester').
- Development of the Garston-Timperley/Fiddlers Ferry line as the primary Manchester-Liverpool passenger route will preclude the possibility of developing this line as a core element of a dedicated Transpennine freight route linking the Port of Liverpool to Greater Manchester, South Yorkshire and ultimately to East Coast ports. See Section 6.6.6.

The fundamental logic of designing a single route to fulfil the triple purpose of a) providing an express service between Manchester and Liverpool, b) serving Manchester Airport and c) serving Warrington, must be questioned. It has resulted in a highly circuitous route that delivers neither the specified end-to-end journey time nor a viable centrally-located station at Manchester Airport; moreover, there are significant concerns with constructing a new 'Low Level' station directly beneath the existing West Coast Main Line at the existing Warrington Bank Quay station.

Journey 04 (B) : Manchester to Leeds via new high speed line and upgraded TPML

No	Journey Time (min)		Capacity Benefit?	Implementation Strategy
	Existing	Predicted		
04	**51**	**33**	Existing capacity doubled	New high speed line from Manchester to Marsden, remainder of route upgraded and electrified. 4-tracking presumed where vacant trackbeds exist from Marsden through Hudders -field to Ravensthorpe, necessary to accommodate freight & local traffic. However, there is no practicable 4-tracking strategy for the critical Ravensthorpe-Dewsbury-Leeds section, and this is presumed to remain 2 tracks.

The predicted journey time and capacity improvements are technically feasible only if the critical 2-track Ravensthorpe-Dewsbury-Batley-Leeds section of the Transpennine Main Line is devoted to intercity traffic. This will leave no capacity to improve local services along this key route, which would appear to be essential in meeting the IRP's parallel ambition for a West Yorkshire Mass Transit System (see Section 6.4).

It should also be noted that the predicted 33 minute Manchester-Leeds journey time fails to meet the requirement for a 30 minute journey time set out in the Northern Powerhouse specification (see Section 6.3).

Journey 05 (C) : Leeds to Bradford via upgraded Calder Valley/New Pudsey Line

No	Journey Time (min)		Capacity Benefit?	Implementation Strategy
	Existing	Predicted		
05	**19**	**12**	Not stated	Upgrade and electrify existing line from Bradford Interchange via New Pudsey to Leeds.

Analysis demonstrates that the predicted 7 minute (37%) journey time reduction can only be achieved with non-stop services operating to the limits of the many tight curves on this steeply-

graded line. As with IRP proposals for the Manchester-Leeds route (see Journey **04** above) this will hugely compromise any ambition for new stations and improved frequencies to serve the major communities along the New Pudsey line, as part of a future West Yorkshire Mass Transit System (see Section 6.4).

The true worth of a 12 minute timing between the city centres of Leeds and Bradford must be questioned, if it prevents the necessary development of local services.

Journey 06 : Bradford to Manchester via existing Calder Valley Line

No	Journey Time (min)		Capacity Benefit?	Implementation Strategy
	Existing	Predicted		
06	**59**	**59**	None	IRP contains no proposal for improved Bradford-Manchester route; improvements via Leeds offer no practical advantage.

The IRP's strategy for an upgraded Transpennine Main Line running via Huddersfield has precluded any possibility of improved links from Bradford to Manchester, Manchester Airport and Liverpool. The predicted 12 minute shuttle service to Leeds, when combined with the 33 minute journey to Manchester and the time and inconvenience of changing trains (see Sections 6.2 and 6.4) at Leeds, will offer no advantage over the existing 59 minute journey to Manchester (Victoria) via Halifax.

Overall, the IRP will deliver no worthwhile improvements to Bradford's connectivity, which, whether viewed from a regional or a national perspective, can only be described as 'dire'.

Journey 07 (D) : Manchester to Sheffield via Upgraded Hope Valley Line

No	Journey Time (min)		Capacity Benefit?	Implementation Strategy
	Existing	Predicted		
07	**50**	**30-35**	3rd fast train/hour	Upgrade of existing route, no commitment either to electrification or diversion of existing freight traffic.

Detailed analysis of the Hope Valley Line indicates no practical options to ease any of its many tight-radius curves, and consequently there is very little potential for significant journey time reductions. The predicted 30-35[25] minute Manchester-Sheffield journey time is not achievable with the present upgrade strategy, a fact that is corroborated by the IRP strategy for the Transpennine Main Line (see Journey **04** above) which requires major lengths of new build to achieve a similar journey time on a similar length of route.

A 30-35 minute journey time could only be realised with major lengths of new construction, and this, given the intervening presence of the Peak District National Park, would effectively dictate a new 'base tunnel' extending from New Mills to near Sheffield, a length of around 33km.

A 40 minute journey time might be achievable if all curves could be engineered to 'express train' standards, with the maximum 150mm cant (i.e. superelevation between rails) and 110mm 'cant deficiency'. However, this would effectively preclude the line's use by heavy raifreight traffic (mostly originating in quarries near Buxton), for which there is no viable alternative route.

In practical terms a 45 minute journey time would appear to be a more likely outcome.

Whichever the case, the IRP strategy to upgrade the Hope Valley Line will fail to meet the 30 minute journey time specified for the Manchester-Sheffield route. See Section 6.3.

Journey 08 : London to Nottingham via HS2 spur to East Midlands Parkway
Journey 09 : Birmingham to Nottingham via HS2 spur to East Midlands Parkway
Journey 10 : London to Sheffield via HS2 spur to East Midlands Parkway
Journey 11 : Birmingham to Sheffield via HS2 spur to East Midlands Parkway

No	Journey Time (min)		Capacity Benefit?	Implementation Strategy
	Existing	Predicted		
08	**92**	**57**	Not stated	Construct residual section of HS2 Phase 2b (east) linking HS2 Phase 1 near Coleshill to the Midland Main Line at East Midlands Parkway. HS2 services will then continue along the Midland Main Line to Nottingham, and to Sheffield via Derby.
09	**74**	**26**	Not stated	
10	**118**	**87**	Not stated	
11	**75**	**62**	Not stated	

Analysis shows that the IRP's predicted journey times from London and Birmingham to Nottingham (Journey **08** & **09**) and from Birmingham to Sheffield (Journey **11**) are all achievable, not requiring (aside from overhead electrification) any major upgrade/acceleration of the Midland Main Line.

However, the predicted 87 minute journey time from London to Sheffield (Journey **10**) appears questionable. Detailed review of published IRP data indicates that the 87 minute timing relies upon an accelerated Derby-Sheffield journey time of 27 minutes, and this would seem to be achievable only by eliminating the major intermediate stop at Chesterfield – which was integral to the previous HS2 proposals (i.e. the 'Predecessor Scheme').

It would therefore seem that the political imperative, to claim for the Integrated Rail Plan an unchanged London-Sheffield journey time, may have triumphed over the need to protect services to intermediate communities, that is championed elsewhere in the IRP. See Section 6.5.

Journey 12 : London to Manchester via HS2 trunk route to Manchester Piccadilly
Journey 13 : Birmingham to Manchester via HS2 trunk route to Manchester Piccadilly

No	Journey Time (min)		Capacity Benefit?	Implementation Strategy
	Existing	Predicted		
12	**126**	**71**	Not stated	Construct HS2 Phase 2b (west) as planned, extending HS2 Phase 1 and 2a to new terminus station at Manchester Piccadilly.
13	**86**	**41/51**	Not stated	

Analysis shows that the IRP's predicted journey times from London and Birmingham to Manchester (Journeys **12** & **13**) are all achievable, with the longer Birmingham-Manchester journey time of 51 minutes including intermediate stops at Crewe and the HS2 Manchester Airport station (which would still require an as-yet-undesigned shuttle transfer to Manchester Airport).

While the proposed service to intermediate stations is unquestionably desirable, it still raises the broader question of why HS2's new-build line (Phase 2a) completely bypasses the major conurbation of Stoke and the Potteries, with a population of nearly 500,000. Again, this squares poorly with the IRP's claimed championing of intermediate communities. See Section 6.5.

Journey 14 : London to Liverpool via Warrington BQ & upgraded Fiddlers Ferry line

No	Journey Time (min)		Capacity Benefit?	Implementation Strategy
	Existing	Predicted		
14	**132**	**92**	Not stated	Construct link from HS2 Phase 2b (west) to link to upgraded Fiddlers Ferry line (as per **03**) with services passing through Warrington Bank Quay en route to Liverpool.

The predicted 92 minute journey time from London to Liverpool appears to be feasible, albeit with major concerns as to the suitability of an upgraded but still highly curved Fiddlers Ferry line as a primary intercity route. This extreme curvature – in places as tight as 250m radius, dictated by the proximity of both the River Mersey and the disused St Helens Canal – will also create major problems in the design of the proposed 'Low Level' station at Warrington Bank Quay, additional to those of constructing a new station directly below the existing station and the West Coast Main Line.

Journey 15 : Birmingham to Leeds via HS2 to Manchester and upgraded TPML
Journey 16 : Birmingham to Newcastle via HS2 to Manchester and upgraded TPML

No	Journey Time (min)		Capacity Benefit?	Implementation Strategy
	Existing	Predicted		
15	**118**	**89**	Not stated	Construct new high speed line from Manchester Piccadilly terminus to Marsden, with services continuing along upgraded Transpennine Main Line to Leeds (as per **04**). Services to Newcastle continue from Leeds along upgraded East Coast Main Line to Newcastle (as per **02**).
16	**206**	**167**	Not stated	

The journey times set out above appear to be compatible with the journey times predicted for the Birmingham-Crewe-Manchester route (Journey **13**), the Manchester-Leeds route (Journey **04**), and northern sections of the East Coast Main Line (Journey **02**). However, there are significant concerns associated with the necessary reversal at the proposed HS2/IRP terminus at Manchester Piccadilly.

The journey times for the Birmingham/Manchester/Leeds/Newcastle services include 5 minutes of 'dwell time' at Manchester Piccadilly to allow for the additional time taken for a train to enter the terminus, for the driver to change ends (or for a crew change), and for the train to set off in the reverse direction. A 5 minute 'bounce back' allowance at a terminus station is certainly achievable, but it relies on smooth and uncongested operation, with 'through' IRP services (requiring 5 minutes dwell time) segregated from terminating HS2 services (requiring circa 20 minutes dwell time).

In these circumstances, the IRP plans for a 6-platform terminus station seem grossly inadequate, when all planned Northern Powerhouse Rail services (6 trains per hour to and from Liverpool, Leeds and Sheffield, a total of 36 trains per hour counting arrivals and departures passing through the 'throat' of the station) are taken into account. HSUK projections indicate that between 10 and 14 platforms would be required for a new HS2/IRP terminus at Manchester Piccadilly.

Note also the concerns highlighted in Section 4.4.5 regarding the need for a 'walking change' between MRH services from Bristol arriving at Birmingham Moor Street, and HS2 services (Journeys **13**, **15** and **16**) departing northbound from Birmingham Curzon Street.

For further details see Sections 6.6 and 6.7 of this study.

6.1.4 Test 1C – Disparities in IRP Service Offer to Manchester & Leeds

It is the basic thesis of this study, that the improvement of connectivity, and therefore the achievement of Levelling-up etc, goes far beyond the delivery of eye-catching journey times from London to the primary cities of the UK regions. However, it is still important that major journey time improvements are achieved, and that they are applied evenly.

Historically, a regional city's journey time to London would be broadly proportional to its distance from London, and this proportionality was maintained throughout the British Rail and post-Privatisation eras as infrastructure and motive power improvements were applied evenly across the network. It is clearly important that the Integrated Rail Plan maintains this fundamental equity, and the simplest touchstone is the comparison between Leeds and Manchester, the cities at the heart of the Northern Powerhouse's two largest conurbations. Both are located approximately 340km from London, and both could reasonably expect very similar journey times to London.

Journey	Journey time (minutes)				
	Existing Network	Predecessor Scheme	Integrated Rail Plan	IRP Assessment by HSUK	HSUK Exemplar Alternative
Leeds-London	**133**	**81**	**113**	**123**	**77**
Manchester-London	**127**	**71**	**71**	**71**	**76**
Difference	**+6**	**+10**	**+42**	**+52**	**+1**

Table 6.1E : Differences between Leeds and Manchester Journey Times to London

Currently, both Leeds and Manchester enjoy journey times to London both slightly above 2 hours, with a difference of only 6 minutes in favour of Manchester, that the vast majority of travellers would consider immaterial. This broadly equitable situation would not have been greatly worsened under the previous 'Predecessor Scheme' proposals for the HS2 Y-network.

All this is changed by the Integrated Rail Plan's cancellation of HS2 Phase 2b (east) and its adoption instead of an ECML upgrade strategy. This is claimed to deliver a London-Leeds journey time of 113 minutes, a difference of 42 minutes. However, analysis shows (refer Journey **01**, Section 6.1.3) the claimed London-Leeds timing to be wildly optimistic; a more realistic journey time is 123 minutes, a difference of 52 minutes in favour of Manchester. From a London-centric perspective, this will impact hugely on Leeds' and Manchester's relative attractiveness as business destinations.

The retrenchment of HS2 from 'Y-network' to 'Telegraph Pole' format essentially strips HS2 and the wider Integrated Rail Plan of all legitimacy as a national scheme. The vast majority of the IRP's new-build interventions are now confined to the west side of the country, and this will result in a huge inequity in critical journey times to key Northern cities that would seem to greatly favour Manchester over Leeds and indeed all other major Yorkshire cities.

This is plainly not the balanced approach required to deliver the greatest possible Levelling-up for the UK regions.

By contrast, the High Speed UK Exemplar Alternative maintains the necessary equity between Leeds and Manchester, with almost identical journey times to London.

6.1.5 Test 1 – Finding

Many of the journey time and route capacity benefits predicted in the Integrated Rail Plan appear to be either unachievable or prejudicial to the development of efficient national and local networks.

While several of the predicted journey times and capacity gains set out in the Integrated Rail Plan appear to be achievable, a major proportion would appear at best to be highly optimistic, with the greatest concerns lying with the following:

- Journey **01 :** London Kings Cross – Leeds ***(journey time)***
- Journey **02 :** London Kings Cross – Newcastle ***(journey time)***
- Journey **04 :** Manchester – Leeds ***(capacity)***
- Journey **05 :** Leeds – Bradford ***(journey time/capacity)***
- Journey **07 :** Manchester – Sheffield ***(journey time)***
- Journey **10 :** London – Sheffield ***(journey time)***

Whilst the precise concern might vary, there is a common thread. All the listed journeys (except **07**) are on the corridors where the Integrated Rail Plan has cancelled high speed line construction and substituted upgrades of existing routes.

The Government has claimed that their proposed upgrading strategy will deliver results that are as good, or almost as good, as the much more expensive new-build strategy embodied in the Predecessor Scheme. There is an obvious incentive for the Government to exaggerate the benefits of their new strategy, and this suspicion is supported by the analysis set out in this study; there are clear examples where:

- IRP journey times have been unjustifiably minimised (Journeys **01**, **02**, **07** and **10**);
- existing journey times have been exaggerated (Journey **03**);
- difficulties associated with additional changes of trains have been ignored (onward connection from Bristol with walking change at Birmingham, Journeys **13**, **15** and **16**).

The Government has claimed that their proposed upgrading strategy will deliver results that are as good, or almost as good, as the much more expensive new-build strategy embodied in the Predecessor Scheme. This claim is belied by the huge differentials the Integrated Rail Plan will introduce into 'headline' journeys from London to Leeds and Manchester; it is unreasonable and unacceptable to claim a Levelled-up North when the IRP will have the effect of making Manchester almost an hour closer to London than Leeds will be.

However, whatever the case, and whatever the outcome of any comparison between the Integrated Rail Plan and its Predecessor Scheme, one fact overshadows all others – the High Speed UK Exemplar Alternative, designed to radically alternative principles, will deliver journey times significantly superior to both, on the headline routes that the Government has chosen to highlight.

However, these comprise only a small fraction of the thousands of routes that comprise the UK network. It is necessary to examine a far wider sample to make a definitive judgment, and hence the following Section 6.2 sets out a comprehensive analysis of network performance in the Midlands Engine and the Northern Powerhouse.

6.2 Testing IRP Claims for Connectivity Benefits and Levelling-up

Test 2 poses the question: ***"Will the Integrated Rail Plan deliver significant connectivity benefits to major regional cities, and thereby support the Government's Levelling-up and Net Zero agendas?"***

6.2.1 Test 2 – Assessment Rationale and Methodology

Although Test 1 has raised serious concerns as to the performance of the Integrated Rail Plan, and the accuracy of certain of its claimed journey times, it must be acknowledged that the routes examined are highly selective, mostly focussed upon primary cities, and not necessarily representative of the wider national network. It is simply not possible to accurately characterise performance across the entire national network by assessing just 16 journeys.

The performance of the Integrated Rail Plan in improving connectivity, and thereby delivering Levelling-up and step-change CO_2 reductions, can only be properly assessed by considering its performance across the entire national network. Test 2 has been designed as a detailed network-wide assessment, and its scope is set out in Figure 2E:

- 55 primary network hubs (50 towns and cities, 5 principal airports), extending from Brighton to Glasgow, Plymouth to Aberdeen and Swansea to Norwich, and including the principal population centres of the Midlands Engine and the Northern Powerhouse;
- 1485 possible journeys between these 55 hubs;
- All 3 Candidate Schemes – HS2/NPR Predecessor Scheme, Integrated Rail Plan and High Speed UK Exemplar Alternative – to be considered.

The success of any candidate scheme in bringing about Levelling-up etc depends upon the improvement in connectivity that it will deliver, and for this it is necessary to baseline the assessments against the performance of the existing network.

There is however no standardised means of assessing the performance of a railway network (which is of course the essential rationale of this study), and it is necessary to develop methodologies that properly reflect the problems that need to be addressed in improving connectivity and thereby delivering Levelling-up. An appreciation of the issues at stake can be gained from Figure 6.2A. This focusses upon 18 principal hubs of the national network, and it charts both the cities that are directly interlinked (i.e. no change of trains), and the quality and speed of these services.

It is immediately apparent that there are presently huge variances in the service levels enjoyed by different cities. Whereas London is connected by direct high quality intercity services to all other 17 cities, cities such as Stoke enjoy few direct links, mostly on services of much poorer quality, with the extreme example of the single coach train that connects Stoke and Derby. These discrepancies are both a symptom and a cause of the North-South Divide that has long afflicted the UK economy – and their resolution is imperative if Levelling-up is ever to become a reality.

Test 2 is therefore predicated upon an aspiration for:

- All principal centres to be interlinked by direct services of 'intercity' quality, operating at hourly or better frequency;
- Improved local services to connect to intercity services by interchange at 'hub' stations.

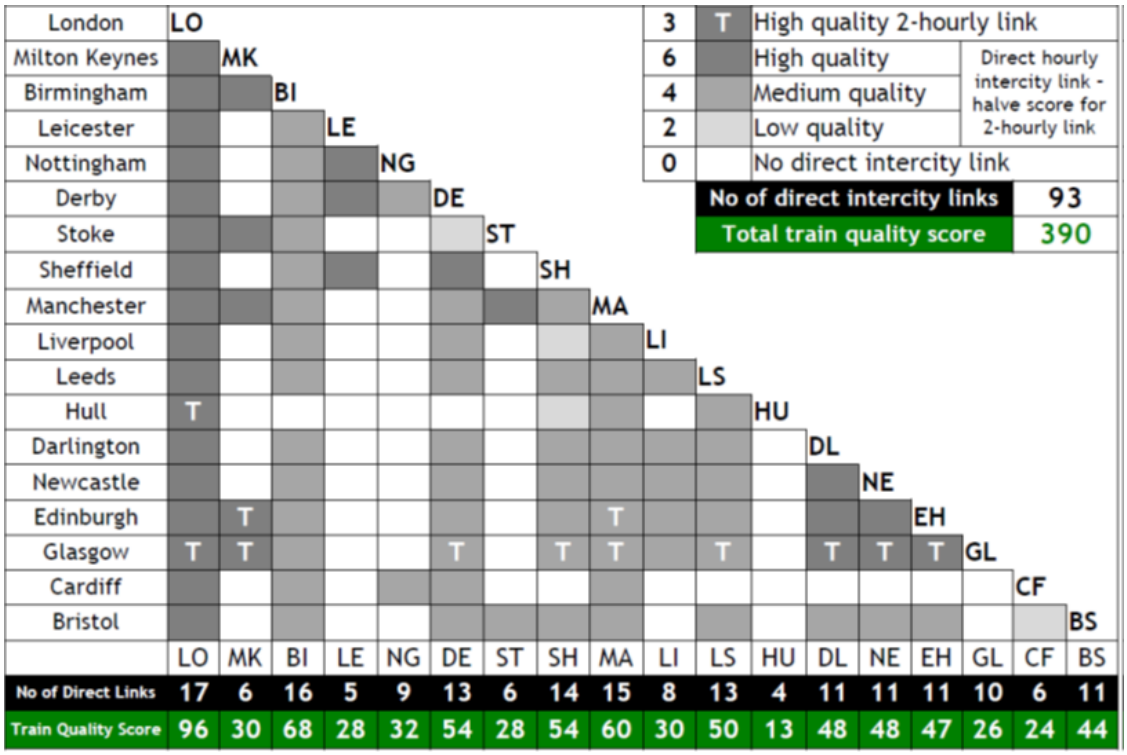


Figure 6.2A : Existing Network – Direct Connectivity between Principal UK Cities

Test 2 is designed to make a detailed assessment of the connectivity improvements that the 3 candidate schemes will achieve for each of the 10 principal communities of the Midlands Engine and 18 principal communities of the Northern Powerhouse.

As with Test 1, journey time reductions are a crucial consideration in the assessment of connectivity improvements, and this must be accomplished not merely for 16 sample 'headline' journeys, but for all 1485 journeys across a 55-centre network. A proportion of these journeys will be direct, requiring no change of trains, and (as with Test 1) timings for these can either be collated from official sources, or from data developed for the HSUK 'Demonstrator Timetable'.

However, the majority of the 1485 journeys will require one or more changes of train, and – in the absence of a real-word operational timetable – it is necessary to fabricate a virtual timetable (or 'Demonstrator Timetable', in HSUK parlance). This will enable the timings of multi-stage journeys to be calculated from the following data elements:

- 'Direct' journey times for each leg of the full journey;
- Time to change trains, usually a minimum of 5 minutes but longer in certain IRP cases where foot or shuttle transfer between nearby stations ('high speed' and 'classic') is required;
- Additional time to allow for frequency of trains on each leg of the journey – for instance, if both legs operate at hourly frequency, an average additional time of 30 minutes will be required to make the change;
- A further 20 minutes 'deterrent value' for each change of trains to reflect passengers' preference for direct journeys, and the inconvenience and uncertainty of waiting at intermediate stations.

Overall, 6 primary factors are considered in the assessment of improved connectivity for each community. Taking the 18 Northern Powerhouse communities as an example, these factors are as follows:

1. Improved direct links within Northern Powerhouse (as percentage score out of 17**);
2. Average reduction in journey time within Northern Powerhouse (as percentage);
3. Establishment of single hub station for local and intercity services[##];
4. Delivery of step-change improvements for local services[##];
5. Improved direct links outside Northern Powerhouse (as percentage score out of 37**);
6. Average reduction in journey time outside Northern Powerhouse (as percentage).

** *Given a 55-centre national network and an 18-centre Northern Powerhouse, there are 17 possible journeys to other Northern Powerhouse communities, and 37 possible journeys outside the Northern Powerhouse. Similar arithmetic applies for Midlands communities.*

[##] *Whereas Factors 1, 2, 5 and 6 are based upon quantified assessment of direct connectivity and journey time reductions, Factors 3 and 4 are more qualitative. For Factor 3, a 100% score is only awarded if local and intercity services intersect at a single hub, or if a fully integrated local metro network exists to seamlessly interconnect multiple stations; and for Factor 4, a 100% score is only awarded if the works necessary to bring high speed intercity services to a particular city also deliver step-change capacity enhancements for local services.*

The 6 factors listed above essentially reflect the ideals (B, C, D, E, G & H) listed in Section 3.1 for railway network performance within the Northern Powerhouse. Note that Ideal A (compliance with the One North/TfN specification) and Ideal F (compatibility with Transport for the North's ambition for a *"freight superhighway connecting Liverpool and the Humber")* are network-wide goals, and hence cannot be applied to any particular community. These issues are considered separately in Sections 6.3 and 6.6.6.

For ease of comparison, Factors 1 – 6 are combined into a single Connectivity Improvement Score, as follows (taking the example of HSUK performance for Leeds within Northern Powerhouse/NP):

		Factor	Qualified	Decimal
1.	Improved direct links to 17 out of 17 NP centres:	100%	100%	1.00
2.	Average journey time reduction within NP:	42%	42%	0.42
3.	All local and intercity services at existing station:	100%		
4.	Step-change capacity gains for local services:	100%	100%	1.00
5.	Improved direct links to 30 out of 37 centres outside NP:	81%	81%	0.81
6.	Average journey time reduction outside NP:	44%	44%	0.44
	Total Connectivity Improvement Score (CIS) *(vs max 3.73 score at Sheffield)*			**3.67**
	Normalised Connectivity Improvement Score = (3.67/3.73) x 10			**9.80**

Note that Factor 3 is not directly counted as a connectivity score, but is instead used to qualify the scores attributable to Factors 1, 2, 5 and 6. This makes no difference to a fully integrated station such as Leeds, where Factor 3 has been evaluated at 100%, and a scaling factor calculates at unity:

$SF_3 = (1 + 100\%)/2 = 1.00$

However, in Birmingham, the proposed HS2 station at Curzon Street can only practicably integrate with local services at the adjacent Moor Street station, from which services radiate to only one third

of local stations within the M42/M6(Toll) ring. Factor 3 has therefore been evaluated at 33%, and Factors 1, 2, 5 and 6 are in turn qualified by a further scaling factor SF_3:

$SF_3 = (1 + 33\%)/2 = 0.67$

For HS2 and the Integrated Rail Plan at Birmingham, the normalised Connectivity Improvement Score would calculate as follows:

		Factor	Qualified	Decimal
1.	Improved direct links to 3 out of 9 Midlands centres:	33%	22%	0.22
2.	Average journey time reduction within Midlands:	19%	13%	0.13
3.	Connection of local stations at adjacent Moor Street:	33%		
4.	Few capacity gains for local services:	33%	33%	0.33
5.	Improved direct links to 12 out of 45 centres outside Mids:	27%	18%	0.18
6.	Average journey time reduction outside Midlands:	18%	12%	0.12
	Total Connectivity Improvement Score (CIS) *(vs HSUK max 3.73 score at Sheffield)*			**0.97**
	Normalised Connectivity Improvement Score = (0.97/3.73) x 10			**2.60**

It is readily acknowledged that the methodology set out above is empirical, and could be refined by a) applying further weighting between the individual factors and b) applying appropriate weighting to reflect the population of the city under consideration. However, the methodology appears to be both representative, and sufficiently accurate for the purpose of like-for-like comparison between different schemes as set out in this study.

It would seem self-evident, that the candidate scheme attaining the highest Connectivity Improvement Score for a particular city will be the scheme that achieves the greatest economic benefit for that city. The same correlation should apply when scores are aggregated across a region, either the Midlands Engine or the Northern Powerhouse.

However, it is only possible to assess whether Levelling-up will happen by comparing the connectivity performance of candidate schemes for regional cities with their performance for London. Existing economic imbalances between the UK regions and London will only be redressed if the regions can enjoy a standard of transport connectivity that approaches or matches the high standard that London currently enjoys. Hence for Levelling-up to occur, greater connectivity improvements must be achieved in the UK regions than in London.

It is therefore necessary to calculate Connectivity Improvement Scores for London on a similar basis to that employed for regional cities. For HS2 and the Integrated Rail Plan in London, a normalised Connectivity Improvement Score would calculate as follows:

		Factor	Qualified	Decimal
1.	Improved direct links to 26 o/o 27 Midlands/North centres:	96%	96%	0.96
2.	Average journey time reduction to Midlands and North:	35%	35%	0.35
3.	Connection of local stations within Greater London:	100%		
4.	Local capacity gains only on WCML/MML/ECML corridors:	20%	20%	0.20
5.	Improved direct links to 10 out of 27 other UK centres:	36%	36%	0.36
6.	Average journey time reduction to other UK centres:	14%	14%	0.14
	Total Connectivity Improvement Score (CIS) *(vs max 3.73 score at Sheffield)*			**2.01**
	Normalised Connectivity Improvement Score = (0.97/3.73) x 10			**5.39**

Two significant differences in methodology should be noted:

- Although London has many terminus stations, they are all efficiently interconnected by the London Underground, an integrated urban metro system that has no rival across the UK. Factor 3 is therefore assessed at 100%, hence SF_3 also calculates at 1.00.
- Factors 1 and 2 consider improvement of links from London to 27 Midlands Engine and Northern Powerhouse towns, cities and airports.
- Factors 5 and 6 consider improvement of links from London to the other 27 UK Primary Network Hubs illustrated in Figure 2E.

6.2.2 Test 2A – Deriving Midlands Connectivity Improvement Scores

The methodologies described in Section 6.2.1 have been employed in the calculation of the Connectivity Improvement Factors and the overall Connectivity Improvement Scores set out in Table 6.2B and Figure 6.2C (re the Midlands) and in Table 6.2E and Figure 6.2F (re the North).

	High Speed UK							HS2/Integrated Rail Plan						
	Local Direct Links	Local Journey Time Reductions	Integrated City Centre Station??	Transformed Local Network??	National Direct Links	National Journey Time Reductions	Agg. Connectivity Score - HSUK	Agg. Connectivity Score - HS2/IPR	Local Direct Links	Local Journey Time Reductions	Integrated City Centre Station??	Transformed Local Network??	National Direct Links	National Journey Time Reductions
Northampton	89%	64%	100%	0%	42%	48%	6.5	0.1	0%	5%	0%	0%	0%	2%
Coventry	100%	52%	100%	0%	38%	37%	6.1	0.6	22%	20%	0%	0%	0%	3%
BHX Airport	100%	49%	100%	0%	38%	34%	5.9	0.5	0%	10%	50%	0%	9%	6%
Birmingham	100%	36%	67%	100%	71%	31%	8.0	2.6	33%	19%	33%	33%	27%	18%
Walsall	89%	71%	100%	100%	31%	43%	8.9	0.0	0%	0%	0%	0%	0%	0%
Wolverhampton	100%	63%	100%	100%	60%	30%	9.5	0.0	0%	0%	0%	0%	0%	3%
Stoke	85%	49%	100%	100%	52%	38%	8.7	0.4	0%	7%	100%	0%	4%	5%
Derby	100%	53%	100%	0%	64%	39%	6.9	1.0	22%	7%	100%	0%	4%	5%
Nottingham	100%	60%	100%	0%	69%	47%	7.4	2.4	44%	33%	100%	0%	2%	9%
Leicester	100%	65%	100%	0%	69%	52%	7.6	0.7	33%	16%	0%	0%	0%	5%
Average	96%	56%	97%	40%	53%	40%	7.5	0.8	16%	12%	38%	3%	5%	6%
London	96%	35%	100%	20%	36%	14%	5.4	3.0	56%	23%	100%	20%	11%	2%

Table 6.2B : Midlands Connectivity Score Elements for HSUK and Integrated Rail Plan

Figure 6.2B above shows Connectivity Improvement Scores for 10 principal communities of the Midlands, and the same data is presented in bar chart form in Figure 6.2C on the following page. Blue shows the connectivity offered by the Integrated Rail Plan, red shows the HS2/MRH Predecessor Scheme and green shows the High Speed UK Exemplar Alternative.

It is plain that HSUK offers a level of connectivity improvement that is an order of magnitude greater than that offered by either the Integrated Rail Plan, or its Predecessor Scheme. Its poorest performance (5.9 at Birmingham International) is more than twice that of the best Integrated Rail Plan performance (2.6 at Birmingham), and its average performance (7.5) is over 9 times that of the IRP. The same huge disparities apply when HSUK is compared with the Predecessor Scheme.

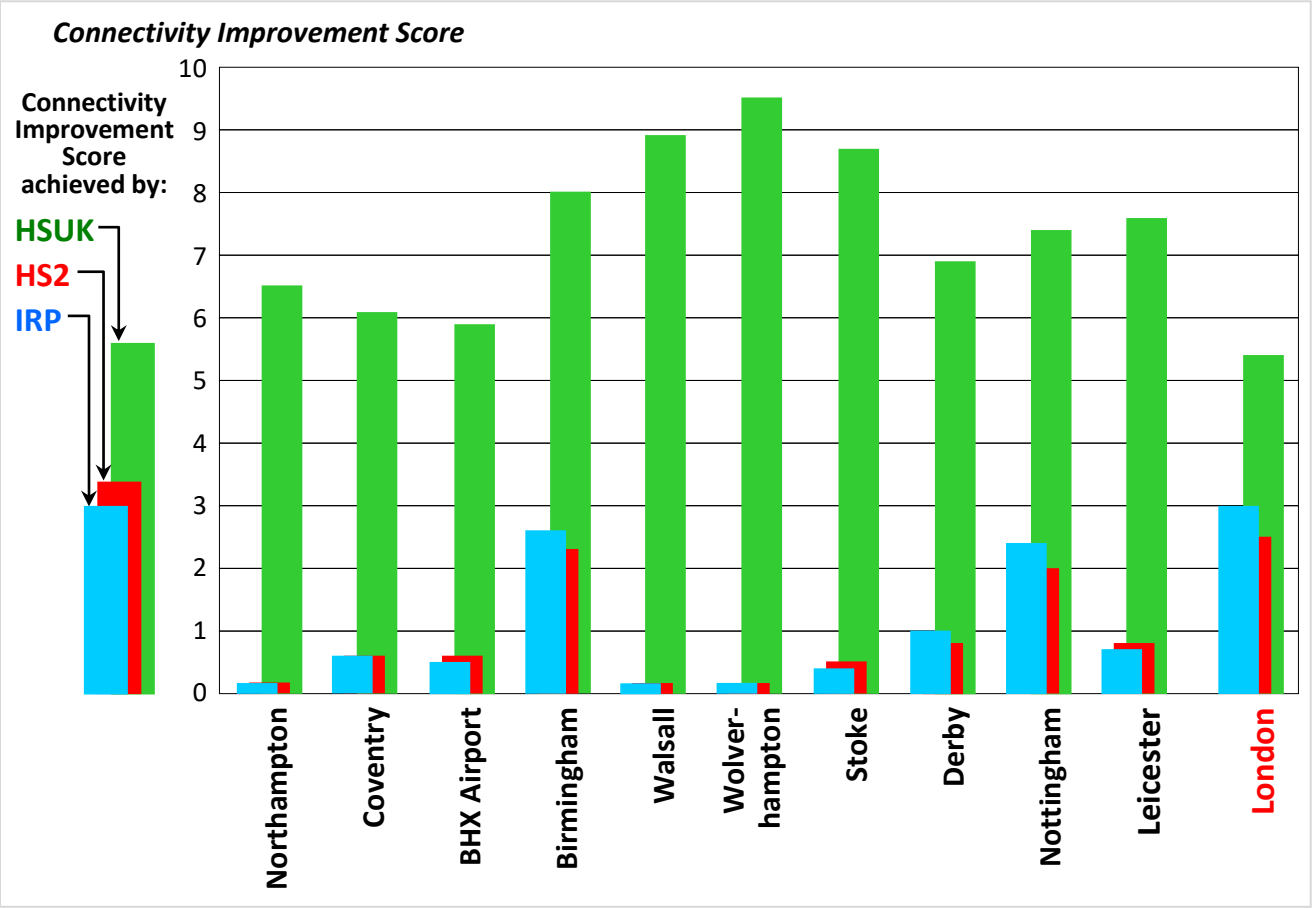


Figure 6.2C : Connectivity Improvement Scores for Major Midlands Communities

Candidate Scheme	Connectivity Improvement Score (CIS)			Average Journey Time Reduction (%)
	Maximum	Minimum	Average	
Predecessor Scheme	**2.3 (BI)**	**0.0 (WV)**	**0.8**	**8%**
Integrated Rail Plan	**2.6 (BI)**	**0.0 (WV)**	**0.8**	**7%**
High Speed UK	**9.5 (WV)**	**5.9 (BHX)**	**7.5**	**45%**

Table 6.2D : Midlands Connectivity Improvement Score Key Data

Figures 6.2B and 6.2C also show Connectivity Improvement Scores for London. These have been included to allow the Levelling-up potential of the 3 candidate schemes to be assessed.

The data shows a stark contrast between the performance of the official schemes (i.e. Integrated Rail Plan and its Predecessor Scheme), and the performance of the HSUK Exemplar Alternative. Whereas the IRP achieves a better Connectivity Improvement Score for London (3.0) than for any Midlands city, HSUK's score for London (5.4) is significantly below any score that it achieves for Midlands cities. These facts illustrate 3 inescapable conclusions:

- The IRP's greatest connectivity gains are in London, and this can only exacerbate existing imbalances and reinforce the North-South Divide.
- By contrast, HSUK's greater regional connectivity indicates clear potential to Level-up.
- The huge margin between HSUK's worst performance (in London) and the IRP's best performance (also in London) plainly demonstrates HSUK's vast overall superiority.

6.2.3 Test 2B – Deriving Northern Connectivity Improvement Scores

	High Speed UK							HS2/Integrated Rail Plan						
	Local Direct Links	Local Journey Time Reductions	Integrated City Centre Station??	Transformed Local Network??	National Direct Links	National Journey Time Reductions	Agg. Connectivity Score - HSUK	Agg. Connectivity Score - HS2/IRP	Local Direct Links	Local Journey Time Reductions	Integrated City Centre Station??	Transformed Local Network??	National Direct Links	National Journey Time Reductions
Stoke	85%	49%	100%	100%	52%	38%	8.7	0.4	0%	7%	100%	0%	4%	5%
Crewe	88%	34%	100%	0%	41%	25%	5.0	2.1	35%	28%	100%	0%	5%	10%
Chester	65%	46%	100%	0%	8%	25%	3.9	0.1	0%	9%	0%	0%	0%	2%
Stockport	94%	49%	100%	100%	54%	31%	8.8	0.9	18%	13%	100%	0%	0%	2%
MAN Airport	100%	55%	100%	100%	16%	27%	8.0	1.7	59%	11%	50%	0%	3%	11%
Manchester	100%	39%	100%	100%	78%	38%	9.5	2.9	71%	20%	100%	0%	5%	11%
Warrington	94%	51%	71%	50%	41%	27%	6.2	1.9	47%	29%	71%	0%	3%	4%
Preston	82%	36%	100%	0%	30%	23%	4.6	0.7	0%	4%	100%	0%	5%	16%
Liverpool	88%	46%	100%	100%	70%	38%	9.2	1.8	47%	12%	100%	0%	3%	4%
Doncaster	59%	28%	100%	50%	35%	33%	5.5	1.7	41%	11%	100%	0%	8%	2%
Sheffield	100%	48%	100%	100%	78%	47%	10.	1.0	18%	7%	100%	0%	8%	4%
Huddersfield	71%	25%	100%	50%	5%	34%	5.0	1.2	53%	26%	0%	0%	3%	11%
Bradford	71%	46%	100%	100%	30%	46%	7.8	0.5	6%	15%	40%	0%	0%	5%
Leeds	100%	42%	100%	100%	81%	44%	9.8	2.6	65%	21%	100%	0%	8%	4%
Hull	88%	44%	100%	0%	16%	36%	4.9	0.6	29%	16%	0%	0%	0%	1%
York	100%	40%	100%	0%	78%	38%	6.9	2.3	53%	18%	100%	0%	11%	3%
Darlington	100%	39%	100%	50%	81%	39%	8.3	2.4	53%	23%	100%	0%	11%	3%
Newcastle	100%	40%	100%	50%	81%	40%	8.3	2.3	53%	19%	100%	0%	11%	2%
Average	**88%**	**42%**	**98%**	**58%**	**49%**	**35%**	**7.2**	**1.5**	**36%**	**16%**	**76%**	**0%**	**5%**	**6%**
London	96%	35%	100%	20%	36%	14%	5.4	3.0	56%	23%	100%	20%	11%	2%

Table 6.2E : Northern Connectivity Score Elements for HSUK and Integrated Rail Plan

As with the Midlands connectivity analysis set out in the previous pages, the data tabulated above is displayed in bar chart form in Figure 6.2F on the following page. This shows Connectivity Improvement Scores for 18 principal communities of the Northern Powerhouse, with blue showing the connectivity offered by the Integrated Rail Plan, red showing the HS2/NPR Predecessor Scheme and green showing the High Speed UK Exemplar Alternative.

Again, HSUK offers a level of connectivity improvement hugely greater than that offered by either the Integrated Rail Plan, or its Predecessor Scheme. Its poorest performance (3.9 at Chester) significantly exceeds that of the IRP's best performance (3.0 at Manchester); and it must be remembered that the Government has placed Manchester at the heart of its high speed rail plans.

By contrast, HSUK offers close to its best performance at Manchester, with a score of 9.5, while the Integrated Rail Plan's worst performance is at Chester, with a score of 0.1. Overall, HSUK's average performance (7.2) is nearly 5 times that of the Integrated Rail Plan (1.5).

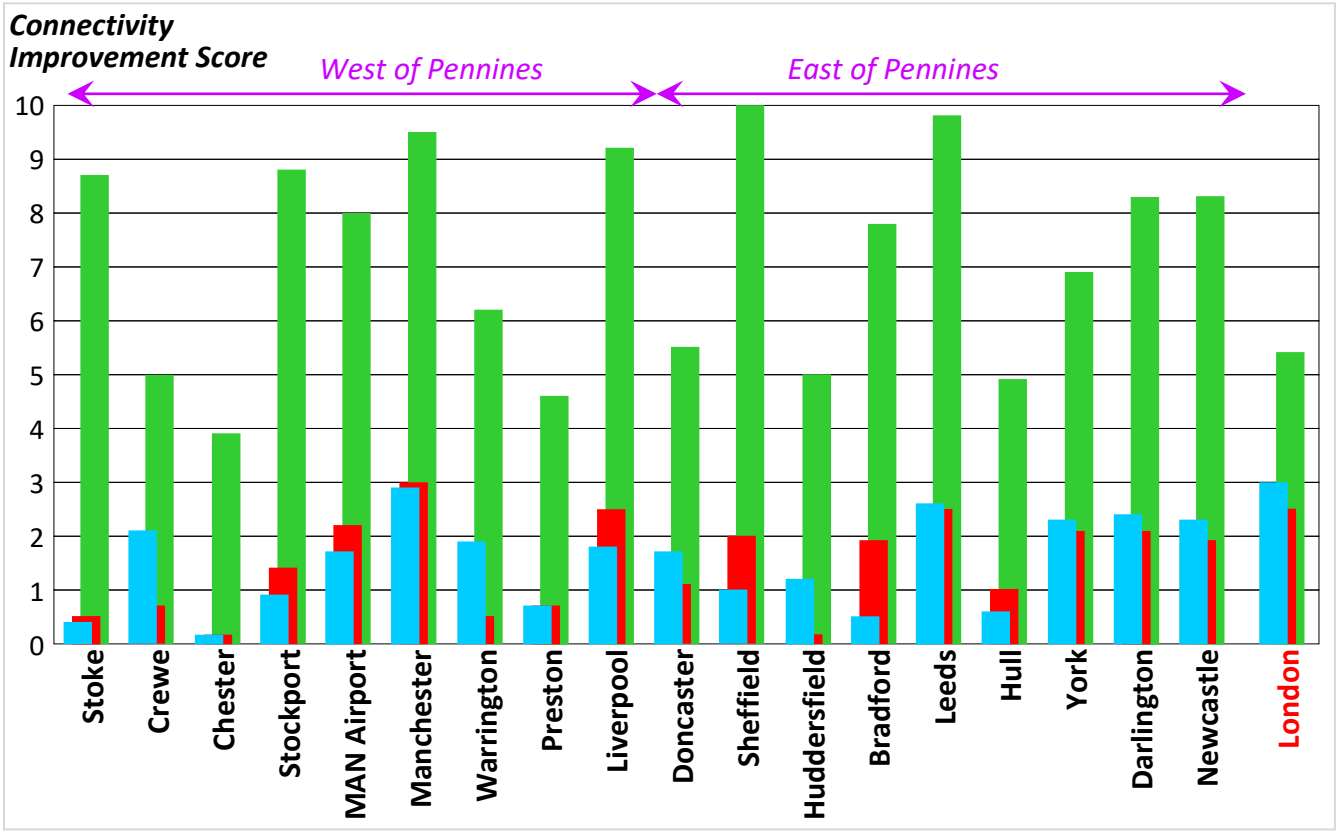


Figure 6.2F : Connectivity Improvement Scores for Major Northern Communities

Candidate Scheme	Connectivity Improvement Score (CIS)			Average Journey Time Reduction (%)
	Maximum	Minimum	Average	
Predecessor Scheme	**3.0 (MA)**	**0.1 (HD)**	**1.5**	**12%**
Integrated Rail Plan	**2.9 (MA)**	**0.1 (CH)**	**1.5**	**9%**
High Speed UK	**10.0 (SH)**	**3.9 (CH)**	**7.2**	**38%**

Table 6.2G : Northern Powerhouse Connectivity Improvement Score Key Data

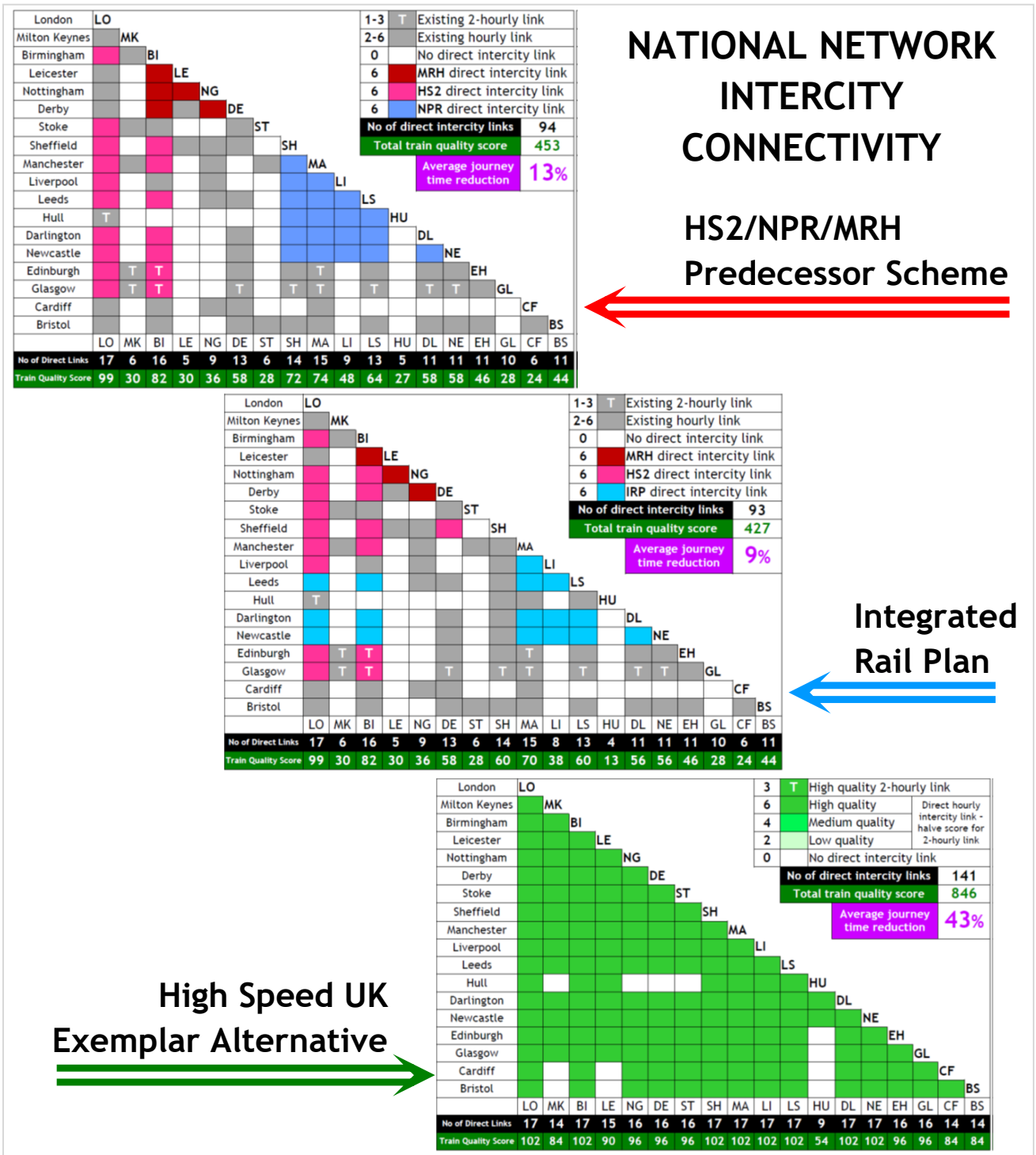
Figure 6.2F and Table 6.2G show clearly that HSUK enjoys the same massive superiority over the Predecessor Scheme as it does over the Integrated Rail Plan. And as with the Midlands, HSUK will achieve connectivity gains across the Northern Powerhouse that are significantly greater than for London; this again indicates major Levelling-up potential. By contrast the greatest IRP gains are in London, and that can only have the effect of reinforcing the North-South Divide.

6.2.4 Test 2C – Consideration of National Intercity Connectivity

It is recognised that there may be a degree of scepticism at the huge 'order of magnitude' differences in network performance between HSUK and the Integrated Rail Plan by (i.e. 5 times greater in the North, 9 times greater in the Midlands) demonstrated in the foregoing quantified assessments. But very similar discrepancies can be seen when a simpler assessment is made of the ability of the 3 candidate schemes to improve links between the UK's principal cities.

Figure 6.2H charts the improved direct links that each scheme will offer between 18 principal UK cities (the same 18 cities as considered in Figure 6.2A). For each city, the number of direct links and

a score for the overall service quality are recorded. The comparisons set out in the table again demonstrate HSUK's massive superiority, and fully corroborate the findings of this study.



Candidate Scheme	No. of Direct Connections	Gain	Total Service Quality Score	Gain	Average Journey Time Reduction
Predecessor Scheme	**94**	**1%**	**906**	**16%**	**13%**
Integrated Rail Plan	**93**	**0%**	**854**	**9%**	**9%**
High Speed UK	**141**	**52%**	**1692**	**117%**	**43%**
(Existing Network)	**(93)**	**----**	**(780)**	**----**	**----**

Figure 6.2H : National Network Intercity Connectivity for 3 Candidate Schemes

6.2.5 Test 2D – Nationwide Assessment of Levelling-up Potential

The connectivity data set out in Figure 6.2H describe the overall connectivity and journey time benefits that each candidate scheme might achieve across an 18-centre national rail network. This does not specifically indicate a potential to Level-up the UK economy; to determine this issue, it is necessary to compare the connectivity benefits that will be achieved for London, with the average benefits that will be achieved for the other 17 regional cities. Levelling-up will happen if a scheme achieves significantly greater benefits for the regional cities, than it does for London.

This issue is examined in Tables 6.2I, 6.2J and 6.2K below, in respect of intercity connectivity, service quality, and journey time reductions, to identify the least London-centric candidate scheme.

Candidate Scheme	Existing Network	Predecessor Scheme	Integrated Rail Plan	High Speed UK
No. of direct links to London	17	17	17	17
Average direct links across network	9.9	10.1	9.9	15.6
Difference	7.1	6.9	7.1	1.4
Least London-centric?	----	----	----	HSUK

Figure 6.2I : Assessment of London-centricity in Direct Intercity Connectivity

Candidate Scheme	Existing Network	Predecessor Scheme	Integrated Rail Plan	High Speed UK
Quality score of links to London	96	99	99	102
Average score across network	40.2	47.5	44.4	93.5
Difference	55.8	51.5	54.6	8.5
Least London-centric?	----	----	----	HSUK

Figure 6.2J : Assessment of London-centricity in Intercity Service Quality Score

Candidate Scheme	Predecessor Scheme	Integrated Rail Plan	High Speed UK
Average JTR on journeys to London	20%	22%	33%
Average JTR across network	13%	9%	43%
Difference	7%	13%	-10%
Least London-centric?	----	----	HSUK

Table 6.2K : Assessment of London-centricity in Intercity Journey Time Reductions

The above tables demonstrate that the Predecessor Scheme and the Integrated Rail Plan will fail to significantly redress the London-centricity of the existing network, and will concentrate their journey time benefits upon London. Whereas HSUK will almost eliminate the network's London-centricity, and will deliver its greatest journey time reductions in the UK regions. This again indicates that only HSUK can bring about major Levelling-up of the UK economy.

6.2.6 Test 2E – HSUK Performance without M1 Corridor Module 5

As noted in Section 5.4, it is likely that ongoing construction of Phase 1 of HS2 from London to the West Midlands will, at least in the short term, compromise the case for building the southern section of High Speed UK following the M1 Corridor (Module 5, as depicted in Figure 5D). This would mean that any building of more northerly sections of HSUK would be forced to conform with the already constructed Phase 1 of HS2 from London to the West Midlands. This would have the effect of increasing HSUK journey times between London and Northern cities by approximately 15-20 minutes – but the vast majority of journeys between regional cities would be unaffected.

This will inevitably have an impact on the Connectivity Improvement Scores that might be attributed to High Speed UK. An approximate quantification of this impact can be made by reviewing the Connectivity Improvement Score calculation for Leeds, as set out in Section 6.2.1.

		Factor	Qualified	Decimal	
1.	Improved direct links to 17/17 NP centres:	100%	100%	1.00	***unchanged***
2.	Average journey time reduction within NP:	42%	42%	0.42	***unchanged***
3.	All local and intercity services at existing station:	100%			
4.	Step-change capacity gains for local services:	100%	100%	1.00	***unchanged***
5.	Improved direct links to 30/37 centres outside NP:	81%	81%	0.81	***unchanged***
6.	Average journey time reduction outside NP:	33%	33%	0.33	***revised***
	Revised Connectivity Improvement Score (CIS)			**3.56**	

Even with HSUK forced either to conform with Phase 1 of HS2 (**#1** as per Figure 5D), or to transfer to Midland or West Coast main lines (**#2** or **#3**) for the onward journey to London and the South-East, most elements (1-5) of the Connectivity Improvement Score will remain unchanged. Only element 6 – HSUK's performance in reducing journey times to destinations outside the Northern Powerhouse – will be compromised by longer journey times to London, and to other South-East destinations (i.e. Luton, Heathrow Airport, Gatwick Airport and Brighton).

But even if this is conservatively estimated to decrease HSUK's performance in reducing journey times by a quarter, it will still have a very small impact on HSUK's overall performance. The calculations above show HSUK's Connectivity Improvement Score for Leeds reducing from 3.67 to 3.56. This contrasts starkly with the Integrated Rail Plan's Connectivity Improvement Score of 0.98 for Leeds.

Similar negligible changes can be anticipated for other Northern and Midlands cities, and HSUK's comprehensively superior performance will be maintained across the UK network.

6.2.7 Test 2F – IRP Performance without HS2 Golborne Link to WCML

A similar assessment to that outlined in Section 6.2.6 above would show that the Government's cancellation (on 7th June 2022) of the HS2 'Golborne Link' to the West Coast Main Line will have an even more marginal impact on the already inadequate network performance of the Integrated Rail Plan. Its most important adverse effect would be to preclude any possibility of a direct northward high speed connection from Manchester and Manchester Airport towards Preston and Scotland; however, since no such service is currently proposed (note commentary In Section 6.7.8), this will have no effect upon the quantified connectivity assessments so far undertaken.

With HS2 services now projected to join the West Coast Main Line at Crewe, and continue northwards through Warrington Bank Quay, all HS2 timings to Preston, Edinburgh and Glasgow (and other West Coast Main Line destinations) are likely to increase by 8 minutes. This will further impact upon HS2's environmental performance – with London-Edinburgh/Glasgow journey times now approaching 4 hours, there will be little chance of attracting passengers from the domestic flights that currently dominate the London-Scotland route. This can only further reduce the Integrated Rail Plan's already minimal chances of achieving the step-change reduction in transport CO_2 emissions necessary to deliver the Government's Net Zero aspirations.

6.2.8 Test 2 – Finding

The Integrated Rail Plan's connectivity benefits are small, and for all major communities they are dwarfed by those of the High Speed UK Exemplar Alternative. Hence it is certain that the IRP cannot deliver either Levelling-up or Net Zero.

This study for the first time presents the data necessary to quantify the connectivity benefits of both the Integrated Rail Plan and its Predecessor Scheme, and to compare them with an Exemplar Alternative developed to radically different principles of integration and optimised network performance.

These comparisons show that the performance of the Integrated Rail Plan across the national network is marginally superior to that of the Predecessor Scheme, and this might be taken to provide some justification for the Government's decision to cancel the greater part of both HS2 Phase 2b (west) and Northern Powerhouse Rail.

However, more importantly, these comparisons demonstrate a huge differential in performance between the official schemes (past and present) and the High Speed UK Exemplar Alternative. HSUK will deliver nearly 5 times the connectivity benefits in the Northern Powerhouse region, and over 9 times the benefits in the Midlands Engine. Quantified review indicates that these differentials would only change marginally if HSUK were compelled to conform with southern sections of HS2 (see Figure 5D), rather than construct the planned route following the M1 Corridor. The recently-announced (7th June 2022) cancellation of HS2's Golborne Link will have an even smaller effect upon this study's quantified connectivity assessments.

Given HSUK's significantly superior performance in the UK regions, and given also the direct linkage between improved connectivity and both economic Levelling-up, and environmental progression towards Net Zero CO_2 emissions, it is clear that HSUK's Levelling-up and Net Zero performances will also be an order of magnitude superior to that of either the Integrated Rail Plan or its Predecessor Scheme (which appear to offer approximately equal performance).

This raises the very obvious question, of why the official proposals perform so poorly as an optimised national or regional railway network. There appears to be a very simple answer – both the Integrated Rail Plan and its Predecessor Scheme are predicated upon the established HS2 proposals which were developed with no concept of either network or optimisation. It should hardly be surprising that a scheme such as HSUK, developed from the outset as an integrated and optimised network, will perform far better.

6.3 Testing IRP Compliance with Northern Powerhouse Specification

Test 3 poses the question: ***"Will the Integrated Rail Plan meet the long-standing journey time targets for the Northern Powerhouse, and provide the necessary step-change in capacity on transpennine routes?"***

6.3.1 Test 3 – Assessment Rationale and Methodology

As described in Section 2.6 and depicted in Figures 2C and 2D, the Northern Powerhouse targets for enhanced journey times and service frequencies were originally established in the 2014 'One North' initiative, and adopted in 2015/16 by Transport for the North as the core specification for its own Northern Powerhouse Rail scheme.

The specification has been developed only to cover the journeys between 'adjacent' primary cities e.g. Liverpool to Manchester, Manchester to Leeds; longer-distance journeys e.g. Liverpool to Leeds journey are presumed to pass through the intermediate city i.e. Manchester. For the purposes of this study, the specification has been slightly modified (see Figure 6.3A) to include a direct journey from Leeds to Manchester Airport, and thus complement the specified airport journeys from Liverpool and Sheffield. A 40 minute journey time (=30 min Leeds-Manchester + 10 min Manchester-Manchester Airport) and a 2 train per hour service (as per airport journeys from Liverpool and Sheffield) have been specified for this journey.

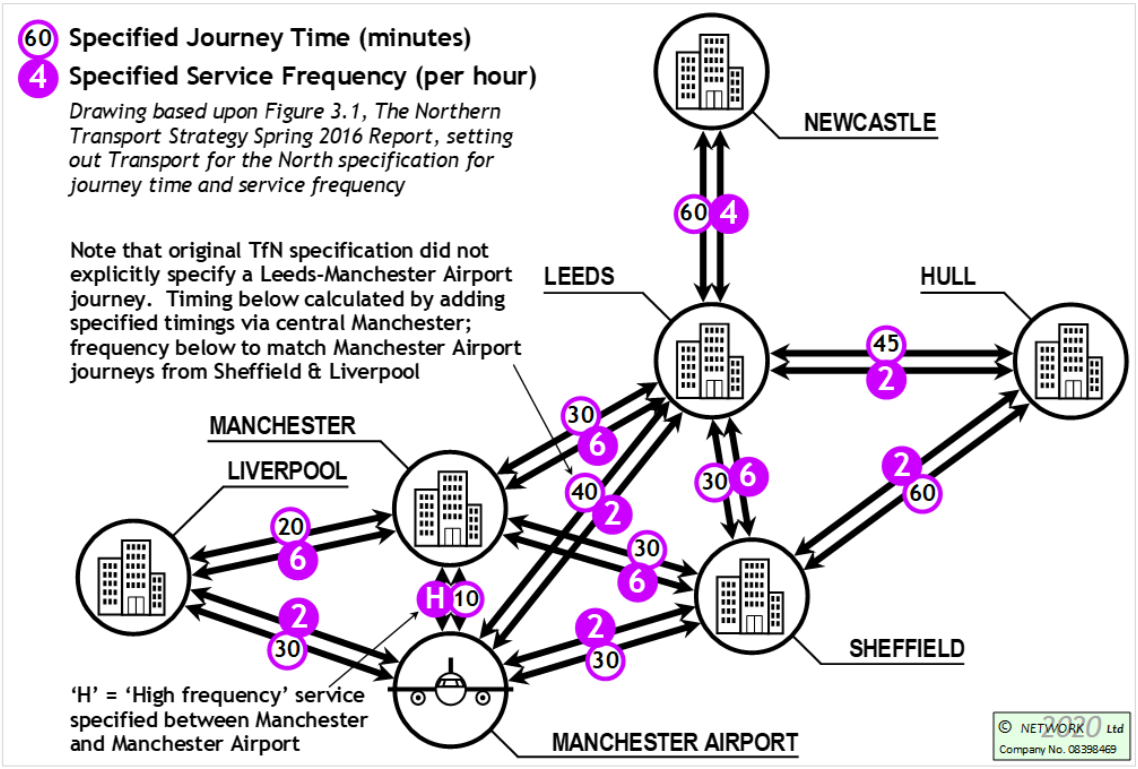


Figure 6.3A : Northern Powerhouse Journey Time & Service Frequency Specification

The inclusion of a Leeds-Manchester Airport journey into the Northern Powerhouse (NP) specification essentially comprises only minor editing/rebalancing of the official requirements, and it should be relatively uncontroversial. A more fundamental issue that must be addressed is the omission of Bradford from the Northern Powerhouse specification.

As a city, Bradford has a population of around 300,000, and it is the largest population centre that was not covered in the official specification. Moreover, given the location of the city within the Manchester/Sheffield/Leeds 'Transpennine Triangle' at the heart of the Northern Powerhouse, there is a major risk that a railway solution will be developed that either fails to properly connect Bradford, or bypasses it completely.

Accordingly the specification set out in Figure 6.3A has been developed to include Bradford, as shown in Figure 6.3B. Timings of 30 minutes have been stipulated for journeys to Manchester and Sheffield to match other specified journey times within the Transpennine Triangle, while the lesser timing of 15 minutes from Bradford to Leeds reflects the much shorter distance between these two cities.

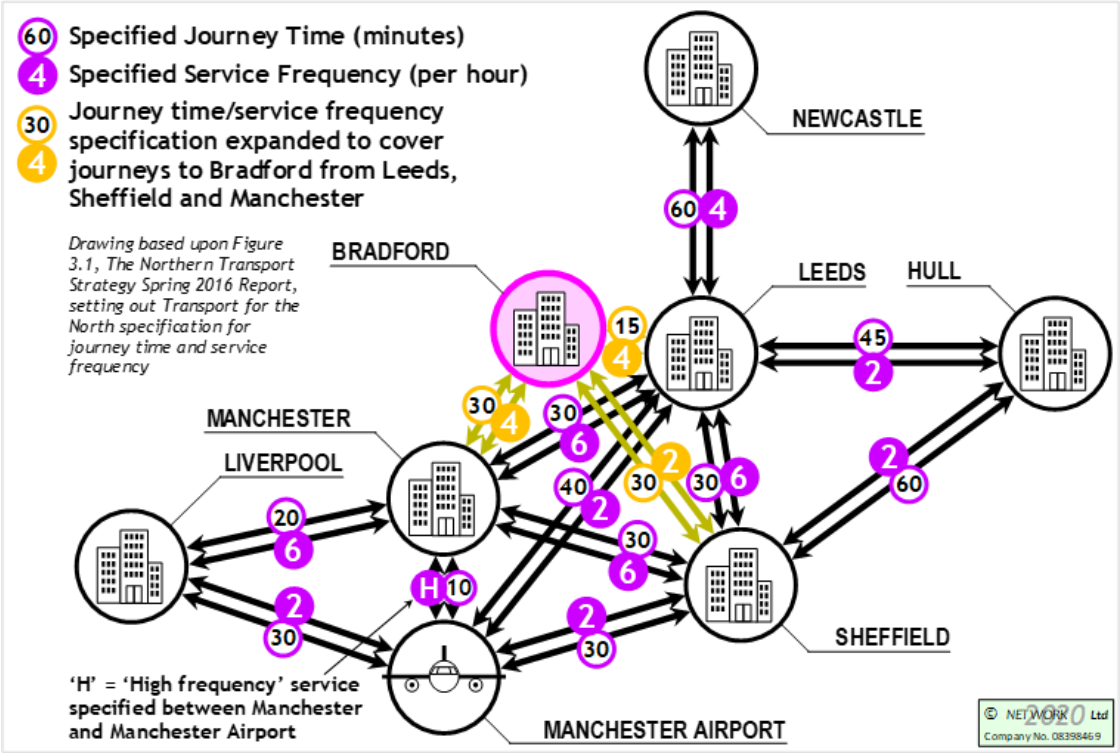


Figure 6.3B : Northern Powerhouse Specification developed to include Bradford

As with Tests 1 and 2, the respective journey times for the 3 candidate schemes – the Integrated Rail Plan, the Predecessor Scheme and the High Speed UK Exemplar Alternative – have been taken from publicly available official sources, or from data developed for the HSUK 'Demonstrator Timetable'. These journey times and associated service frequencies are set out in Figures 6.3C, 6.3E and 6.3G in Sections 6.3.2 – 6.3.4 on the following pages. These diagrams also document the success of the 3 candidate schemes in meeting the One North/TfN specification for both journey time and service frequency. A black arrow indicates a journey meeting or beating the specification; a red arrow indicates a failure against the specification.

It is also necessary to assess whether the IRP will deliver new rail capacity to address likely levels of suppressed demand for transpennine travel. As described in Section 2.5, data for road vehicle traffic flow between the major conurbations of the North indicates a massive suppressed demand which is plainly restricting economic development of the Northern Powerhouse, and therefore working contrary to the Government's Levelling-up agenda.

This suppressed demand for transpennine traffic flows can only practicably be released by the provision of new east-west railways linking Greater Manchester to South and West Yorkshire. Test 3 therefore attempts also to determine whether the Integrated Rail Plan's proposals for improved Transpennine links comprise interventions of sufficient scale and capacity to eliminate (or substantially alleviate) the barriers that the Pennine hills currently present to communications across the Northern Powerhouse.

These issues are addressed in Section 6.3.5.

6.3.2 Test 3A – Testing Predecessor Scheme against NP Specification

The east-west Northern Powerhouse Rail (NPR) proposals developed over the period 2015-2020 by Transport for the North (TfN) in conjunction with the north-south HS2 Phase 2b proposals comprise the 'Predecessor Scheme' in the North of England. These proposals, including a new Manchester Leeds high speed line via Bradford, are shown in blue on Figure 4A.

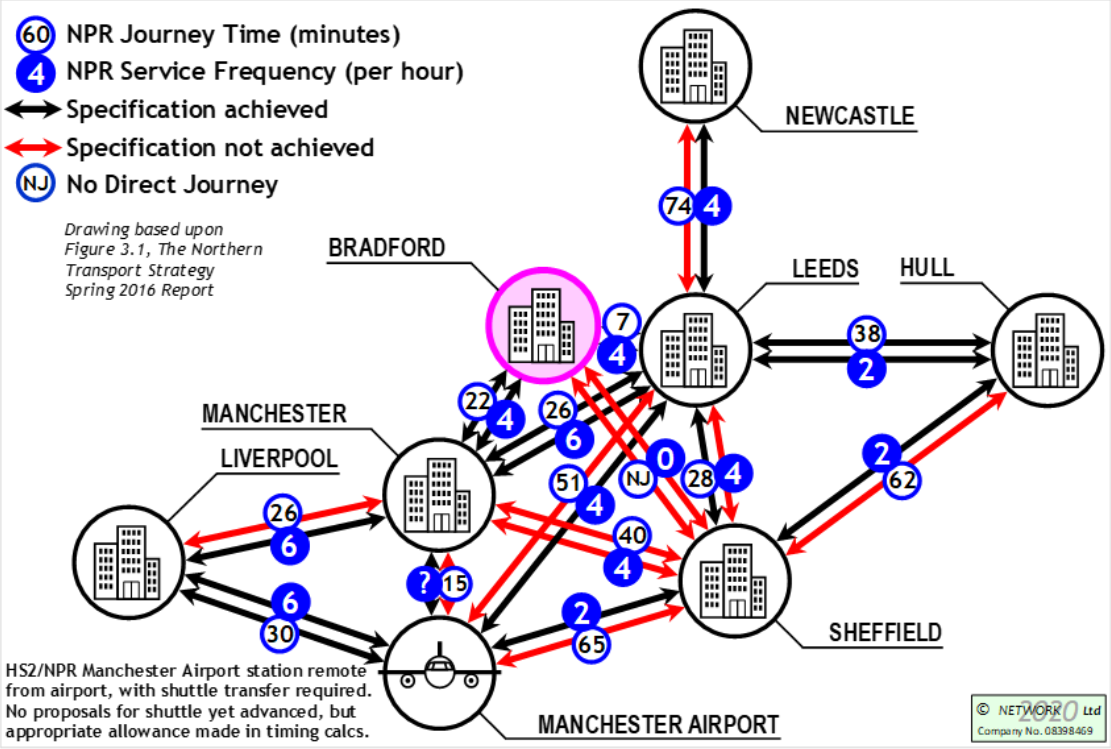


Figure 6.3C : HS2/NPR Predecessor Scheme – Performance against NP Specification

Figure 6.3C shows the performance of the HS2/NPR Predecessor Scheme. Key points are as follows:

- The proposed NPR new-build route from Manchester via Bradford to Leeds (see Figure 4A) would easily meet the specification for both journey time and service frequency.
- Journeys from Manchester and Leeds to Bradford would also meet the specification, but only if an acceptable city centre station can be established in Bradford.
- With no direct Bradford-Sheffield route proposed, this specification cannot be met.
- With only upgrading of the Hope Valley route proposed, and the proposed new NPR route via Bradford located too far to the north, it is not possible to deliver either the journey times or service frequencies specified between Manchester and Sheffield.

- The proposed NPR Leeds-Sheffield routeing via HS2 and the upgraded 'Northern Loop' via Thurnscoe should meet the 30 minute journey time specification, but the upgraded 2-track existing route could not accommodate both the specified 6 express services per hour and a much-required improvement in local services.
- The circuitous Manchester-Liverpool route via Manchester Airport cannot meet the journey time specification for this route.
- The HS2 'Manchester Airport' station will be remote from the airport, and will require a shuttle transfer to the airport terminals. When the extra time of this transfer is taken into account, it will not be possible to deliver the specified 10 minute journey time from central Manchester to the heart of Manchester Airport.
- Without any proposal for a new-build Darlington-Newcastle high speed line (as was indicated in the original 'One North' proposition, see Figure 2C), the specified Leeds-Newcastle journey time cannot be met.

6.3.3 Test 3A – Testing Integrated Rail Plan against NP Specification

The publication of the Integrated Rail Plan in November 2021 has inflicted major reductions in the scope of official railway schemes in the Northern Powerhouse Region. As shown in Figure 4B, the proposed new high speed line linking Manchester-Bradford-Leeds has been deleted in favour of an upgraded Tranpennine Main Line via Huddersfield, and all of HS2 Phase 2b (east) within Yorkshire has been cancelled.

Figure 6.3D below shows current Integrated Rail Plan proposals in the Northern Powerhouse region.

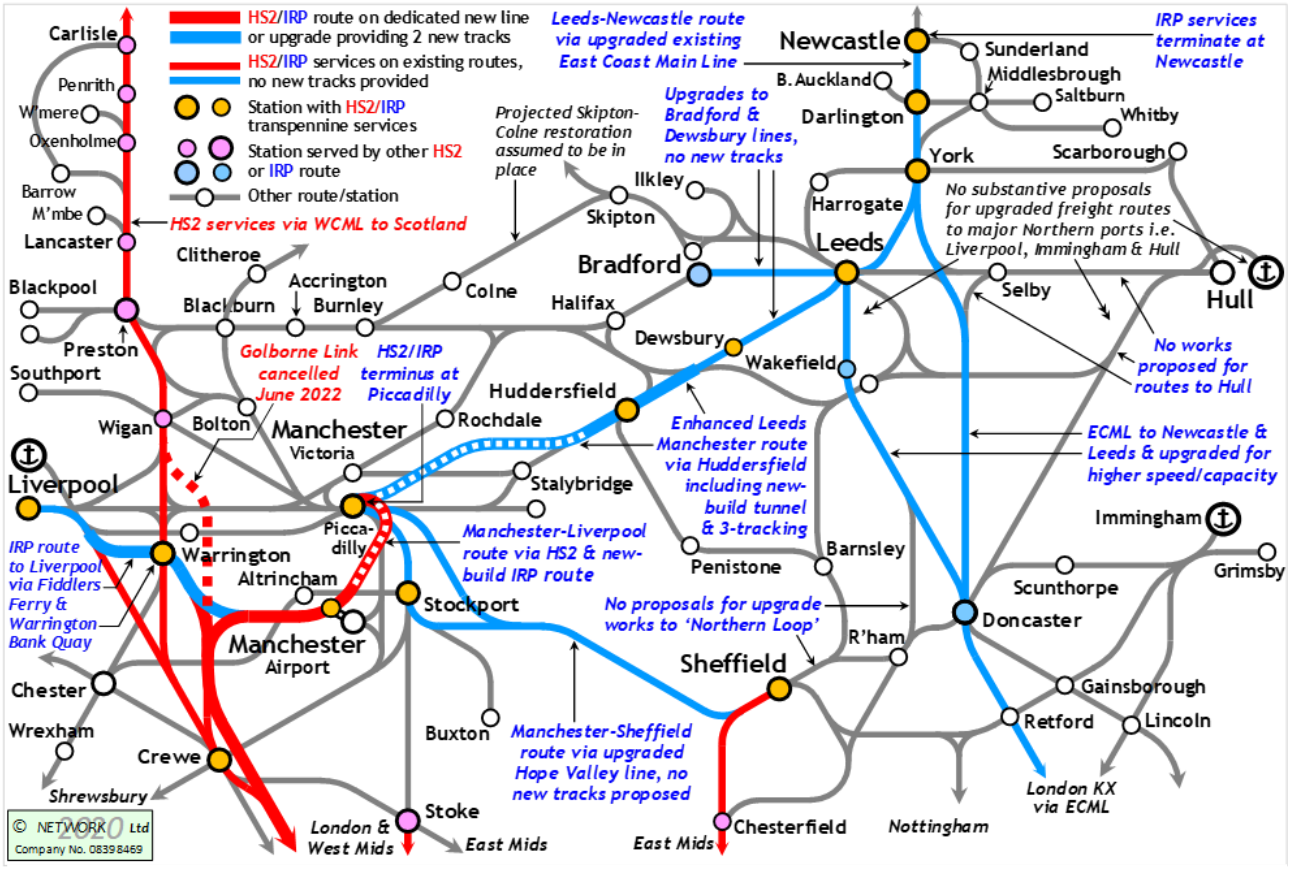


Figure 6.3D : Integrated Rail Plan Proposals within Northern Powerhouse

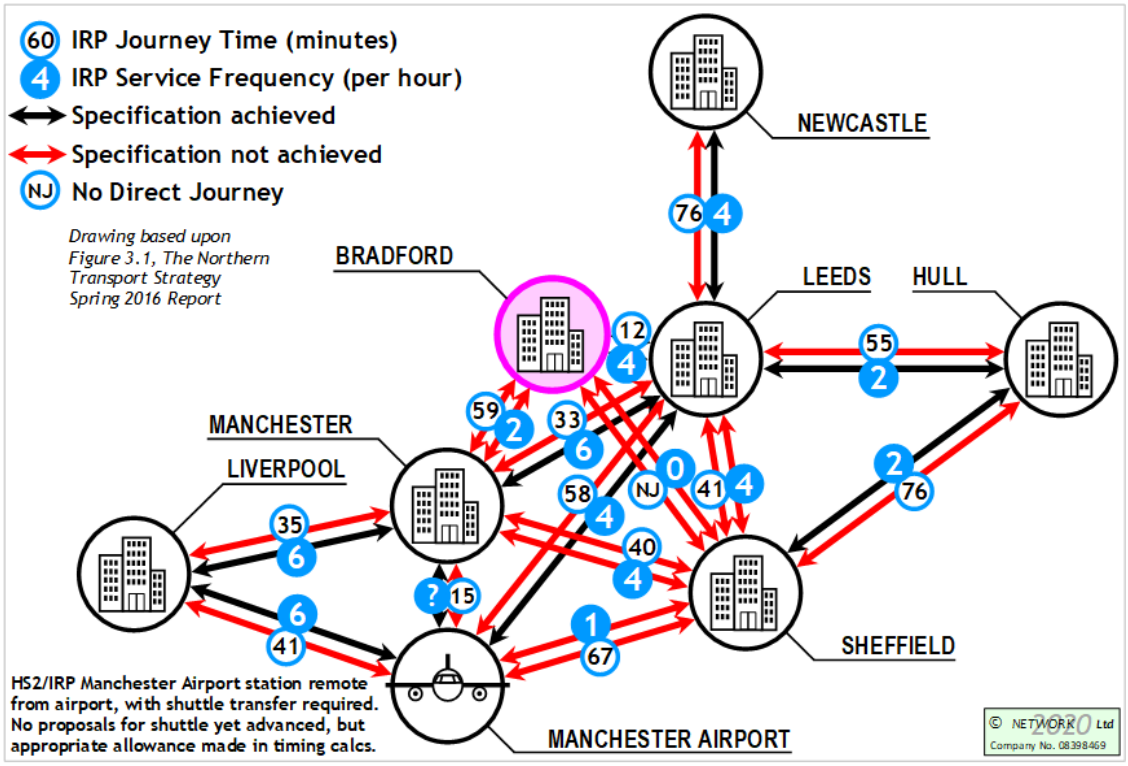


Figure 6.3E : Integrated Rail Plan – Performance against NP Specification

The Integrated Rail Plan's cuts to official proposals for railway development in the Northern Powerhouse will inevitably have a major adverse impact upon its performance, and this is confirmed in Figure 6.3E. Key points are as follows:

- The revised Manchester to Leeds route via Huddersfield and the existing 2-track TPML route through Dewsbury fails the specification for both timing and frequency.
- Aside from the claimed 12 minute journey time from Leeds, the IRP fails on all aspects of the specification for routes to Bradford.
- The IRP fails to offer any new proposal for a Manchester-Sheffield route.
- The cancellation of HS2 Phase 2b (east) leaves the IRP's Leeds-Sheffield route failing on both journey time and service frequency.
- The circuitous Manchester-Liverpool route via Manchester Airport will be made even slower by the proposed routeing via Warrington Bank Quay (Low Level).
- The IRP offers no new proposals for any shuttle link to Manchester Airport.
- The IRP fails to offer any new proposal for major acceleration of the Leeds-Newcastle route, hence this will continue to fail for both journey time and service frequency.
- The IRP also cancels the projected NPR upgrade of the Leeds-Hull route, therefore this route will also fail the journey time specification.

Overall, as set out in Table 6.3H, the Integrated Rail Plan now fails every aspect of the Northern Powerhouse specification for improved journey times.

The inadequacies set out on the previous pages can, at least in part, be attributed to the official proposals' excessive reliance on new-build routes, and the failure to integrate these new-build routes with upgraded routes on the existing network.

6.3.4 Test 3A – Testing High Speed UK against NP Specification

By contrast, the High Speed UK Exemplar Alternative is built on a strategy of full integration between new build routes, upgraded existing routes and restored routes, as depicted in Figure 6.3F below.

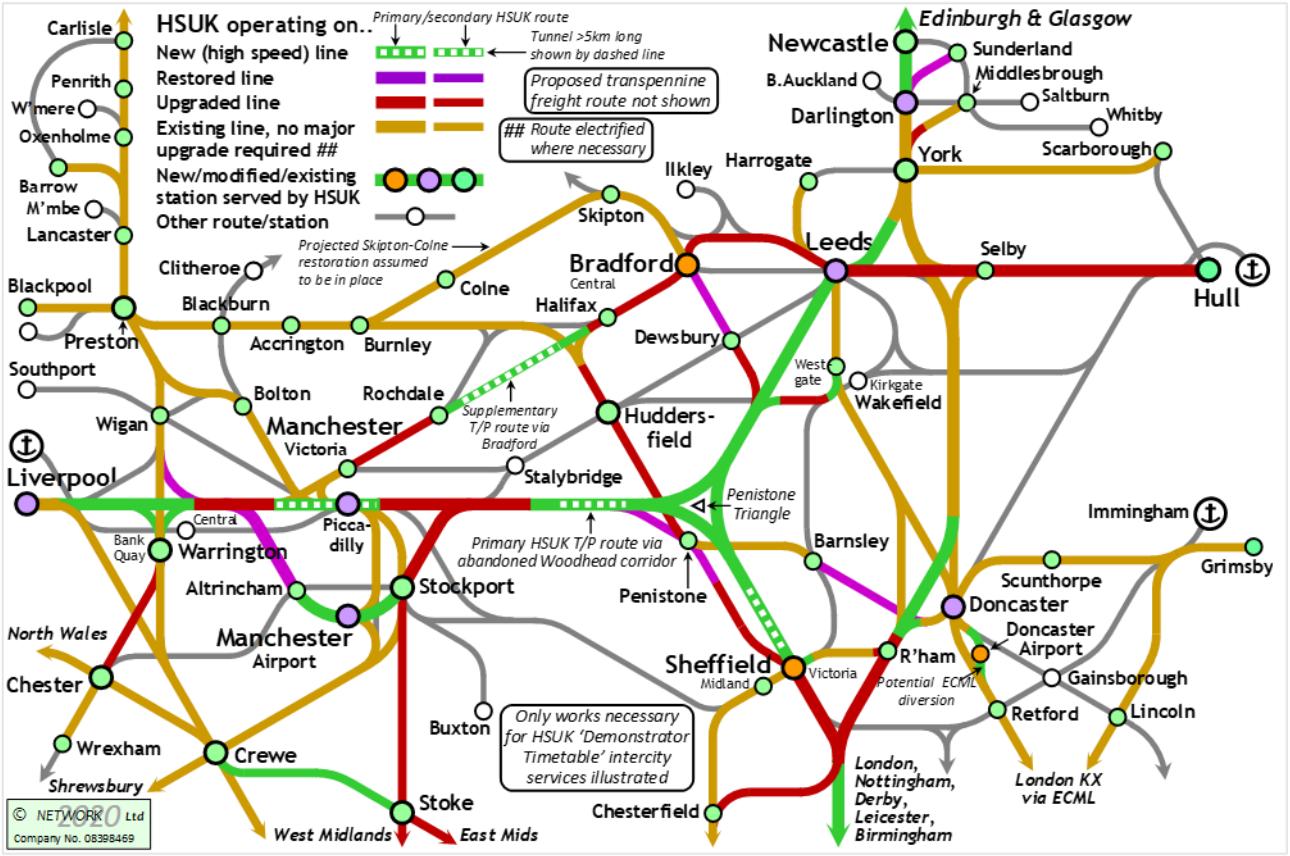


Figure 6.3F : High Speed UK – Infrastructure Proposals in Northern Powerhouse

Key to the HSUK strategy is a new-build Transpennine route via the Woodhead corridor, capable of connecting Leeds and Sheffield to Manchester and onwards (via a tunnelled 'through' route passing under central Manchester) to Liverpool. The eastern approach routes to the same Woodhead route will also provide a high speed connection between Leeds and Sheffield.

However, the HSUK Woodhead route cannot practicably provide improved Transpennine connections for Bradford. Proposals for a supplementary route, based upon upgrading of existing lines, a new Transpennine tunnel between Littleborough (near Rochdale) and Greetland (near Halifax), and a new 'Crossrail' link between the existing terminus stations in Bradford, will deliver the necessary transformation along the Calder Valley corridor.

Figure 6.3G and Table 6.3H show the performance of the HSUK Exemplar Alternative in meeting the Northern Powerhouse specification. All targets are met, with the exception of:

- Sheffield-Manchester Airport (34 mins HSUK journey time vs 30 mins specified)
  – a marginal non-compliance, but the HSUK strategy for a south Manchester loop serving the existing Manchester Airport station will deliver high speed services to the heart of the airport. This represents a strategy far superior to the HS2/IRP strategy for a high speed line serving a new parkway station remote from the airport.

- Manchester-Manchester Airport (15 mins existing journey time vs 10 mins specified) *– there appears to be no practicable way by which the 10 minute specification for a city centre to airport link can be met by any new-build intercity railway, and it must be questioned whether this particular requirement is appropriate to the wider context of the Northern Powerhouse specification for an improved intercity railway interlinking the key communities of the region.*

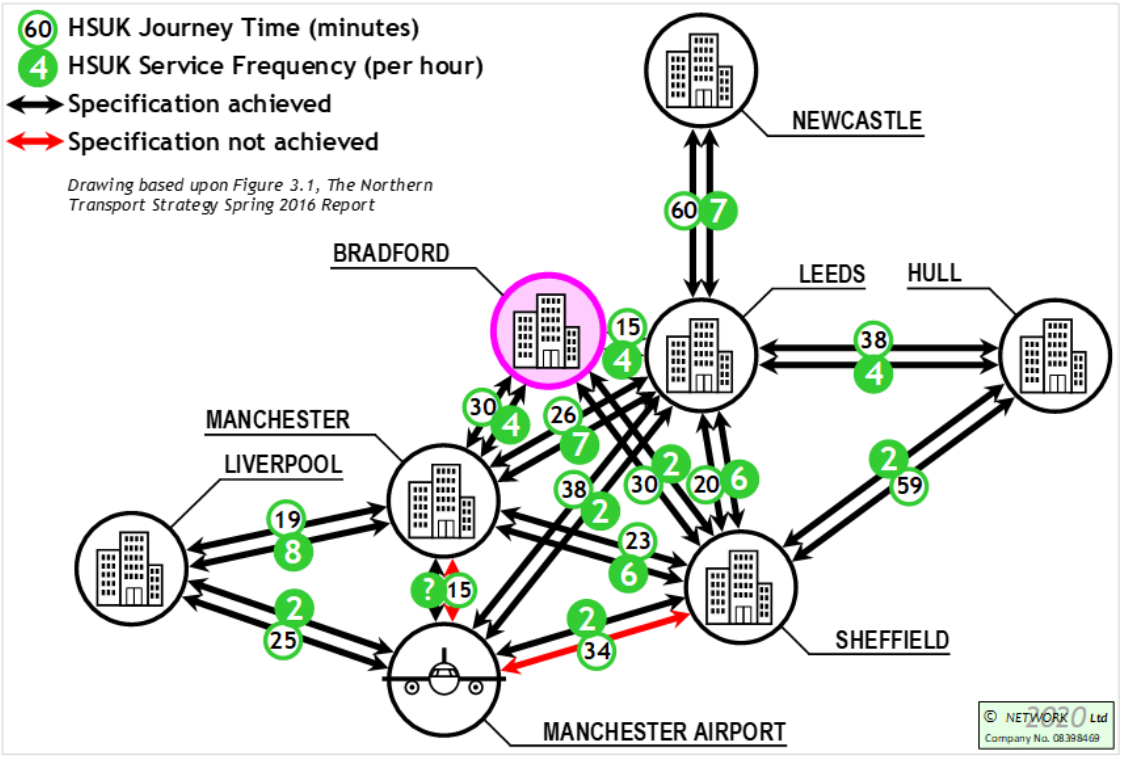


Figure 6.3G : High Speed UK – Performance against NP Specification

The performances of the 3 candidate schemes in meeting the Northern Powerhouse journey time specification are summarised in Table 6.3H. This shows that:

- Northern Powerhouse Rail (as proposed under either Predecessor Scheme or Integrated Rail Plan) will only perform well along the specific corridors where new construction is proposed.
- NPR performance is greatly compromised by the requirement to conform with established elements of the HS2 design, in particular the Manchester Spur and the proposed terminus at Manchester Piccadilly.
- With the cancellation of all new-build routes east of the Pennines, the Integrated Rail Plan will fail to deliver on any of the journey time targets.
- By contrast, the HSUK Exemplar Alternative will meet all targets for intercity journey times, and will only fail marginally on certain journeys to Manchester Airport.
- The provision of new tracks on key intercity routes will also enable HSUK to meet all of Transport for the North's targets for service frequencies. The overall HSUK service proposition is illustrated in Figure 6.3I.

The performance of the 3 candidate schemes in providing the additional Transpennine route capacity necessary to deliver Levelling-up is discussed in Section 6.3.5.

Journey between Northern Powerhouse centres	Existing journey time (mins)	Specified journey time (mins)	NPR journey time (mins)	IRP journey time (mins)	HSUK journey time (mins)
Liverpool - Manchester	**32**	**20**	28	35	**20**
Manchester - Sheffield	**48**	**30**	40	40	**23**
Manchester - Leeds	**49**	**30**	26	33	**26**
Sheffield - Leeds	**40**	**30**	28	41	**19**
Manchester - MAN Apt	**13**	**10**	15	15	**15**
Leeds - MAN Apt	**62**	**40**	47	58	**37**
Sheffield - MAN Apt	**73**	**30**	60	66	**34**
Liverpool - MAN Apt	**65**	**30**	28	41	**26**
Leeds - Newcastle	**87**	**60**	51	76	**51**
Leeds - Hull	**55**	**45**	38	55	**38**
Sheffield - Hull	**86**	**60**	60	60	**59**

Journey time meeting specification

Journey time failing to meet specification

MAN Apt = Manchester Airport

Table 6.3H : Candidate Scheme Performance vs Northern Powerhouse Specification

6.3.5 Test 3B – Meeting Levelling-up Targets in Northern Powerhouse

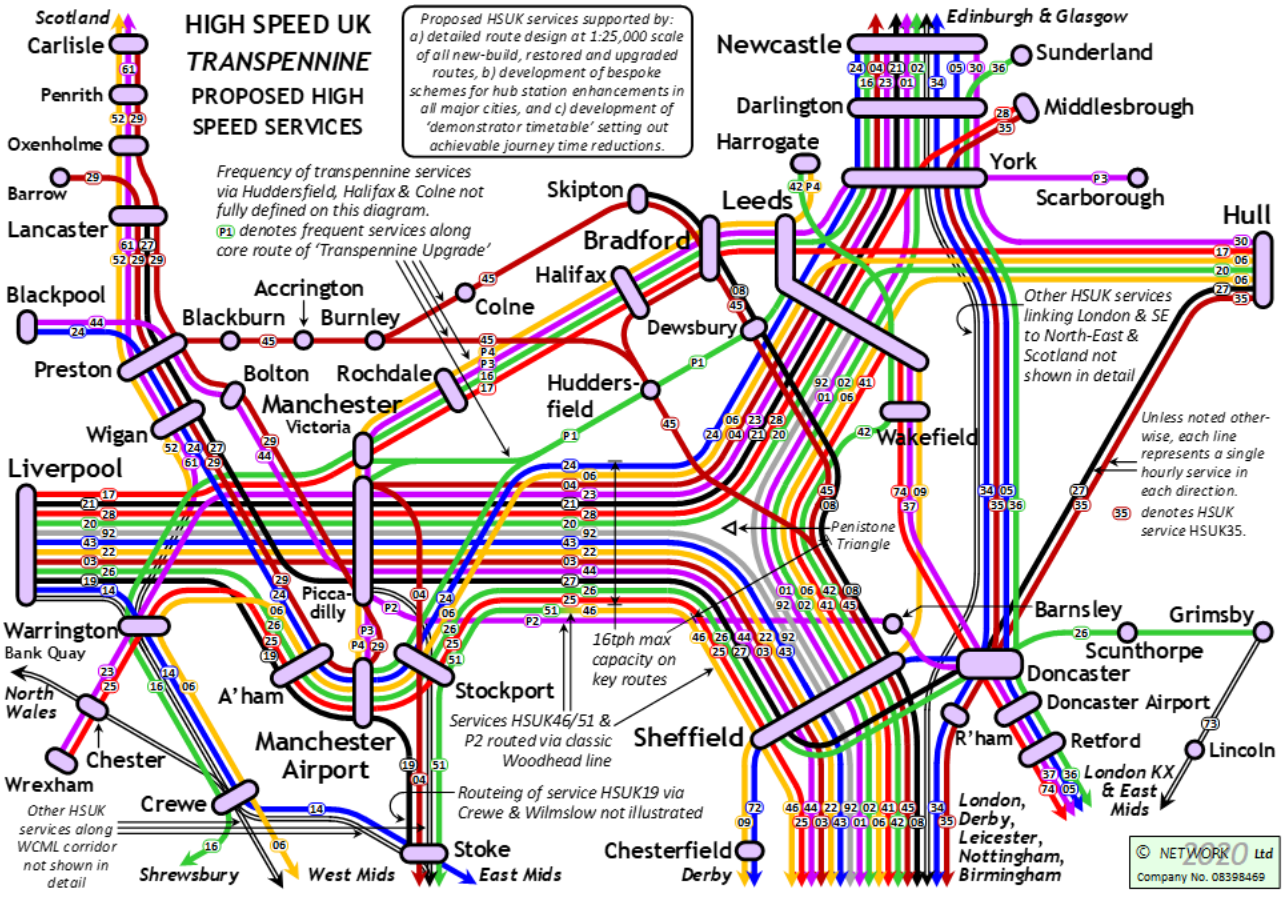


Figure 6.3I : High Speed UK – Intercity Services in Northern Powerhouse

The drastic cuts inflicted by the Integrated Rail Plan have left Transport for the North's proposals for Northern Powerhouse Rail in complete disarray. Not only is there no prospect of intercity rail services meeting the Northern Powerhouse journey time specification, there is also little prospect of achieving the major enhancement of service frequencies demanded by Transport for the North.

This is not merely a question of compliance with a possibly arbitrary technical specification. Radical improvements in links between the communities of the Northern Powerhouse are necessary to fulfil the Government's ambitious Levelling-up targets, and this requires not only compliance with a technical specification, but also a developed vision for how an enhanced network linking Northern cities might perform.

With the demise of Northern Powerhouse Rail, the High Speed UK Exemplar Alternative is left as the only viable proposal capable of delivering the required journey times, train frequencies and a proposition for a service pattern extending beyond the primary cities (i.e. Liverpool, Manchester, Sheffield and Leeds) to most other major communities. Figure 6.3I on the previous page sets out proposed HSUK services in the Northern Powerhouse.

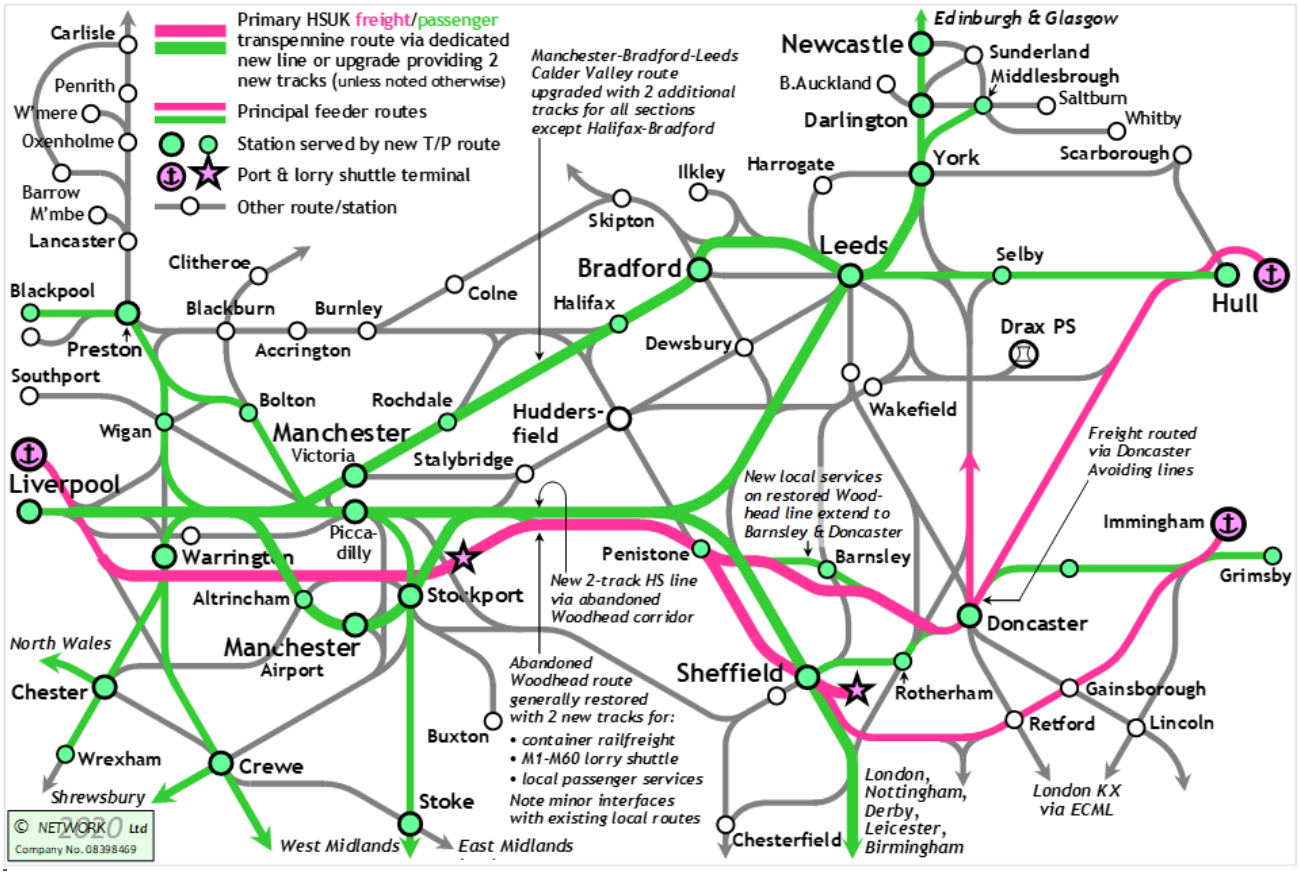


Figure 6.3J : HSUK Primary Transpennine Routes offering New-Build Capacity

Considered in terms of primary Transpennine routes offering significant new capacity (see Figure 6.3J above), either as a new-build high speed line, a restored line or 4-tracking of an existing 2-track railway, the HSUK passenger service proposition would include:

- 16 trains per hour on the new Transpennine high speed line via Woodhead;
- 2 trains per hour on the adjacent restored Woodhead line;
- 4 trains per hour on the upgraded Calder Valley route.

These 22 trains per hour would be additional to the existing Transpennine services, routed variously via the Hope Valley (Manchester-Sheffield), via Diggle/Standedge (Manchester-Huddersfield-Leeds) or via the Calder Valley (Manchester-Todmorden-Bradford-Leeds). As shown in Figure 6.3J, these services would distribute passengers to at least 16 points on each side of the Pennines.

Figure 6.3J also illustrates HSUK's dedicated 'prime user' Transpennine freight route, extending from the Port of Liverpool via a restored Woodhead route to South Yorkshire. Allowing for limited use of the restored Woodhead line by passenger services (see above), and allowing also for suitable terminal locations on both sides of the Pennines, this new Transpennine route should be able to support at least 12 freight trains per hour in each direction.

Considered on the same basis, the new Transpennine passenger services envisaged under the Integrated Rail Plan (see Figure 6.3D) on the sole proposed Manchester-Huddersfield-Leeds route would be heavily compromised by the lack of continuous new tracks from Manchester to Leeds, and by parallel ambitions for a West Yorkshire Mass Transit System (refer Section 6.4). Taken overall, the Integrated Rail Plan might be capable of offering 2 new Transpennine trains per hour.

And with just a single additional track proposed for freight services on the critical eastern ramp through Huddersfield to Standedge Tunnel, it is difficult to see how the infrastructure proposals detailed in the Integrated Rail Plan could support more than one additional freight train per hour, in each direction.

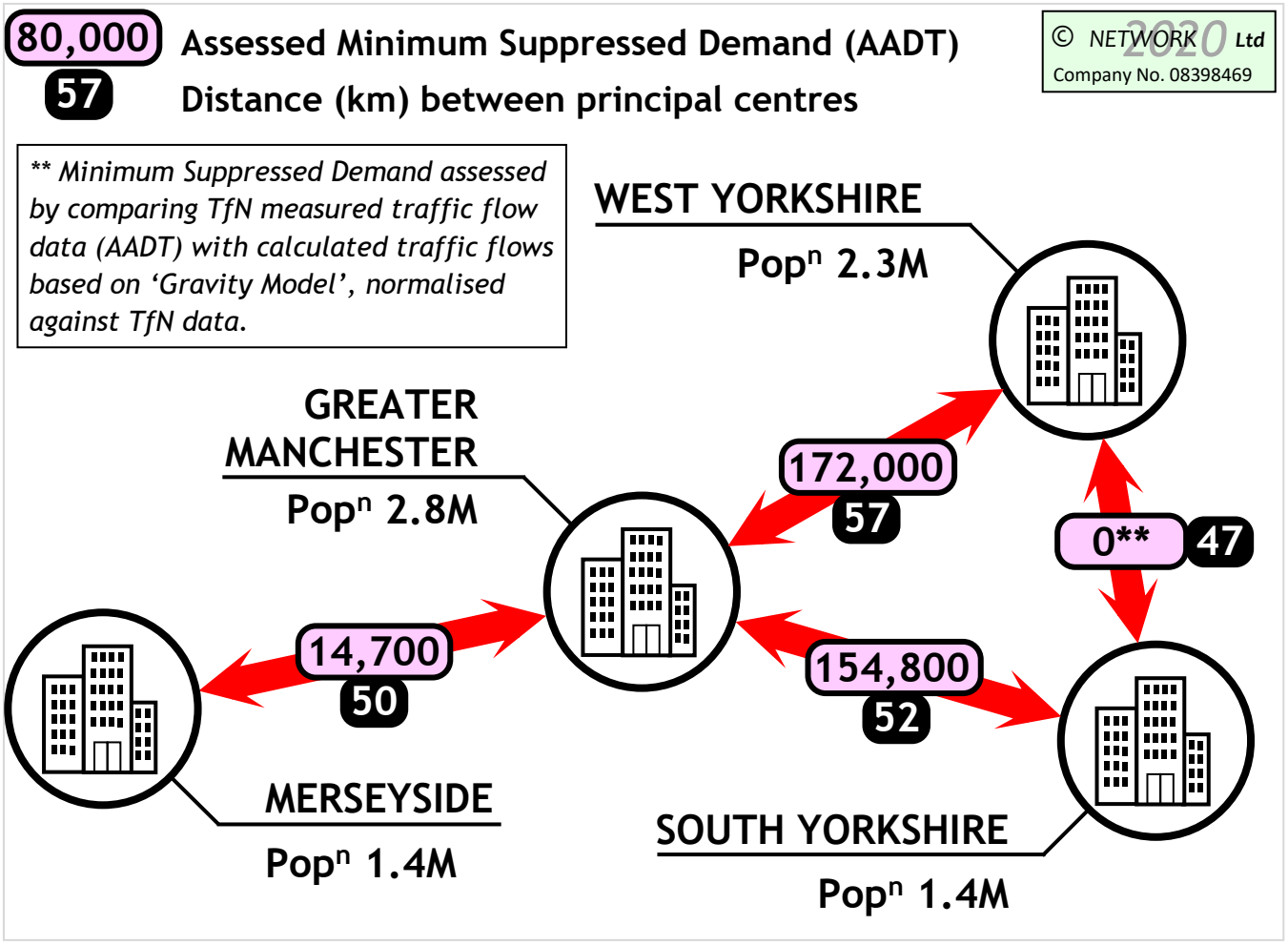


Figure 6.3K : Assessed Suppressed Demand in Northern Powerhouse Traffic Flows

In order to understand the Levelling-up potential of the Integrated Rail Plan, and of the High Speed UK Exemplar Alternative, the new capacity offered by each scheme should be scaled against the current suppressed demand for Transpennine traffic flows.

As discussed in Section 2.5 of this study, traffic flow data between the primary conurbations of the North (see Figure 2A and Table 2B) indicates a huge suppressed demand that is directly attributable to the restricted road connectivity (i.e effectively only the M62 motorway and the massively inadequate A628T Woodhead Road) across the Pennines. With no prospect of new motorway construction, it falls to new (or restored) railway construction to provide the necessary new capacity.

The suppressed demand for TransPennine road traffic flows can be deduced from Figure 6.3K, by combining the 'AADT' flows from Greater Manchester to South Yorkshire and to West Yorkshire:

- Total Transpennine suppressed demand is 326,800 vehicles per day (AADT).
- AADT flows are 2-way. A single-direction flow would be 163,400 vehicles per day.
- Assume 75% cars, 25% lorries. Hence 122,550 cars per day, 40,850 lorries per day.
- Assume 1.5 occupants per car, hence 183,825 persons per day.
- Assume 6m average loaded length per lorry, hence 245,100m total loaded length.

The HSUK passenger service might be assumed to comprise 22 additional intercity trains per hour, each of 500-seat capacity, operating at average 80% average load factor for 12 hours per day. Total HSUK intercity capacity would therefore be 105,600 persons per day, with (at least) 16 feeder points on each side of the Pennines. This might be viewed still as a shortfall of 78,225 (=183,825-105,600); however, a significant part of this shortfall, perhaps 20,000 persons per day, can be addressed by HSUK's proposed local network improvements in Greater Manchester, South Yorkshire and West Yorkshire (as set out in Figures 6.6G, 6.6K and 6.4G respectively).

The HSUK freight service, comprising 12 trains per hour each of 750 metres loaded length, might be assumed to operate for 18 hours per day. This would provide a total loaded length of 162,000 metres per day.

The above reasoning is only approximate, based on many crude and possibly not entirely realistic assumptions. But it does demonstrate that the HSUK Exemplar Alternative will deliver connectivity and capacity gains across the North at least of the order of magnitude necessary to deliver the Government's Levelling-up objectives.

By contrast, the Integrated Rail Plan might offer the equivalent of 2 additional intercity services per hour, with a total capacity of 9,600 persons per day. This is essentially insignificant against an assessed suppressed demand of 183,825 persons per day, with only 4 feeder points to the west of the Pennines and 6 to the east – and it must be noted that the IRP offers no improvements in local capacity to provide any additional mitigation.

The same inadequacies pertain to the Integrated Rail Plan's proposition for freight. A single additional freight path per hour would deliver a total loaded length of 18,000 metres per day, as against a theoretical requirement of 254,100 metres per day.

Overall, it can be concluded that the infrastructure proposals contained in the Integrated Rail Plan will fail by an order of magnitude to satisfy the requirements of the Government's Levelling-up agenda.

The comparison between the Transpennine capacities of the Integrated Rail Plan and the High Speed UK Exemplar Alternative is summarised below in Table 6.3L.

	Passenger Flows (Persons per day)			Feeder Points		Freight loaded length (m/day)
	Intercity	Local	Total	West	East	
Integrated Rail Plan	9,600	0	9,600	4	6	18,000
High Speed UK	105,600	20,000	125,600	16	16	162,000
Suppressed Demand	------	------	183,825	------	------	245,100

Table 6.3L : Comparison of IRP/HSUK Capacity vs Assessed Suppressed Demand

6.3.6 Test 3C – Accounting for the Failure of Official NPR Schemes

It is necessary to understand the trajectory of failure, whereby the HS2/NPR Predecessor Scheme (dating from 2016 to 2020) performed poorly against the Northern Powerhouse specification, and the 2021 Integrated Rail Plan now misses every single journey time target, and fails also to provide the increased capacity necessary to support the Government's Levelling-up agenda.

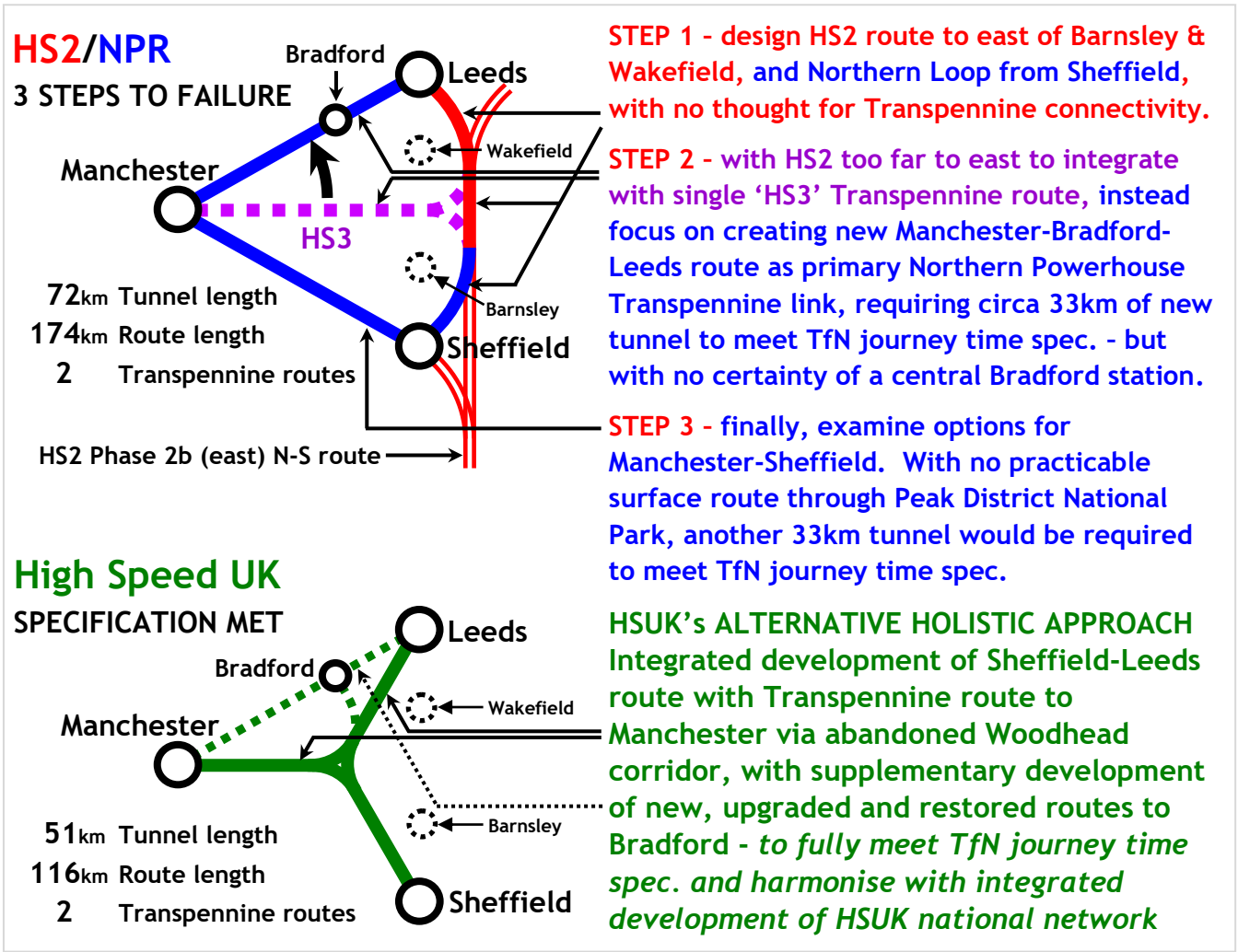


Figure 6.3M : HS2/NPR Predecessor Scheme – Epic Fail in the Transpennine Triangle

The reason can be found in the disjointed manner in which the HS2 and Northern Powerhouse Rail proposals were developed, without any concept of national network. When HS2 Phase 2b (east) was launched in 2012, its only ostensible priority was to create the fastest possible route from London and Birmingham to Leeds, and this resulted in an alignment through the flatter land of Yorkshire, to the east of Barnsley and Wakefield (as shown in Figure 6.3M on the previous page), which would also bypass central Sheffield. Any routes running to the west of Barnsley and Wakefield were rejected early in the option selection process, and were never examined for their potential to connect to and integrate with a Transpennine high speed line.

When the 'One North' concept was launched in 2014, it called for this specific integrated concept – a new Transpennine high speed line connecting with the north-south route in Yorkshire 'at a delta junction[26]'. This would have enabled high speed links from Liverpool and Manchester to Leeds and Sheffield. Regrettably, however, the route of HS2 in Yorkshire was already fixed too far to the east (either on its pre-2016 route via a Sheffield station at Meadowhall, or its post-2016 bypassing route via the M18 corridor – neither capable of offering a through route serving central Sheffield), and the 'One North' concept was abandoned.

Instead, Transport for the North pursued 2 separate schemes to improve Transpennine connectivity:

- a new Manchester-Leeds Transpennine route via Bradford;
- upgrades to the Manchester-Sheffield 'Hope Valley' route.

No details of TfN's proposed Manchester-Bradford-Leeds route have ever been published. However, HSUK's analysis indicates that any Transpennine route via Bradford designed to deliver the specified 30 minute Manchester-Leeds journey time would have required as a minimum 33km of tunnel between Littleborough and Calverley (in the Aire Valley) – a hugely expensive proposition, with no practicable site for a central Bradford station, that was ultimately rejected in the development of the Integrated Rail Plan. See commentary re Journey **04** in Section 6.1.3.

HSUK's assessment of the 'Hope Valley' route indicates a similar outcome – no feasible option for a 30 minute Manchester-Sheffield journey time, short of constructing another 33km long tunnel from New Mills to the western suburbs of Sheffield. Such an option proved unpalatable to TfN, who instead proposed an upgrade of the existing line which cannot possibly (despite IRP claims) deliver the specified journey time. See commentary re Journey **07** in Section 6.1.3.

And as demonstrated in the preceding Section 6.3.5, the limited additional Transpennine capacity generated by the Integrated Rail Plan bears no relation whatsoever to the step-change increase in demand for Transpennine rail travel indicated by the Government's Levelling-up agenda.

The folly of the sequential approach taken by official bodies is exposed by the High Speed UK Exemplar Alternative. Its design as an optimised national network, with the primary aim of interlinking all UK primary cities including Manchester, Leeds and Sheffield, has dictated a Sheffield-Leeds new-build route running to the west of Barnsley and Wakefield, connecting with a new Transpennine high speed line routed via the abandoned Woodhead corridor.

This routeing concept, developed years previously, exactly matches that of the 'One North' initiative; and when 'One North' was launched in 2014, HSUK's Transpennine design was found to easily meet all the stated targets for intercity journey times. Moreover, its routeing via the established Woodhead corridor requires a much lesser length of tunnel, and hence a much lower cost to construct.

6.3.7 Test 3 – Finding

The Integrated Rail Plan will fail to meet every single official target for improved intercity journey times across the Northern Powerhouse, and it will fail also to deliver the step-change capacity enhancement necessary for Levelling-up.

The targets for radically reduced journey times and greatly improved service frequencies originally established by 'One North' do not fully define all aspects of the connectivity improvements necessary to spur economic development of the Northern Powerhouse, and to deliver Levelling-up. However, compliance with these targets provides a representative and accurate touchstone for the performance of the 3 candidate schemes.

This study has also attempted to scale the Transpennine capacity improvements offered by the Integrated Rail Plan and by the High Speed UK Exemplar Alternative against the suppressed demand that is currently imposed upon Transpennine connectivity by the Pennine range, a key indicator of the deficiencies that the Government's Levelling-up agenda must address in the North. It has established that while HSUK offers capacity improvements that approximately match this suppressed demand, any gains offered by the IRP fail utterly to address the scale of the challenge.

The comparisons set out in Tables 6.3H and 6.3L provide further stark indicators of High Speed UK's massive superiority over both the Integrated Rail Plan and its Predecessor Scheme, and therefore, its much greater potential to deliver Levelling-up and step-change CO_2 reductions.

Again, the reason for the dire performance of the Integrated Rail Plan and its Predecessor Scheme seems clear – the predication of all official proposals for improved Transpennine connectivity upon the established scheme for the HS2 'Y-network', which was developed with no thought for Transpennine connectivity.

6.4 Potential IRP Conflict with West Yorkshire Mass Transit System

Test 4 poses the question: ***"Are the Integrated Rail Plan's proposed main line upgrades compatible with emerging proposals for a West Yorkshire Mass Transit System?"***

6.4.1 Test 4 – Assessment Rationale and Methodology

In January 2021, the West Yorkshire Combined Authority (WYCA) launched its vision for a 'West Yorkshire Mass Transit System' (WYMTS). WYMTS is promoted[27] as a *"bold approach to public transport"*, to *"make West Yorkshire greener, more inclusive and better connected"* and thus *"support levelling-up in the Northern Powerhouse"*. It is intended to function as an integrated system alongside other modes of transport, both personal (walking and cycling) and public (bus and rail).

The need for an improved public transport system in West Yorkshire can be appreciated from a swift review of Figures 6.4A and 6.4B. These show the existing local rail system, and chart the direct links between 8 principal communities.

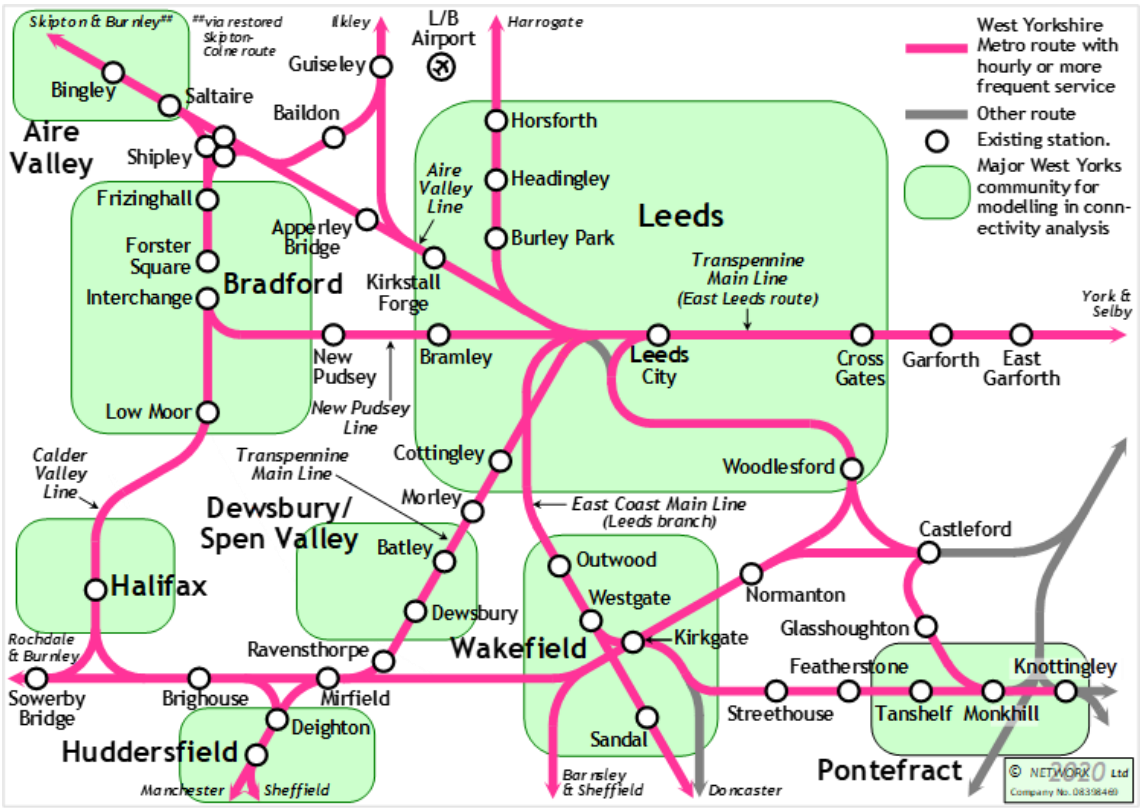


Figure 6.4A : West Yorkshire Rail Network and Principal Communities

	LS	AV	BD	HX	HD	DB	WF	PF
Leeds								Direct rail link
Aire Valley								No direct link
Bradford								Total links 14
Halifax								
Huddersfield								
Dewsbury								
Wakefield								
Pontefract								
No of Direct Links	7	2	4	3	5	2	3	2

Figure 6.4B : Existing rail connectivity between West Yorkshire Principal Communities

The local railway system operated under the 'West Yorkshire Metro' branding essentially comprises the strategic public transport system within West Yorkshire. It is primarily focussed upon Leeds, with most outlying communities (and all the 'principal communities' defined in this analysis) enjoying frequent direct services to Leeds. By contrast it offers relatively poor links between the outlying communities, with few direct services and many journeys only possible with a change of trains at Leeds.

West Yorkshire's local rail network embodies several specific defects:

- It suffers major congestion at Leeds station, where services and passenger flows are concentrated.
- The congestion is significantly exacerbated by the unbalanced configuration of Leeds station, with 6 different routes entering from the west, and only a single route entering from the east; this compels the station to operate largely as a terminus, with long turn-around times and as a consequence huge pressure on platform space.
- The congestion is also exacerbated by the poor connectivity between outlying communities, which compels more passenger journeys to be routed via Leeds.
- Bradford is served by 2 separate disconnected terminus stations, hence there is no rail connection between the networks to north and south of the city – and as a consequence, greater congestion at Leeds.
- Many major population centres, including the Spen Valley, west Bradford, north-east Leeds and Leeds Bradford Airport, are not served by the local rail network, and instead are reliant on slower and less convenient bus services.

The WYCA proposals for the West Yorkshire Mass Transit System have been developed to address these (and other) deficiencies by augmenting the existing rail system with new tramway/light rail routes. There is no intention to replace rail services – indeed, WYMTS documentation[28] is clear that rail services on reserved tracks, rather than mostly street-running light rail mass transit, will remain the fastest and most efficient links between principal communities. Huddersfield-Dewsbury-Leeds (Transpennine Main Line) and Halifax-Bradford-Leeds (Calder Valley Line) are both cited as corridors on which rail will remain dominant. It is therefore vital that capacity along these rail routes is maintained for improved local services.

This study aims to determine:

- whether WYCA's proposals for a West Yorkshire Mass Transit System are compatible with the more strategic regional/national proposals set out in the Integrated Rail Plan;
- whether the WYMTS proposals constitute in themselves an efficient scheme that will bring about the best-connected local transport network, and therefore deliver the best possible Levelling-up and Net Zero outcomes.

6.4.2 Test 4A – WYCA Scheme for West Yorkshire Mass Transit System

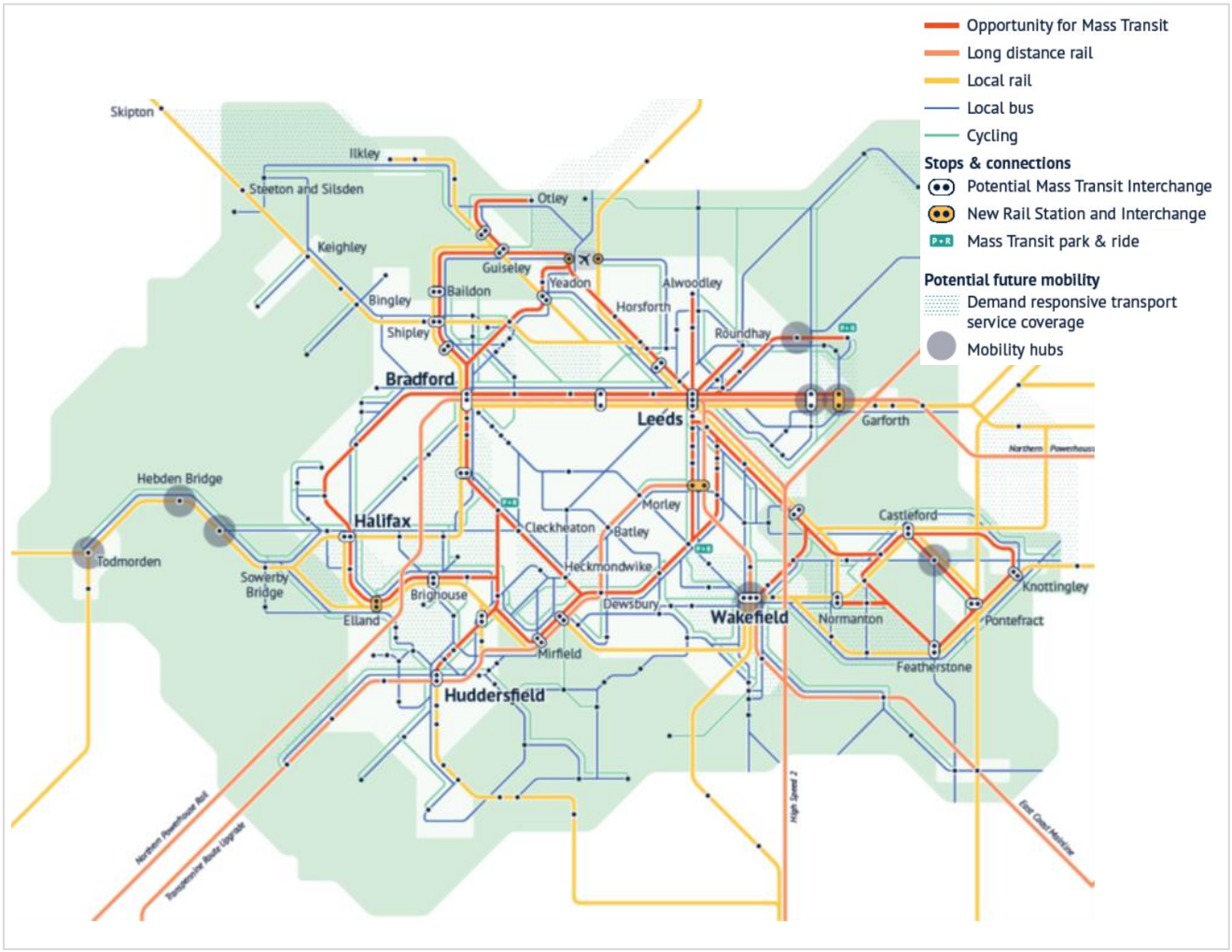


Figure 6.4C : WYCA Scheme for West Yorkshire Mass Transit System

Extract from Mass Transit Vision, October 2021, West Yorkshire Combined Authority

WYCA's preliminary proposals for a West Yorkshire Mass Transit System are set out in Figure 6.4C. This identifies:

- proposed mass transit routes (in red);
- bus feeder services (in blue);
- the proposed upgrade of the Transpennine Main Line via Huddersfield (in salmon pink);
- proposed new strategic main lines i.e. Northern Powerhouse Rail running Manchester-Leeds via Bradford and HS2 Phase 2b (east) to Leeds (also in salmon pink), both clear of existing main lines.

The WYMTS scheme along the Huddersfield-Dewsbury-Leeds corridor has ostensibly been developed under the presumption that the proposed 'Transpennine Upgrade' will allow for improved local services to intermediate stations such as Dewsbury, Batley and Morley et al.

This would appear to be a reasonable presumption for a regional scheme such as the proposed Transpennine Upgrade, and the new-build Northern Powerhouse Rail and HS2 schemes would plainly not pose any additional capacity pressures along the Transpennine Main Line.

6.4.3 Test 4A – IRP Conflict with West Yorkshire Mass Transit System

However, the Integrated Rail Plan's cancellation of both Northern Powerhouse Rail and HS2 Phase 2b (east), and its adoption of a route upgrade strategy, will create major conflicts with WYMTS:

- NPR cancellation will leave the existing Transpennine Main Line shouldering the entire burden of improving connectivity across the Northern Powerhouse, from Liverpool and Manchester to Leeds, Newcastle and Hull.
- HS2 Phase 2b (east) cancellation will have the effect of placing the Transpennine Main Line on the fastest route from Birmingham to Yorkshire and the North-East (as per Journeys **15** and **16** illustrated in Table 6.1A and Figure 6.1B).

Cancellation of Northern Powerhouse Rail will also place major additional pressures on the primary Leeds-Bradford route via New Pudsey. Under the IRP this route is slated for electrification and enhancement to deliver a 12 minute Leeds-Bradford journey time, presumably in compensation for Bradford's loss of through NPR services offering accelerated and direct links to Newcastle, Hull, Leeds, Manchester and Liverpool etc. However, as documented in Section 6.1, the introduction of a superfast Leeds-Bradford service will deliver very little real benefit, but will have the huge adverse effect of preventing the proper development of this route, with increased services and new stations, to serve the large local population along the Leeds-New Pudsey-Bradford corridor.

Increased IRP services along the York and Wakefield lines may also imperil the prospects for improved local services.

Likely conflicts between the West Yorkshire Mass Transit System and enhanced IRP strategic services on main line routes are highlighted in Figure 6.4D.

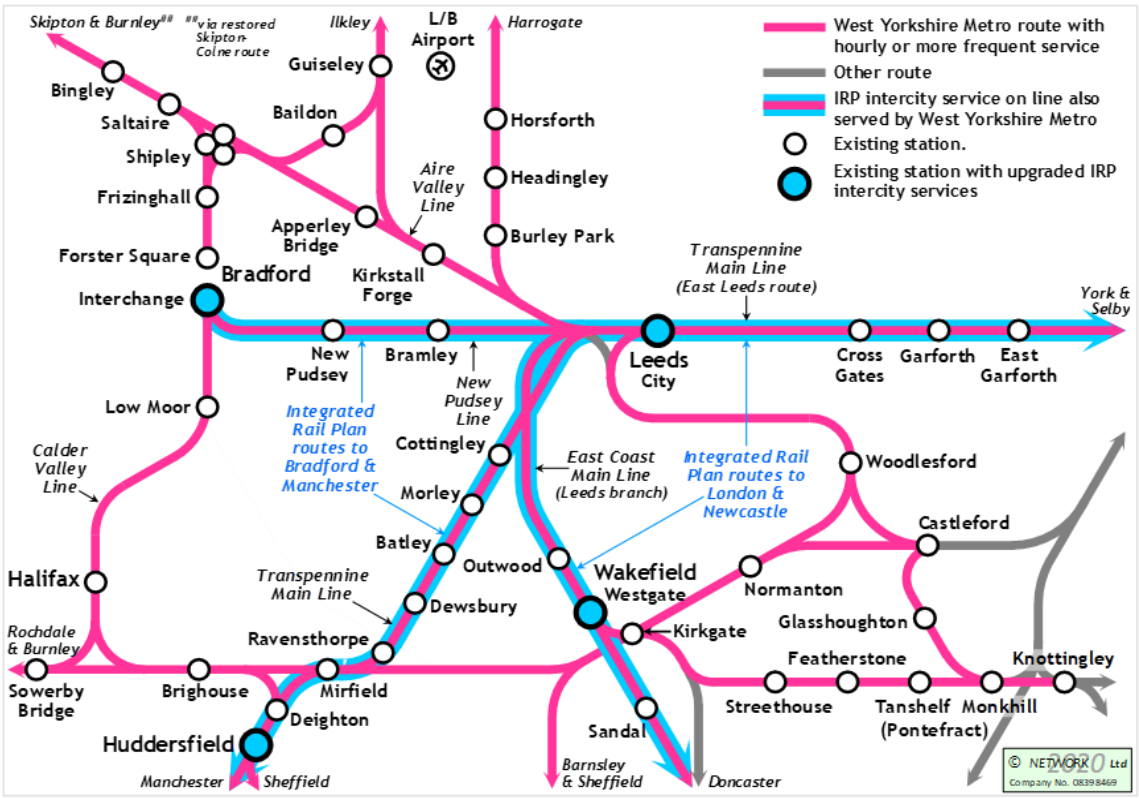


Figure 6.4D : Integrated Rail Plan and Existing West Yorkshire Network

6.4.4 Test 4A – Benefits of West Yorkshire Mass Transit System??

While the introduction of a light rail mass transit system to the streets of West Yorkshire represents a long-overdue transformation, capable of bringing major public transport benefits to many communities, it is still legitimate to question the benefit that WYCA's proposed West Yorkshire Mass Transit System will bring to the overall network.

When considered in terms of the existing railway network as depicted in Figures 6.4A and 6.4B, WYMTS provides only 2 new links, from Dewsbury to Halifax and to Bradford. See Figure 6.4E. Whereas the existing network offers 7 links out of a possible 21 between the 7 outlying communities (i.e. Aire Valley, Bradford, Halifax, Huddersfield, Dewsbury, Wakefield and Pontefract), WYMTS only increases the non-Leeds connectivity score to 9 out of 21. Expressed as a percentage network efficiency (where 100% represents direct services interlinking all centres), efficiency is only improved from 33% to 43%.

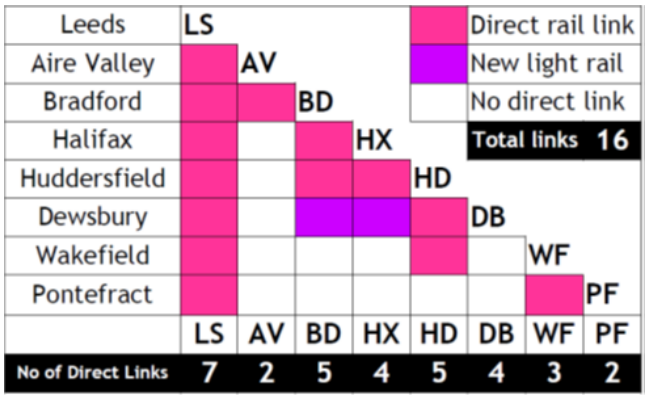


Figure 6.4E : Local Connectivity achieved by preliminary scheme for West Yorkshire Mass Transit System

This would seem to indicate a major flaw in the design philosophy underpinning WYCA's current proposals for a West Yorkshire Mass Transit System. Its light rail proposals may well have considerable merit in enhancing transport corridors where no railway line exists, and where buses offer an inadequate solution; however, it appears unable to address the many gaps in the existing (local rail) strategic network which plainly need to be filled if West Yorkshire is to have an efficient interurban transport system.

Wider review of WYMTS documentation[29] indicates that West Yorkshire Combined Authority has examined the West Yorkshire local rail network to identify the gaps in the connectivity that it offers; yet in the published WYMTS scheme, street-running light rail is the only proposed intervention, and the existing 'heavy rail' system will be left in place, to be developed by others.

This would seem to indicate a clear 'silo' approach, in which the West Yorkshire Combined Authority has primary responsibility only for light rail, while responsibility for conventional heavy rail lies with Transport for the North (i.e. Northern Powerhouse Rail) and the Department for Transport (i.e. HS2), along with Network Rail. The perils of such a fragmented design philosophy are self-evident, and are well demonstrated in all the many failures of the Integrated Rail Plan; and again, the vastly superior performance of the High Speed UK Exemplar Alternative, as set out in Section 6.4.5, highlights the crucial importance of a holistic and integrated design approach in which the needs of local, regional and national transport are considered together.

6.4.5 Test 4A – West Yorkshire Mass Transit System à la High Speed UK

The HSUK proposals within West Yorkshire are set out in Figure 6.4F. These proposals comprise a suite of new-build high speed lines, upgrading of existing main lines (both electrification and 4-tracking), restoration of abandoned lines and a major programme of opening new stations.

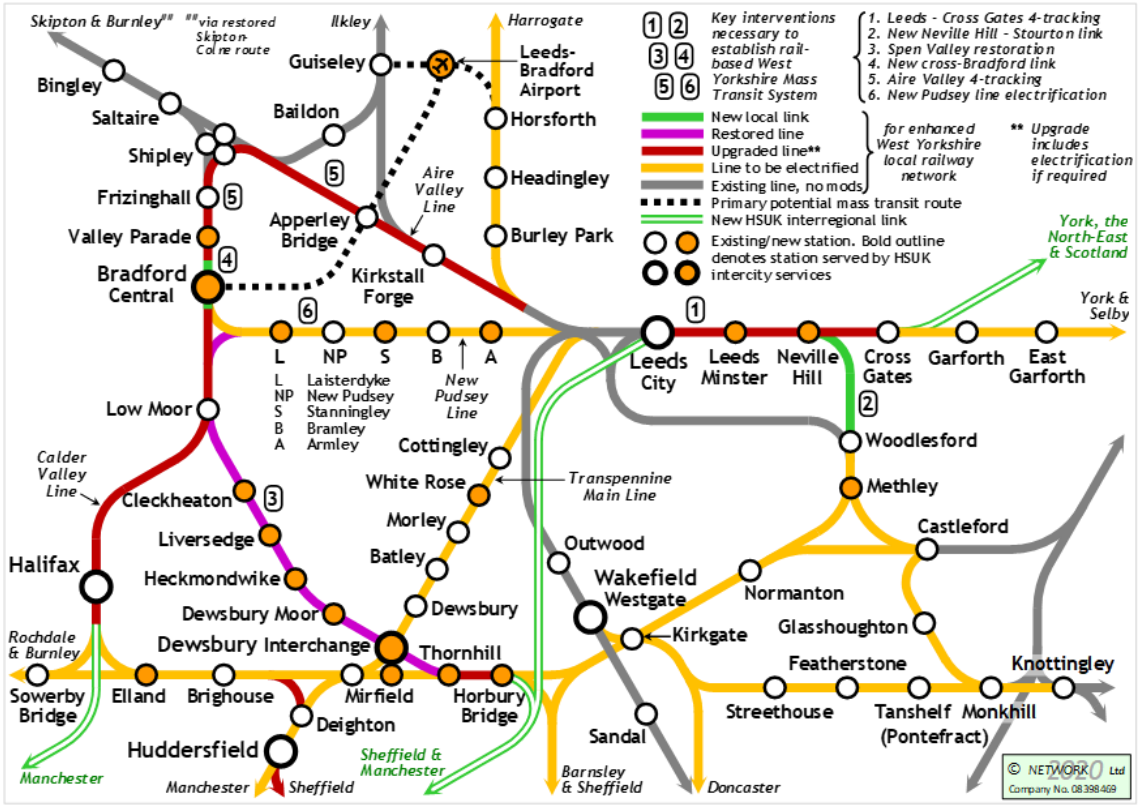


Figure 6.4F : HSUK Key Infrastructure Proposals in West Yorkshire

Figure 6.4F highlights 6 key HSUK interventions:

1) 4-tracking of East Leeds Viaduct and existing route to Cross Gates;
2) Construction of new Neville Hill-Stourton link;
3) Restoration of Spen Valley line;
4) Construction of new 'Bradford Crossrail' link, replacing existing Interchange and Forster Square termini with new 'through' Bradford Central station;
5) 4-tracking of existing Forster Square branch and Aire Valley Line to Leeds;
6) Electrification of Leeds-New Pudsey-Bradford line, with 3 new intermediate stations.

Intervention **1)** is necessary to create a reserved path for high speed intercity traffic through Leeds, segregated from local traffic, and Intervention **2)** is necessary to enable much more local traffic to enter Leeds from the east, thus eliminating much of the need to terminate services and thereby increasing capacity.

Interventions **3)**, **4)** and **5)** are necessary to create viable intercity routes through Bradford, for instance London-Leicester-Sheffield-Bradford-Aire Valley-East Lancashire and Liverpool-Manchester-Bradford-Leeds-Hull. Intervention **6)** is necessary to avoid the congestion that would be caused by Aire Valley electric services terminating at Forster Square; instead these services would continue via New Pudsey to Leeds and beyond.

However, these same interventions also create the opportunity for a transformation of local services, as illustrated in Figure 6.4G:

- Interventions **1)** and **2)** will enable greatly increased through running at Leeds, and massively enhance the capacity of the existing Leeds City station. 4-tracking of Leeds East Viaduct will also permit the establishment of a new 'Leeds Minster' station, at last allowing convenient interchange with bus services at the main city centre bus station.
- Intervention **3)** will restore rail services to the Spen Valley towns of Cleckheaton, Liversedge and Heckmondwike, and will also – with the new 'Dewsbury Interchange' station at the intersection with the Transpennine Main Line – transform the connectivity of Dewsbury (see also Section 6.5).
- Interventions **4)** and **5)** will enable the diversion of time-critical services on the Leeds-New Pudsey-Bradford-Halifax-Rochdale-Manchester 'Calder Valley' corridor to the Aire Valley line via Shipley, thereby avoiding any need to terminate in Bradford.
- This then enables Intervention **6)** – the much-needed opening of new stations on the New Pudsey line, along the highly populated corridor between Leeds and Bradford.

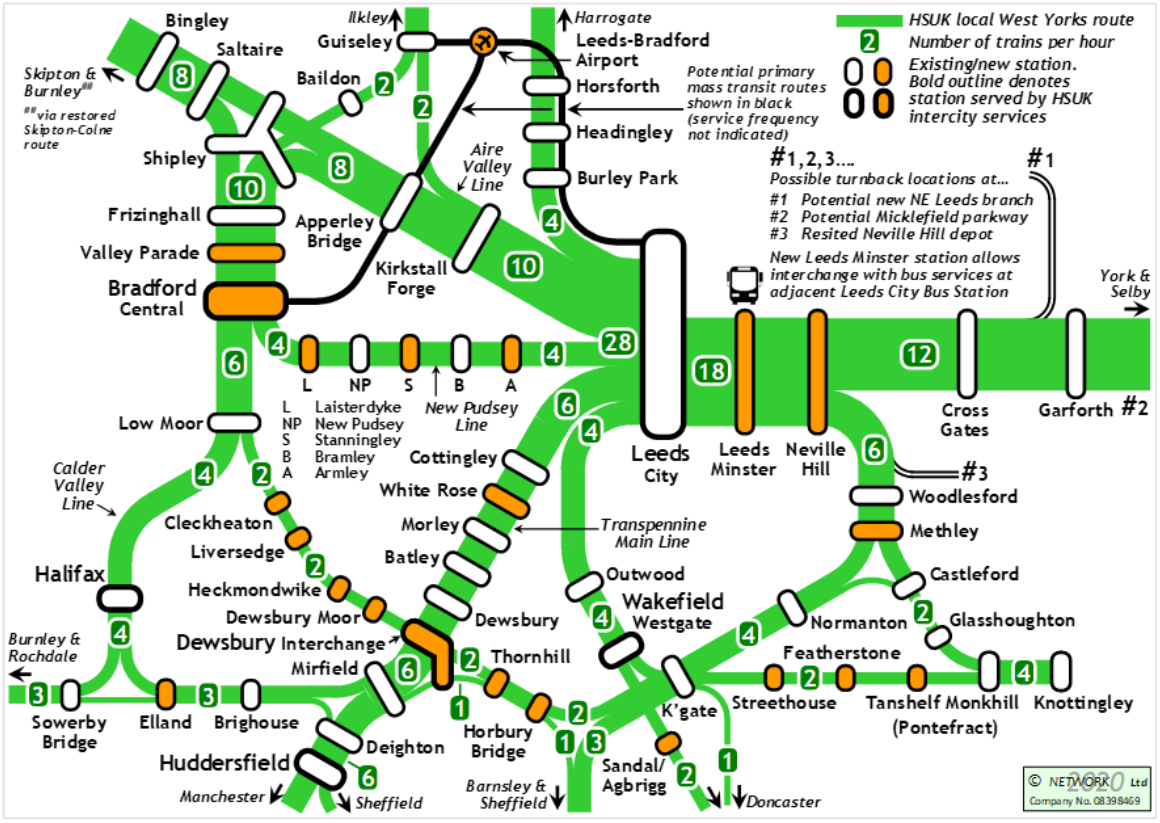


Figure 6.4G : HSUK Scheme for 'Heavy Rail' West Yorkshire Mass Transit System

	LS	AV	BD	HX	HD	DB	WF	PF
Leeds								
Aire Valley	■							
Bradford	■	■						
Halifax	■		■					
Huddersfield	■		■	■				
Dewsbury	■	■	■	■	■			
Wakefield	■	■	■		■	■		
Pontefract	■	■	■			■	■	
No of Direct Links	7	5	7	4	5	7	6	5

■ Direct rail link
No direct link
Total links 23

Figure 6.4H : HSUK local connectivity between West Yorkshire Principal Communities

Figure 6.4H illustrates the vastly improved connectivity that HSUK could deliver between the principal communities of West Yorkshire. Out of 21 non-Leeds journeys, HSUK could offer 16 direct interurban links – a network efficiency of 76%, nearly twice that of the official WYMTS scheme.

It is hence reasonable to advance the HSUK scheme within West Yorkshire as a legitimate and entirely superior 'heavy rail' alternative to the West Yorkshire Mass Transit System proposed by WYCA. This does not eliminate the need for light rail mass transit – indeed Figure 6.4F shows light rail routes to Leeds Bradford Airport from both Leeds and Bradford, and there will certainly be other viable routes where light rail will deliver major benefits.

However, the superior performance of the High Speed UK Exemplar Alternative shows clearly the necessity for integrated heavy rail as the primary intervention in creating a West Yorkshire Mass Transit System.

6.4.6 Test 4 – Finding

The Integrated Rail Plan's proposed West Yorkshire main line upgrades, with faster and more frequent services on key Transpennine routes, are fundamentally incompatible with emerging proposals for a West Yorkshire Mass Transit System.

This will leave any West Yorkshire Mass Transit System hugely inefficient, and incapable of delivering the improved interurban connectivity necessary to support Levelling-up.

This deficiency would appear to be directly attributable to the failure of official bodies (both central Government and Transport for the North) to develop an integrated railway scheme for the Northern Powerhouse that can address local, regional and national needs. This is demonstrated conclusively by HSUK's comprehensively superior integration, whereby the interventions necessary to create a national and regional high speed network will also deliver massive improvements for local networks.

This offers a radical new way forward for the West Yorkshire Mass Transit System – to be based upon HSUK's 'heavy rail' local network which will deliver near-complete direct interconnectivity between the principal communities of West Yorkshire.

6.5 Determining the IRP's Benefits for 'Small Town' Communities

Test 5 poses the question: ***"Will the Integrated Rail Plan deliver significant connectivity benefits to smaller regional communities, and thereby support the Government's Levelling-up and Net Zero agendas?"***

6.5.1 Test 5 – Assessment Rationale and Methodology

It is plainly imperative that the benefits of the UK high speed rail project, of delivering improved links between the nation's primary cities (e.g. Birmingham, Manchester and Leeds) are not compromised by the harm that would be inflicted by bypassing smaller communities, and leaving them with reduced intercity services.

This self-evident principle has been belatedly endorsed by the Government in its Integrated Rail Plan; it now seeks to justify its cancellation of HS2 Phase 2b (east) and Northern Powerhouse Rail by proclaiming the benefits that will accrue to a range of 'Small Town' communities on existing main line routes.

12 specific communities are cited[30] as potential beneficiaries of improved services:

- Grantham, Newark, Retford, Doncaster, Wakefield (East Coast Main Line/ECML);
- Kettering, Market Harborough, Leicester, Loughborough (Midland Main Line/MML);
- Dewsbury, Huddersfield and Stalybridge (Transpennine Main Line/TPML).

Currently, most of the smaller communities (e.g. Retford or Market Harborough) only enjoy hourly stopping services, with the longer-distance, higher-speed services generally passing through non-stop. Only the larger 100,000+ communities (i.e. Doncaster, Wakefield, Leicester and Huddersfield) enjoy what might be described as a 'premium' service level, with most trains stopping, and (at Doncaster and Leicester) opportunities for interchange with services on other trunk routes.

The Integrated Rail Plan notes possible improvements to services in terms of destinations served, electrified trains, higher frequencies, more seats and/or faster services. However, it offers no evidence to demonstrate how these benefits might be realised.

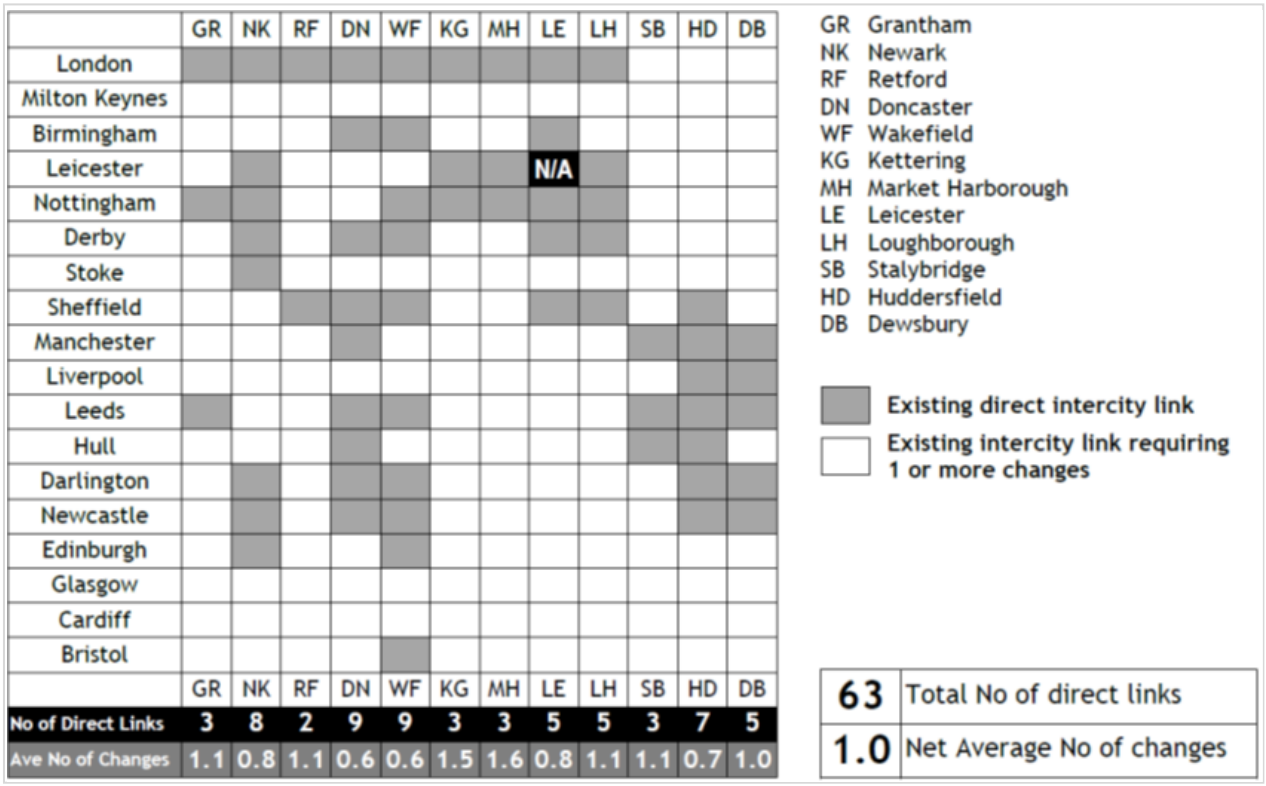
Whilst it is difficult to make definitive comment on future electrification projects, the frequency of services or the provision of more seats, it is possible – on a similar basis to that set out in Section 6.2 – to quantify the connectivity of any candidate scheme in regard to destinations served and journey times. This study therefore aims to test the connectivity benefits that the Integrated Rail Plan might offer to the 12 'Small Town' communities listed above.

It should first be noted that not all 12 communities can be fairly characterised as 'Small Towns'; indeed, Doncaster, Leicester and Huddersfield are all included among the 55 hubs considered in HSUK's analysis of the UK network. Moreover, Leicester, at over 300,000 population, has been considered as one of the UK's 18 primary network hubs cited in Figure 2E.

However, the typical population of the remaining communities – ranging from Wakefield at 100,000 down to Retford at 24,000 – is much smaller than what might justify inclusion in a 'Top 55' list. Instead, for a comprehensive and representative list, an analysis encompassing of the order of 150 communities, and over 10,000 journeys to link these communities, would be required.

This is plainly a daunting prospect, and it must be questioned whether such a complex analysis would deliver worthwhile results – or whether a simplified methodology might be more appropriate. It is also necessary to question whether all the 6 Connectivity Factors employed in Section 6.2 are appropriate, since these presuppose that the town or city under consideration could form a hub in a national network, and would have a reasonable expectation of direct 'no-change' journeys to other hubs. This is clearly not the case for most of the cited 'small towns'.

Currently, most of the smaller communities only enjoy hourly stopping services, with longer-distance, higher-speed services generally passing through non-stop. Only the larger 100,000+ communities (i.e. Doncaster, Wakefield, Leicester and Huddersfield) enjoy what might be described as a 'premium' service level, with most trains stopping, and (at Doncaster and Leicester) significant opportunities for interchange with services on other trunk routes.



	GR	NK	RF	DN	WF	KG	MH	LE	LH	SB	HD	DB
London												
Milton Keynes												
Birmingham												
Leicester								N/A				
Nottingham												
Derby												
Stoke												
Sheffield												
Manchester												
Liverpool												
Leeds												
Hull												
Darlington												
Newcastle												
Edinburgh												
Glasgow												
Cardiff												
Bristol												
	GR	NK	RF	DN	WF	KG	MH	LE	LH	SB	HD	DB
No of Direct Links	3	8	2	9	9	3	3	5	5	3	7	5
Ave No of Changes	1.1	0.8	1.1	0.6	0.6	1.5	1.6	0.8	1.1	1.1	0.7	1.0

Figure 6.5A : 12 'Small Towns' – National Connectivity with Existing Network

The connectivity problems facing the UK's small towns are demonstrated in Figure 6.5A. This charts the direct services currently available between the 12 'Small Towns' cited in the Integrated Rail Plan, and 18 principal towns and cities representing the UK's major conurbations (as featured also in Section 6.2 and Figure 6.2A).

Figure 6.5A shows the direct connectivity offered by the existing network to be mainly concentrated along the main line corridor – either East Coast, Midland or Transpennine – on which the 'Small Town' in question is located. Out of the 215 possible journeys (note that Leicester is present in both the 'Small Towns' and the 'Principal Cities' list) there are only 63 direct links. This can be expressed as a 'network efficiency' of 29% (=63/215).

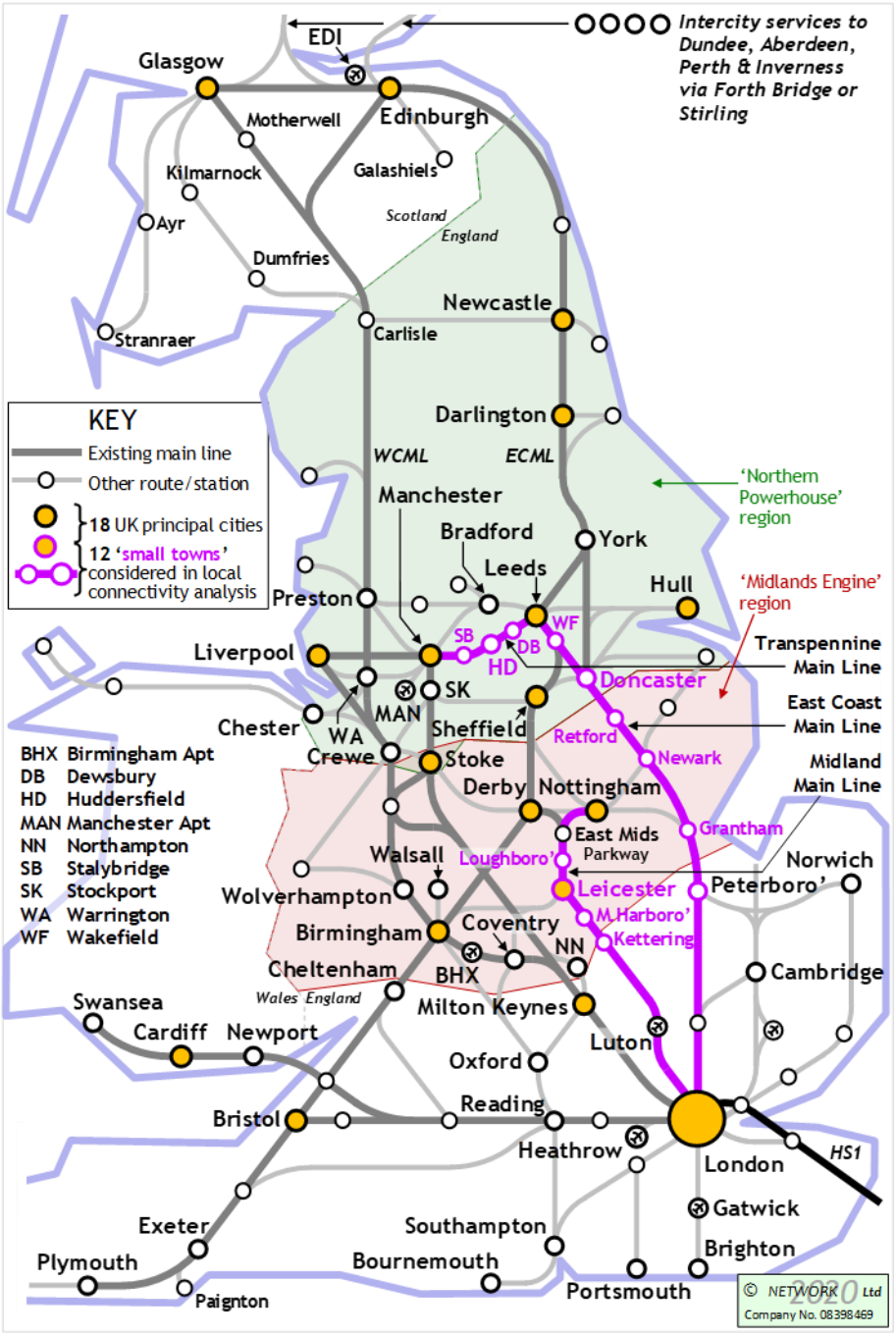


Figure 6.5B : Location of 12 'Small Towns' and 18 Principal UK Towns/Cities

This signposts a more simplified methodology whereby:

- Links between the 12 'Small Town' communities are assessed only to the 18 principal towns/cities, as set out in Figures 6.5A and 6.5B.
- Journey times are calculated using the same methodologies outlined in Section 6.2 to take account of the extra journey time inherent in changing trains.
- Only 2 Connectivity Factors – reduction in journey times, and reduction in number of changes required – are considered in the calculation of a 'Simplified Connectivity Improvement Score.'
- Only 2 Candidate Schemes – the Integrated Rail Plan and the HSUK Exemplar Alternative – are considered alongside the Existing Network in this assessment.

6.5.2 Test 5A – HSUK and IRP Connectivity along Main Line Corridors

An appreciation of the connectivity benefits of the Integrated Rail Plan relative to the High Speed UK Exemplar Alternative can be gained from Figures 6.5C, 6.5D and 6.5E. These demonstrate how the 12 'Small Towns' will be placed in future Integrated Rail Plan and HSUK intercity networks.

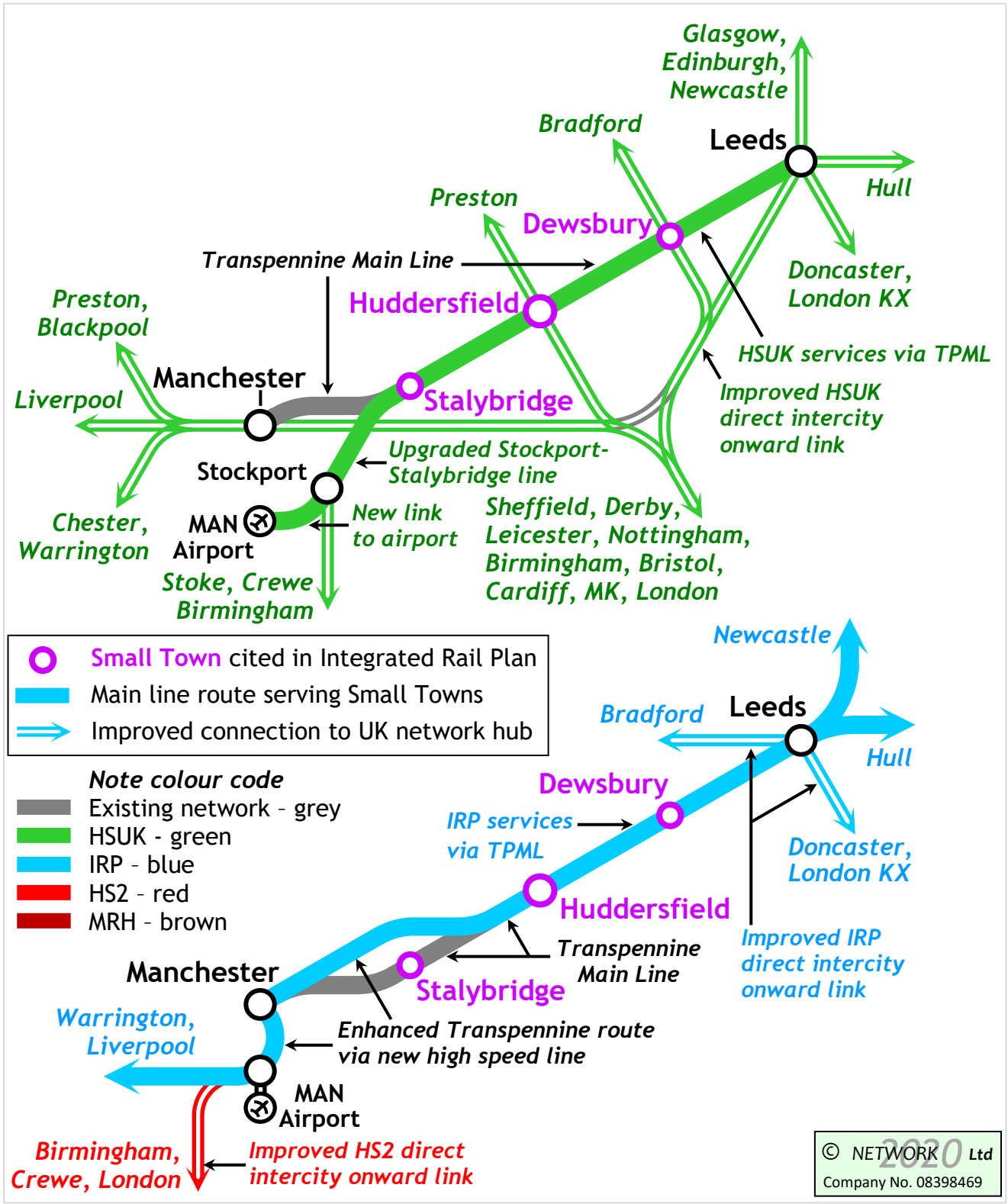


Figure 6.5C : HSUK & IRP Links to 'Small Towns' on Transpennine Main Line

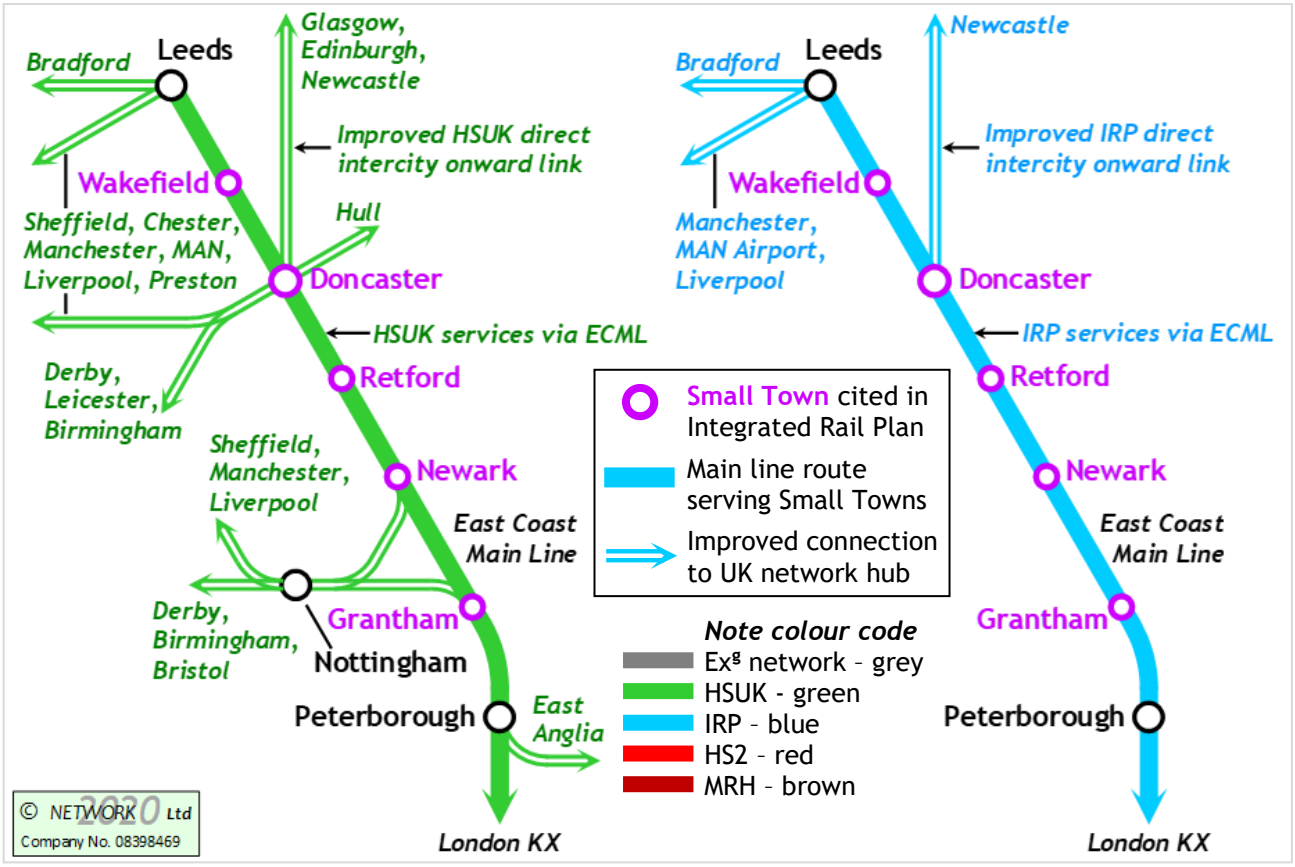


Figure 6.5D : HSUK & IRP Links to 'Small Towns' on East Coast Main Line

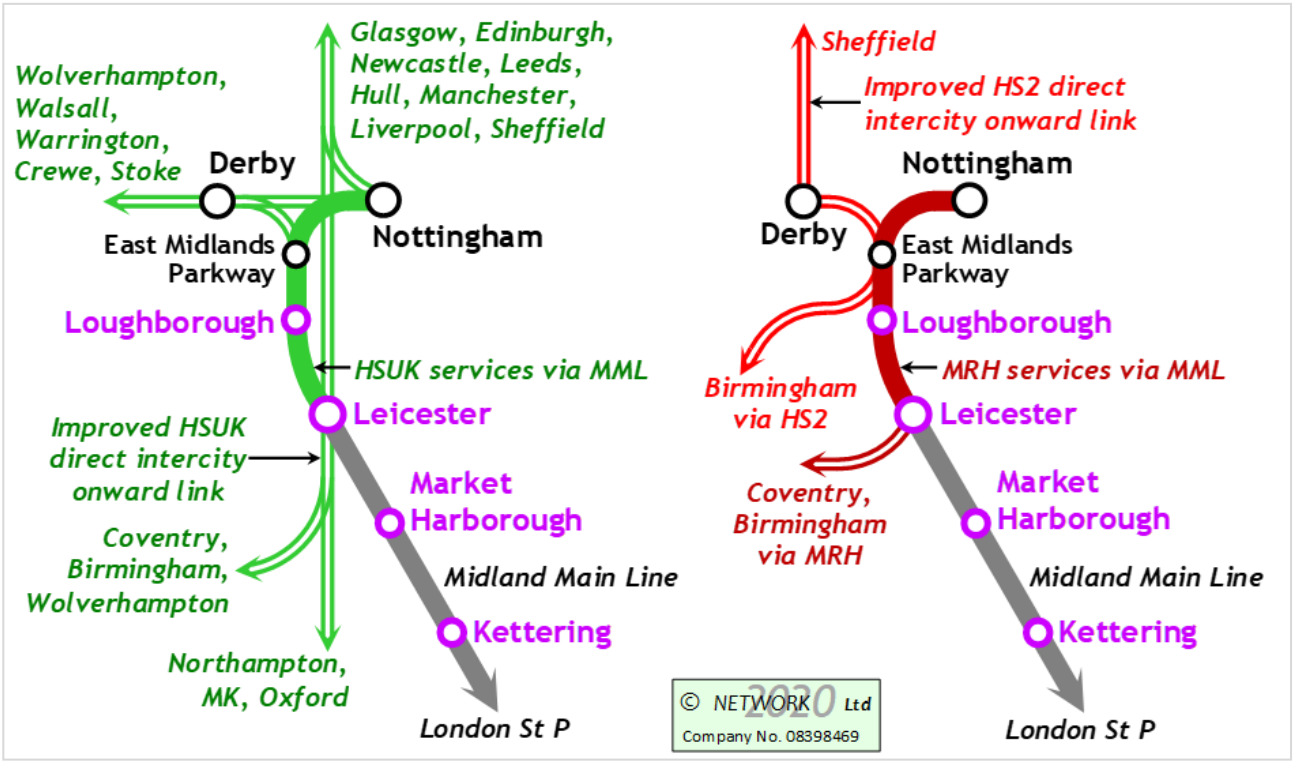


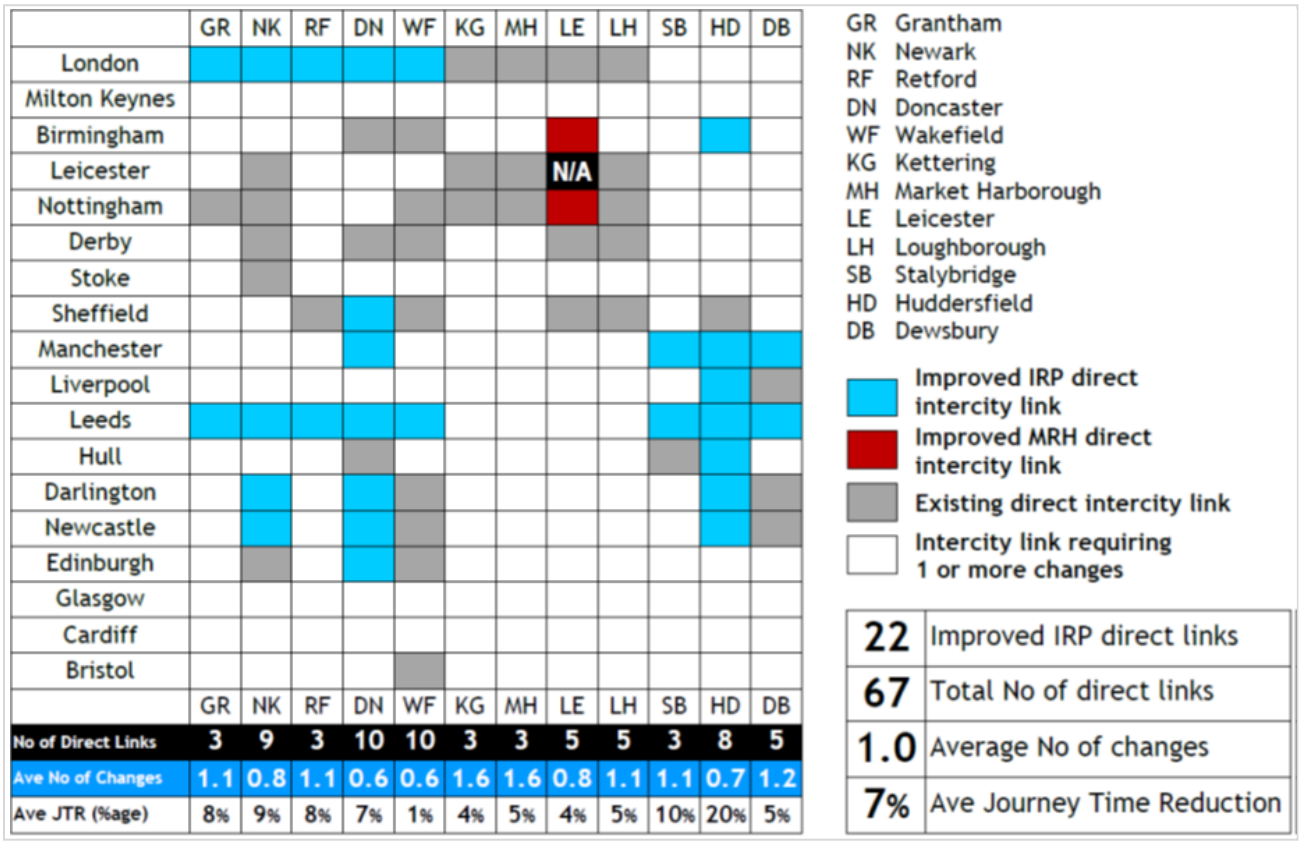
Figure 6.5E : HSUK & IRP Links to 'Small Towns' on Midland Main Line

Whilst the enhancements to existing main line corridors proposed under the Integrated Rail Plan may deliver some local improvements to the 'Small Town' communities along the main line route in question, it is highly unlikely that (for instance) a new stop at Retford will be introduced onto express intercity services from London to Newcastle and Edinburgh. The inevitable tension between operating long-distance time-sensitive express services capable of competing with the airlines, and incurring extra journey time for each additional stop necessary to serve smaller intermediate communities, will always remain.

6.5.3 Test 5B – HSUK and IRP Connectivity across National Network

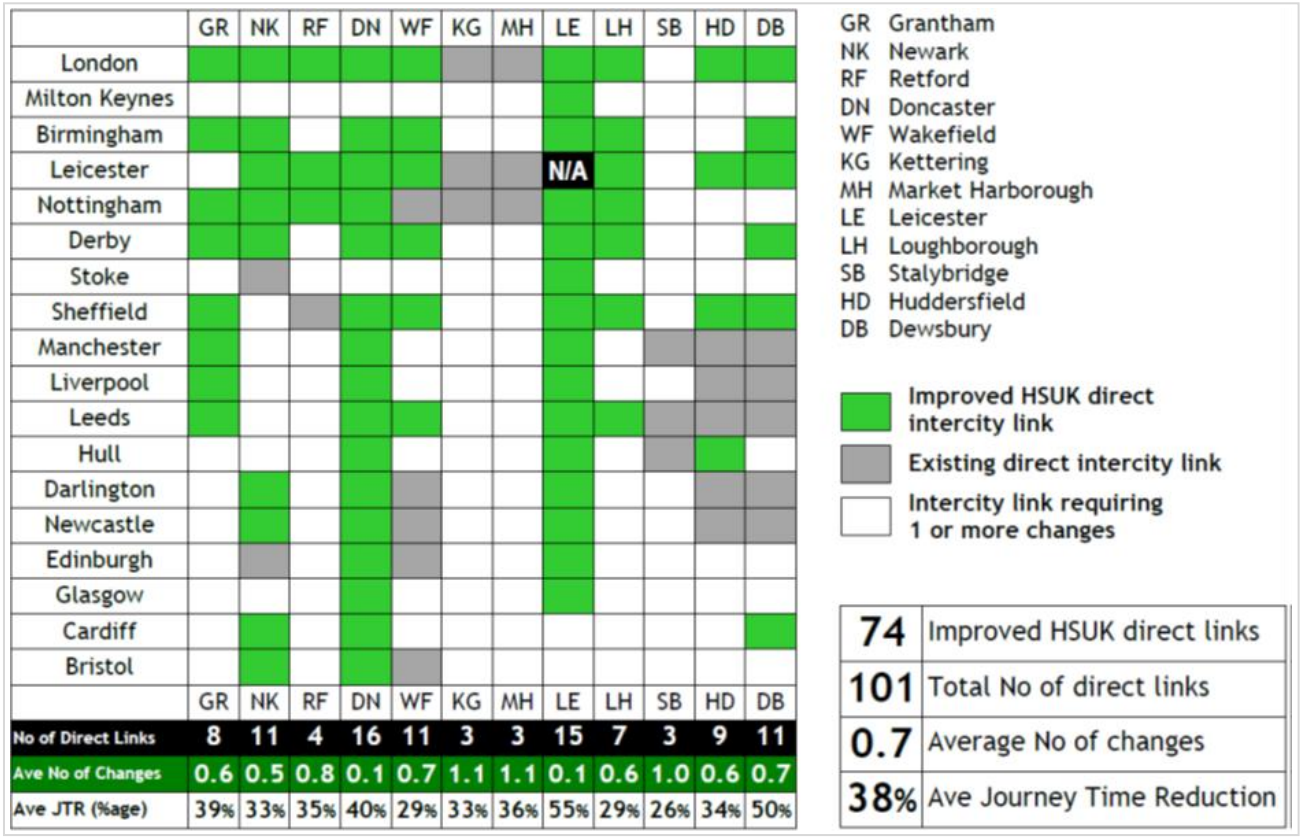
Wider improvements across the national network are primarily dependent upon the opportunity for interchange at nearby hub stations (i.e. Doncaster on the ECML, Leicester on the MML and Manchester and Leeds on the TPML), and by the creation of entirely new intercity routes. These opportunities for improved network performance are illustrated for the 2 candidate schemes in Figures 6.5C, 6.5D and 6.5E.

These diagrams show the High Speed UK Exemplar Alternative to offer the 12 'Small Towns' a level of connectivity that far surpasses anything that is possible with the Integrated Rail Plan. This is immediately apparent from the more quantified assessments of direct connectivity and journey time reduction set out in Figures 6.5F and 6.5G, and summarised in Table 6.5H.



	GR	NK	RF	DN	WF	KG	MH	LE	LH	SB	HD	DB
London												
Milton Keynes												
Birmingham												
Leicester												
Nottingham												
Derby												
Stoke												
Sheffield												
Manchester												
Liverpool												
Leeds												
Hull												
Darlington												
Newcastle												
Edinburgh												
Glasgow												
Cardiff												
Bristol												
	GR	NK	RF	DN	WF	KG	MH	LE	LH	SB	HD	DB
No of Direct Links	3	9	3	10	10	3	3	5	5	3	8	5
Ave No of Changes	1.1	0.8	1.1	0.6	0.6	1.6	1.6	0.8	1.1	1.1	0.7	1.2
Ave JTR (%age)	8%	9%	8%	7%	1%	4%	5%	4%	5%	10%	20%	5%

Figure 6.5F : 12 'Small Towns' – National Connectivity with Integrated Rail Plan



	GR	NK	RF	DN	WF	KG	MH	LE	LH	SB	HD	DB
London												
Milton Keynes												
Birmingham												
Leicester								N/A				
Nottingham												
Derby												
Stoke												
Sheffield												
Manchester												
Liverpool												
Leeds												
Hull												
Darlington												
Newcastle												
Edinburgh												
Glasgow												
Cardiff												
Bristol												
	GR	NK	RF	DN	WF	KG	MH	LE	LH	SB	HD	DB
No of Direct Links	8	11	4	16	11	3	3	15	7	3	9	11
Ave No of Changes	0.6	0.5	0.8	0.1	0.7	1.1	1.1	0.1	0.6	1.0	0.6	0.7
Ave JTR (%age)	39%	33%	35%	40%	29%	33%	36%	55%	29%	26%	34%	50%

Figure 6.5G : 12 'Small Towns' – National Connectivity with High Speed UK

Candidate Scheme	Improved direct links	Existing direct links	Total direct links	%age direct (out of 215)	Average Changes	Average JT Reduction
Integrated Rail Plan	**22**	**45**	**67**	**31%**	**1.0**	**7%**
High Speed UK	**74**	**27**	**101**	**47%**	**0.7**	**38%**
(Existing Network)	**---**	**---**	**(61)**	**(28%)**	**(1.0)**	**---**

Table 6.5H : Summary of Candidate Scheme Performance

Table 6.5H includes for purposes of comparison the performance of the existing network in connecting the 12 'Small Towns' to the 18 'Principal Cities'. This reveals the almost negligible effect that the Integrated Rail Plan will have on improving the connectivity of these 'Small Town' communities, and also the massive superiority of the High Speed UK Exemplar Alternative.

6.5.4 Test 5C – Deriving Simplified Connectivity Improvement Scores

The results of the assessments of national connectivity set out in the previous sections have been combined with the journey time reductions set out in Table 6.5I to derive a 'Simplified Connectivity Improvement Score' for each of the 12 'Small Towns' cited in the Integrated Rail Plan.

As with the derivation of Connectivity Improvement Scores for major communities of the Midlands Engine and the Northern Powerhouse set out in Section 6.2, these scores are, for purposes of comparison, scaled against a maximum score of 10 for the best-connected 'Small Town' (which in fact turns out to be Leicester!!). This comparison demonstrates another order of magnitude difference, with HSUK offering 9 times the connectivity benefits of the Integrated Rail Plan.

	High Speed UK			HS2/Integrated Rail Plan		
	Average Reduction in Change of Trains	Average Journey Time Reduction	Aggregate Connect-ivity Score HSUK	Aggregate Connect-ivity Score HS2/IRP	Average Reduction in Change of Trains	Average Journey Time Reduction
Grantham	0.56	39%	8.0	0.7	0.00	8%
Newark	0.28	33%	5.1	0.7	0.00	9%
Retford	0.28	35%	5.3	1.2	0.06	8%
Doncaster	0.47	40%	7.3	0.8	0.03	7%
Wakefield	0.00	29%	2.4	0.1	0.00	1%
Kettering	0.39	33%	9.5	0.3	0.00	4%
M.Harborough	0.50	36%	6.2	0.4	0.00	5%
Leicester	0.64	55%	10.0	0.4	0.00	4%
Loughborough	0.44	29%	6.2	0.4	0.00	5%
Stalybridge	0.06	26%	2.6	0.9	0.00	10%
Huddersfield	0.06	34%	3.3	1.7	0.00	20%
Dewsbury	0.33	50%	7.0	0.4	0.00	5%
Average	**0.33**	**38%**	**6.2**	**0.7**	**0.01**	**7%**

Table 6.5I : 'Small Town' Connectivity Score Elements for HSUK and IRP

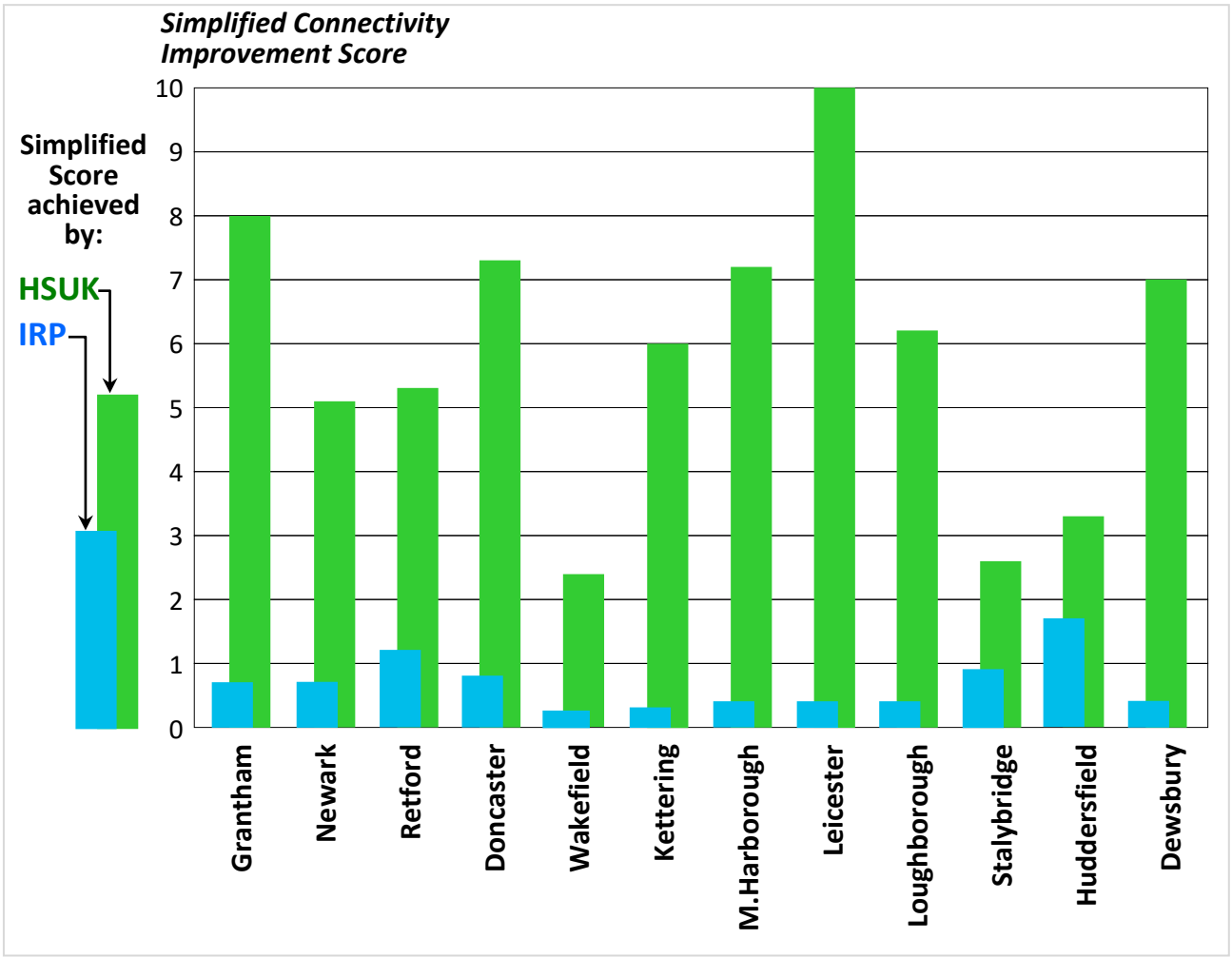


Figure 6.5J : Simplified Connectivity Improvement Scores for 12 'Small Towns'

6.5.5 Test 5 – Finding

The Integrated Rail Plan is incapable of delivering significant connectivity benefits to the 'Small Town' communities that it has pledged to protect; again, it is hugely outperformed by the High Speed UK Exemplar Alternative.

The Integrated Rail Plan has, at least in part, justified its massive cuts to HS2 Phase 2b (east) and Northern Powerhouse Rail by highlighting the connectivity needs of 12 'Small Town' communities on existing main line routes which would have seen major reductions in services if HS2 and NPR had been constructed in full.

The analysis set out in this study demonstrates that for all the 12 'Small Town' communities cited as potential beneficiaries in the Integrated Rail Plan – Grantham, Newark, Retford, Doncaster, Wakefield, Kettering, Market Harborough, Leicester, Loughborough, Stalybridge, Huddersfield and Dewsbury – far greater connectivity benefits will accrue from the High Speed UK Exemplar Alternative.

Moreover, there is no reason to suppose that HSUK would not show very similar massive superiority if the same analysis were applied to a different group of 12 communities, for instance: Durham, Sunderland, Middlesbrough, Harrogate, Halifax, Barnsley, Chesterfield, Altrincham, Bolton, Blackpool, Burnley and Carlisle. Results for these communities will shortly be published.

The IRP's championing of 'Small Town' communities must also be challenged in a wider context. It raises huge questions concerning major communities such as Milton Keynes, Coventry and Stoke, which are due to be bypassed by either Phase 1 or Phase 2a of HS2, and which as a consequence will suffer significant reductions in premium intercity services. If it is worth cancelling sections of HS2 further north, to protect communities that would suffer economic harm if bypassed, why has this principle not been extended to the sections of HS2 already under construction?

6.6 Gauging the IRP's Transformation of Regional Rail Networks

Test 6 poses the question: ***"Can the Integrated Rail Plan transform the railway network in the Midlands and the North, and provide the additional capacity to spur the development of regional 'powerhouse' economies?"***

6.6.1 Test 6 – Assessment Rationale and Methodology

This study has presented many detailed comparisons of journey times and direct intercity links, and calculations of 'Connectivity Improvement Scores' etc, but – as with Harry Beck's iconic map[31] of the London Underground – it is sometimes easier to present the concept of a fully-connected Midlands or North in graphical form.

Politicians have frequently called for a 'Crossrail for the North'; however, the Integrated Rail Plan offers no graphical vision to demonstrate how its proposed interventions will deliver a transformed railway network in the North, or in any UK region. This leads to a strong suspicion that there is no real ambition for such a network, that might see all principal centres within a UK region directly interconnected with high quality, high speed and high frequency intercity services. It leads also to an equally strong suspicion that there is little or no concept that such a network, capable of supporting Government's Levelling-up agenda, and capable of bringing about the desired 'powerhouse' economy, might even be possible.

There is a clear need for a 'Tube Map for the North', and a 'Tube Map for the Midlands', to demonstrate the official vision; and in the absence of any convincing official images, it falls to this study to present 'Tube Map' comparisons of how the Integrated Rail Plan and the High Speed UK Exemplar Alternative perform in interconnecting the principal cities of the North and the Midlands.

There is also a need for detailed schemes to demonstrate how local networks in all the major conurbations of the Midlands and the North will be transformed to support the Government's Levelling-up and Net Zero agendas. Regrettably, however, the Integrated Rail Plan offers no vision for how the required step-change enhancements in capacity will be achieved; and again, it falls to this study to demonstrate the potential transformations in local connectivity and capacity that a well-designed and integrated national high speed rail scheme could bring about.

Section 6.6 sets out the following tests/comparisons of network performance:

Test	Section	Test/Comparison
6A	**6.6.2**	**Network Comparisons in the Northern Powerhouse**
6B	**6.6.3**	**Capacity Improvements in Central Manchester**
6C	**6.6.4**	**Network Development in Liverpool City Region**
6D	**6.6.5**	**Network Development in Sheffield City Region**
6E	**6.6.6**	**New Transpennine Railfreight Route**
6F	**6.6.7**	**Network Comparisons in the Midlands Engine**
6G	**6.6.8**	**Capacity Improvements in West Midlands**
6H	**6.6.9**	**Network Development in Potteries Region**

Table 6.6A : Local Network/Capacity Comparisons presented in Section 6.6

6.6.2 Test 6A – Network Comparisons in the Northern Powerhouse

The limitations of the Integrated Rail Plan offering for the Northern Powerhouse are readily apparent from Figure 6.6B.

Any improvements are small, all failing the requirements of the Northern Powerhouse journey time specification, and Bradford – the worst-connected major city in the Northern Powerhouse region – will be left isolated on the end of 2 separate branch lines.

When considered from the perspective of railway network performance, probably the greatest concern lies with the deeply-flawed proposals for a new terminus station at Manchester Piccadilly. Located at the fulcrum of the entire system, its proposed 6 platforms must handle both HS2 services and IRP services across the North. 5 HS2 services (3 from London and 2 from Birmingham) and up to 18 IRP services (6 from each of Liverpool, Leeds and Sheffield, in line with the Northern Powerhouse specification) will crowd into the station each hour, and the same number will depart.

This would appear to be completely impractical for the 6 platforms that are currently proposed. And if the station were to be built as planned, the capacity for premium intercity services operating across the Northern Powerhouse – in particular, for through services from Liverpool to Sheffield and Leeds – would be hugely limited.

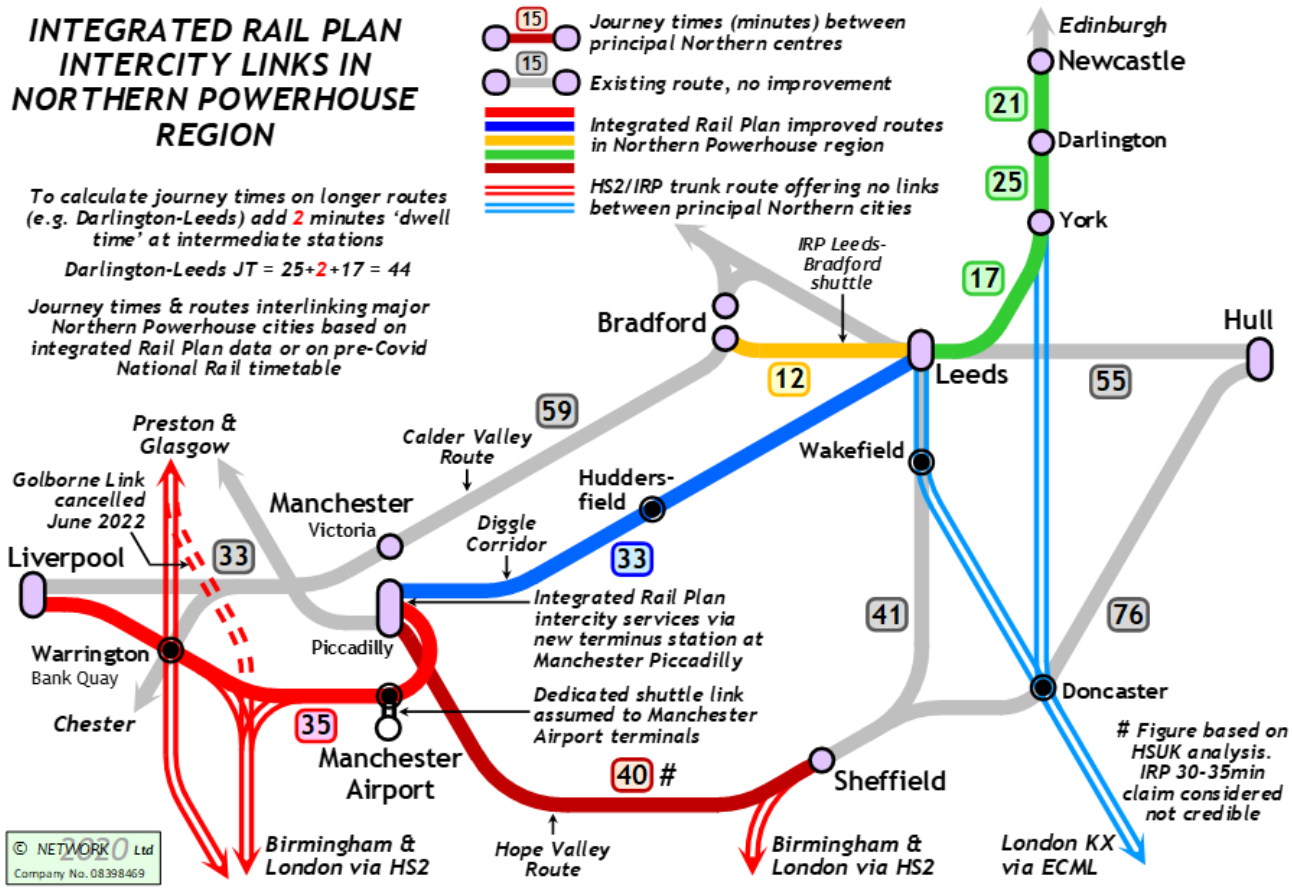


Figure 6.6B : Northern Powerhouse 'Tube Map' illustrating principal IRP services

Coloured lines indicate improved intercity services, with journey times shown in the same colour; whereas journeys with no improvement are shown grey.

The IRP's problems, of its comprehensive failure to meet the Northern Powerhouse journey time specification (see Section 6.3), and its wholly inadequate proposals for a new station in Manchester, are entirely avoided with the High Speed UK Exemplar Alternative (promoted locally as 'Network North').

Figure 6.6C shows the core HSUK (Network North) system in the Northern Powerhouse region. This will:

- Fully interlink the 7 largest cities (Liverpool, Manchester, Sheffield, Bradford, Leeds, Hull and Newcastle).
- Meet all the intercity journey time requirements of the Northern Powerhouse specification.
- Provide an underground 'through' station at Manchester Piccadilly, addressing all of the concerns regarding the HS2/IRP proposal for a terminus station, and delivering a step-change in capacity for local services – see Section 6.6.3.
- Deliver bespoke solutions for similar transformations of city networks in Leeds, Liverpool and Sheffield – see Sections 6.4.5, 6.6.4 and 6.6.5.
- Allow the establishment of a new Transpennine railfreight route extending from the Port of Liverpool to principal East Coast ports – see Section 6.6.6.

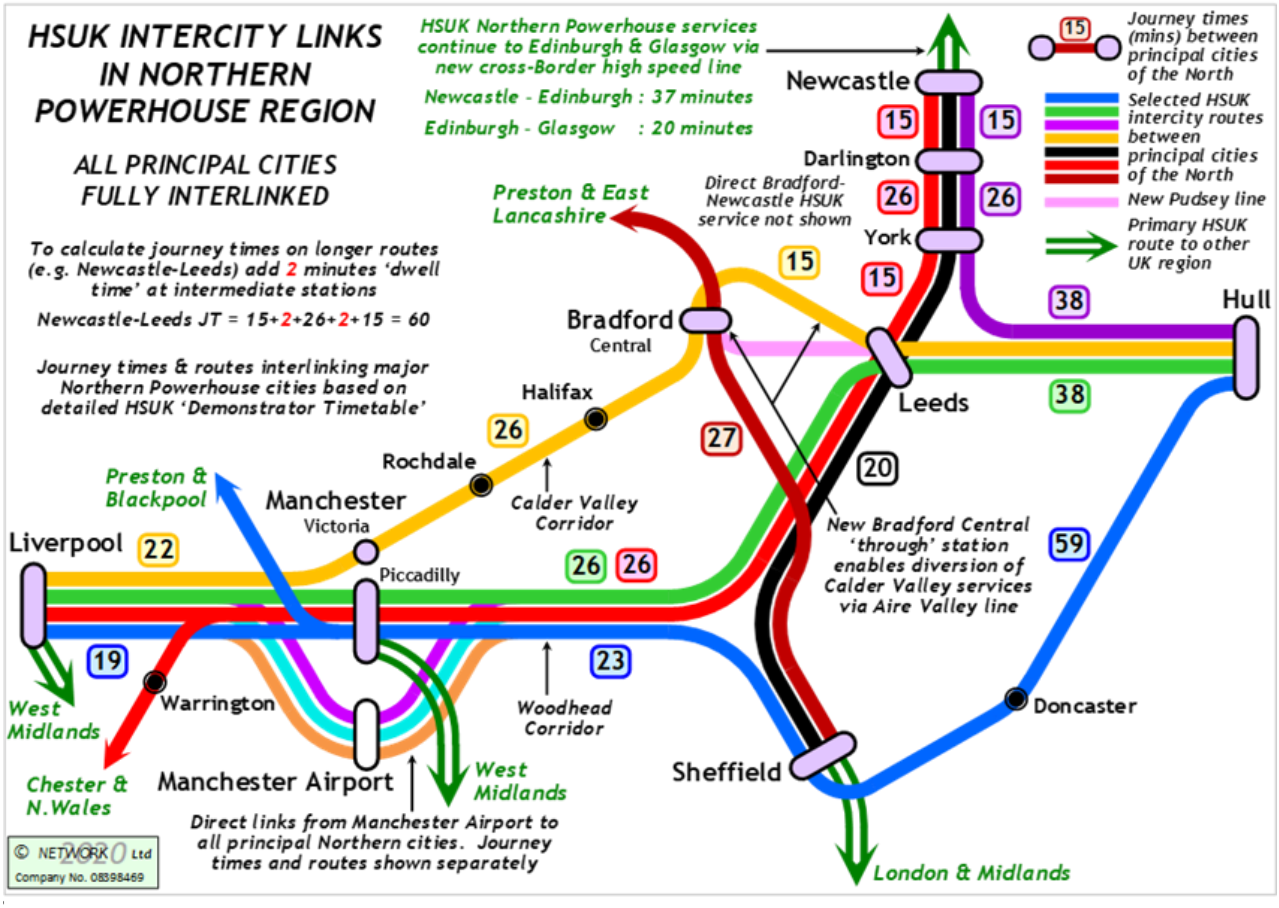


Figure 6.6C : Northern Powerhouse 'Tube Map' illustrating principal HSUK services

Figure 6.6D on the following page shows the HSUK/Network North direct links to the region's principal international gateway at Manchester Airport. These will transform the airport's rail connectivity, with high quality services extending beyond the region's 7 largest cities (as above} to most principal population centres of the Northern Powerhouse.

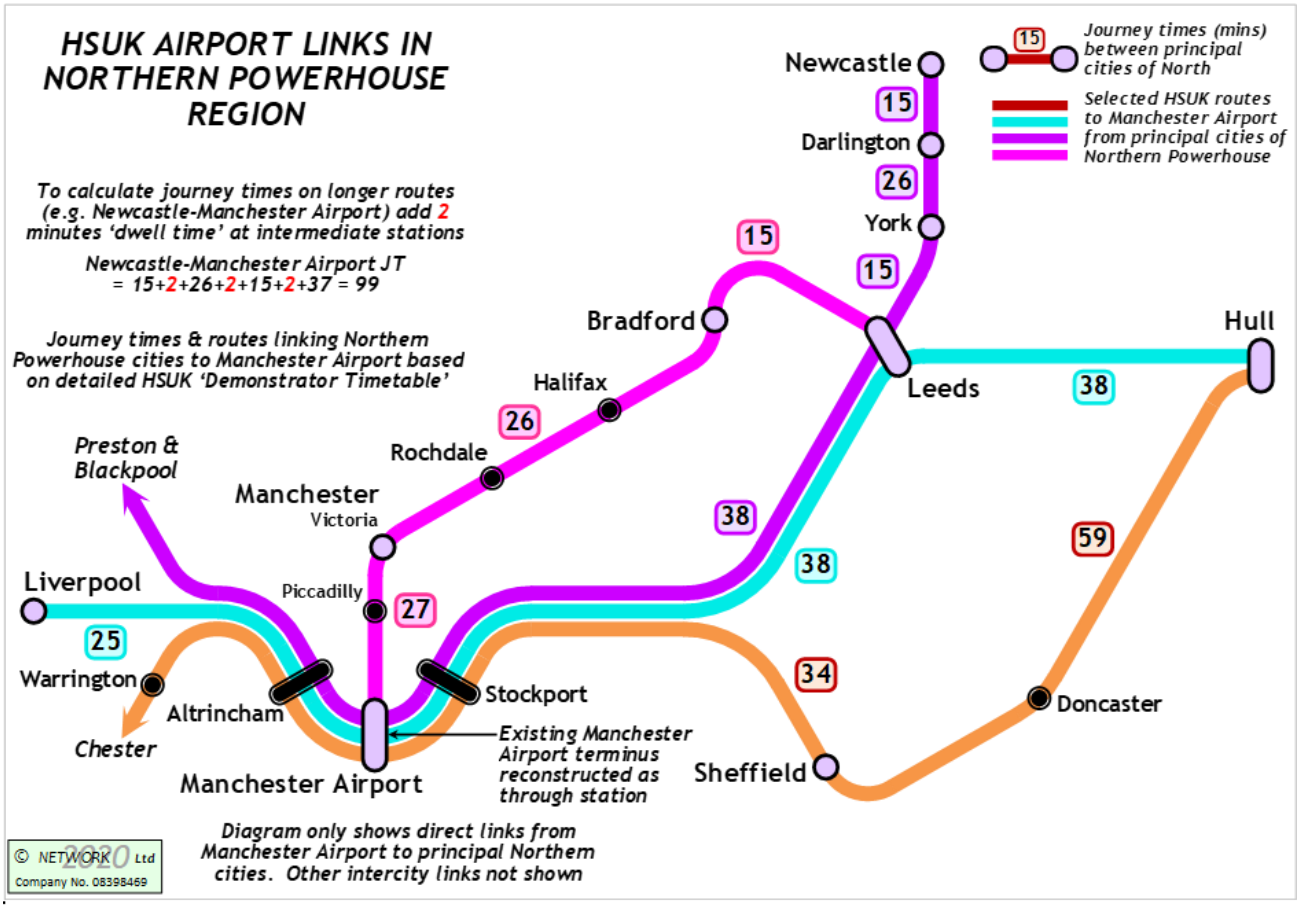


Figure 6.6D : Northern Powerhouse 'Tube Map' illustrating HSUK airport services

Figure 6.6E below summarises the contrasting direct connectivity offers of the Integrated Rail Plan and High Speed UK between 8 principal centres of the Northern Powerhouse. Whereas the IRP improves only 12 links out of a possible 28, and leaves 8 'city pairs' disconnected, HSUK delivers improved direct connections on all 28 possible journeys.

Sheffield	SH							IRP direct link
MAN Airport		MAN						Existing link
Manchester			MA					No direct link
Liverpool				LI				Total links 20
Bradford					BD			
Leeds						LS		
Hull							HU	
Newcastle								NE
	SH	MAN	MA	LI	BD	LS	HU	NE
No of Direct Links	6	5	7	5	2	7	3	5

Sheffield	SH							HSUK direct link
MAN Airport		MAN						No direct link
Manchester			MA					Total links 28
Liverpool				LI				
Bradford					BD			
Leeds						LS		
Hull							HU	
Newcastle								NE
	SH	MAN	MA	LI	BD	LS	HU	NE
No of Direct Links	7	7	7	7	7	7	7	7

Figure 6.6E : Northern Powerhouse IRP/HSUK Direct Connectivity Comparisons

6.6.3 Test 6B – Capacity Improvements in Central Manchester

Proposed HS2/IRP links to Greater Manchester are illustrated in Figures 4B and 6.3D. However, no detailed proposals have so far emerged, to describe how the Integrated Rail Plan proposals will integrate with the existing railway network, and deliver a step-change capacity improvement for local rail services in Greater Manchester – in other words, the 'local capacity dividend' that has been long promised for the HS2 project, which has so far failed to materialise.

Major concerns with the proposed HS2/IRP terminus at Manchester Piccadilly have already been set out in Section 6.1.3, in the commentary specifically relating to IRP Journeys **15** and **16**. This station, comprising just 6 terminus platforms, appears incapable of handling the planned traffic – 5 HS2 services per hour, and up to 18 Northern Powerhouse Rail services per hour (to Liverpool, Leeds and Sheffield as indicated in Figure 2D). There is also no indication that either HS2 or the Integrated Rail Plan will do anything to relieve the intense congestion along the 'Castlefield Corridor' between Piccadilly and Deansgate.

Viewed from either a local, a regional or a national perspective, the priority for an inland conurbation such as Greater Manchester cannot be the terminus station proposed in the Integrated Rail Plan. The IRP's connectivity and capacity problems are avoided through HSUK's radically different station strategy in Manchester, for a centrally-located station on a through route from Liverpool to Leeds and Sheffield; this effectively dictates a tunnel running west-to-east below central Manchester, with underground platforms at Manchester Piccadilly.

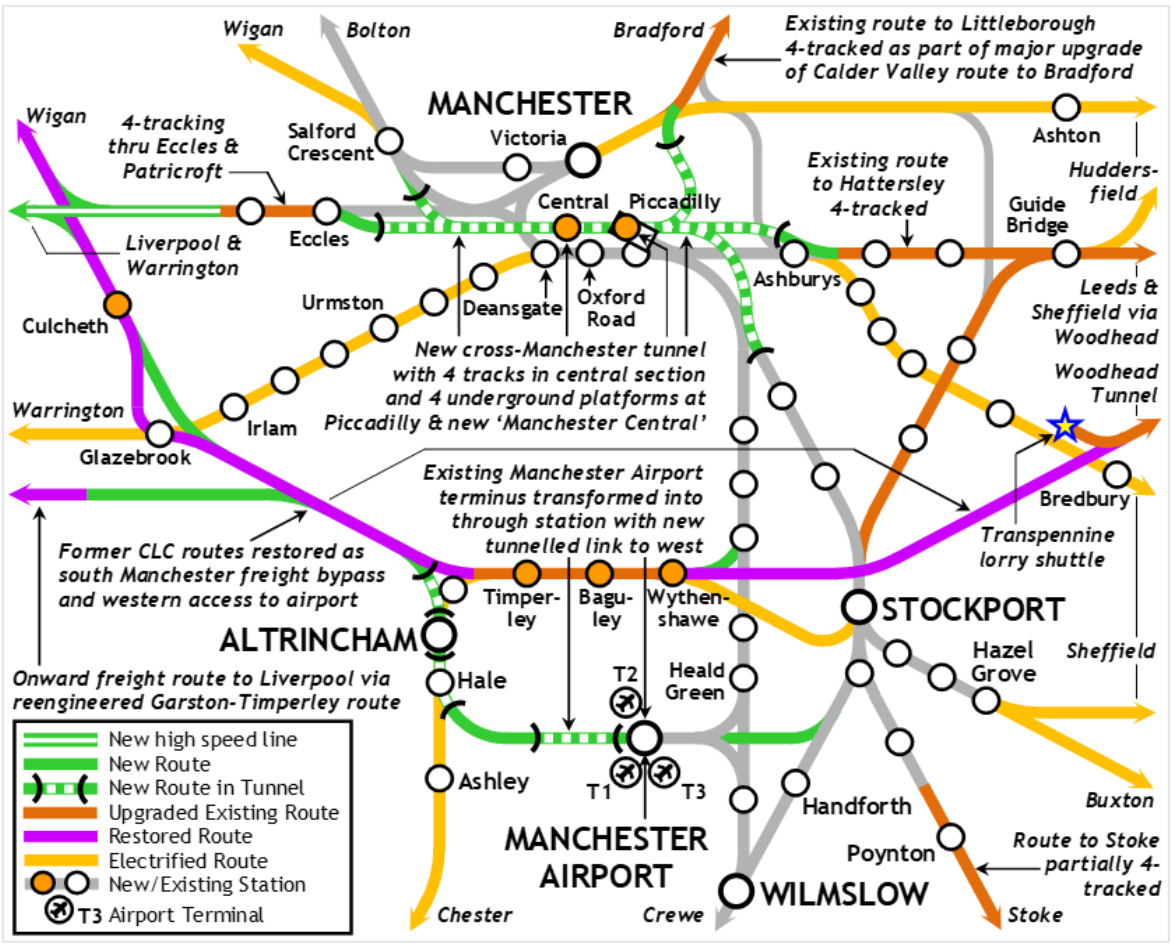


Figure 6.6F : HSUK proposed New Works & Upgrades in Greater Manchester

Figure 6.6F on the previous page sets out the key HSUK proposals in Greater Manchester, including the proposed cross-Manchester tunnel:

- In its central section, the new tunnel will comprise 4 tracks (2 in each direction).
- At its east end, the tunnel will connect to an upgraded/restored Woodhead route towards Leeds and Sheffield, and also to the WCML route towards Stockport.
- At its west end, the tunnel will connect to an upgraded Chat Moss (former 'Liverpool and Manchester') line towards Liverpool, and also to the Bolton line.
- A new underground station at Manchester Piccadilly comprising 4 platforms will connect to local, regional and national services at the existing Piccadilly station.
- An additional 'Manchester Central' station will bring commuter services closer to the centre of the city.

The HSUK proposals will also create a new 'South Manchester Loop' that will revolutionise rail access to Manchester Airport, the principal international gateway of the Northern Powerhouse.

- The South Manchester Loop will comprise a mixture of upgraded existing routes, new routes and restored routes.
- The Loop will serve the existing Manchester Airport Station, which will be transformed from its existing terminus configuration into a 'through' station offering much greater capacity.
- The Loop will also serve the existing stations at Stockport and Altrincham.

The third strand of the HSUK proposals for Greater Manchester is the creation of a dedicated cross-Manchester freight route. Currently, with all Transpennine routes compelled to pass through the congestion of central Manchester (either through Piccadilly or Victoria stations), there is little or no capacity for new Transpennine railfreight flows, and a new bypassing route is an essential element of any project to deliver on Transport for the North's ambition for a *"freight superhighway connecting Liverpool and the Humber"*.

Within Greater Manchester, this ambition will be realised through the HSUK proposals for a restored/reengineered Garston-Timperley route, and a restored Tiviotdale route through Stockport. The HSUK freight proposals are documented in greater detail in Section 6.6.6.

Overall, the HSUK proposals – principally, the construction of a new cross-Manchester tunnel, but also the elimination of railfreight flows from city centre stations – will radically enhance the railway network of Greater Manchester. The new tunnel will add 4 new cross-city tracks to Manchester's railway network, and will be available for both intercity and local traffic. From a local perspective, this will have the effect of both doubling the capacity of the Castlefield Corridor, and also eliminating the necessity to terminate trains at Piccadilly. This will enable a transformation of Greater Manchester's suburban network, as shown in Figure 6.6G.

This is the 'local capacity dividend' that the HS2 project has so far failed to deliver for Greater Manchester – or, indeed, for any other regional UK conurbation. It cannot come about simply by the act of building a new high speed line in isolation – it will only happen if that new line, not necessarily 'high speed', is fully integrated with the existing network.

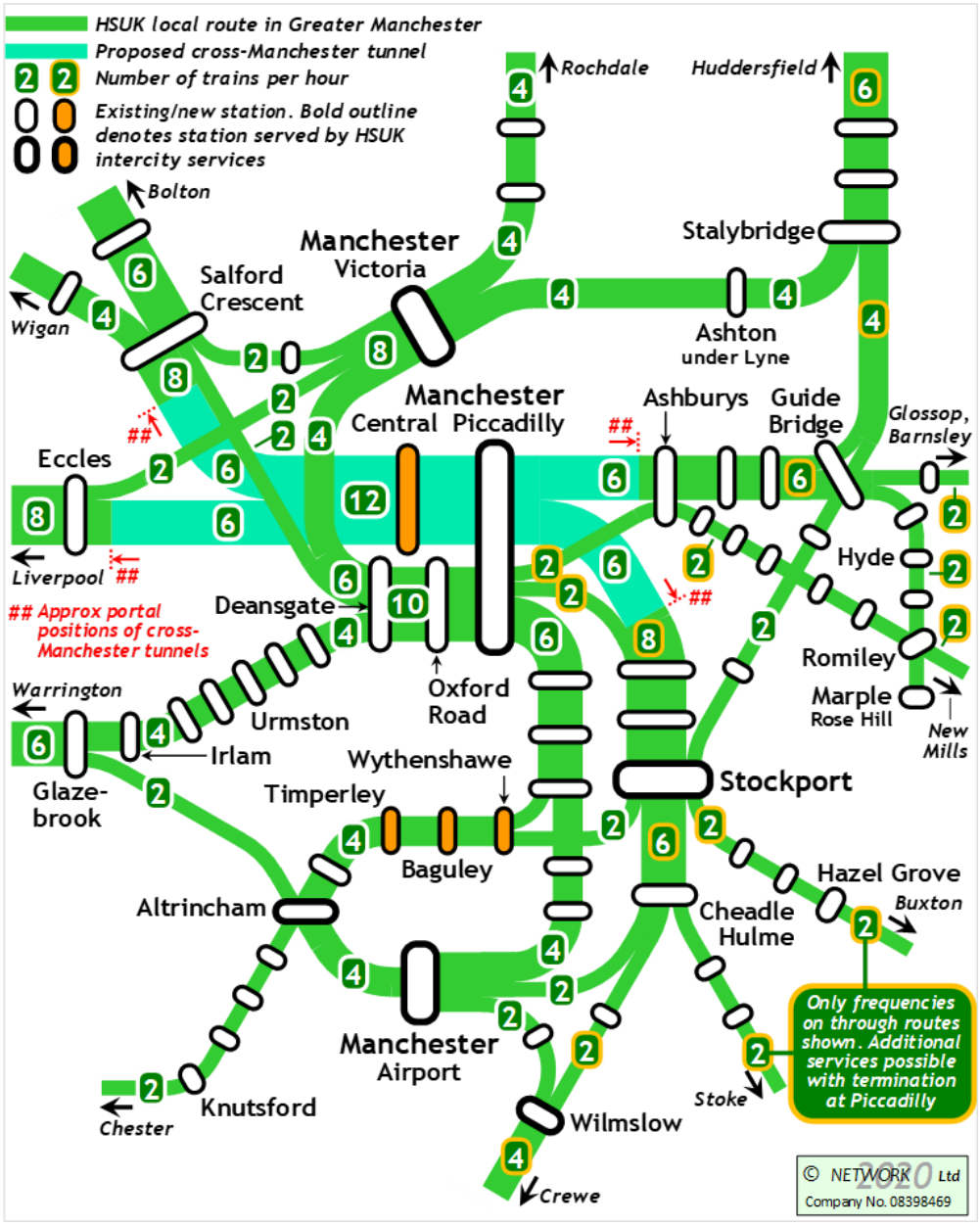


Figure 6.6G : HSUK proposed cross-Manchester suburban services

6.6.4 Test 6C – Network Development in Liverpool City Region

As with Manchester, any official scheme that might indicate how the Integrated Rail Plan could transform the railway network of Liverpool and its wider City Region is conspicuous by its absence. The need for integrated planning of railway schemes in Liverpool is clear:

- Over 13 years into the UK high speed rail project, viable proposals for a new high speed line accessing Liverpool and serving a central hub station have yet to emerge.
- Any such proposal must be integrated with the development of upgraded freight routes to the Port of Liverpool – the UK's premier Atlantic-facing port.

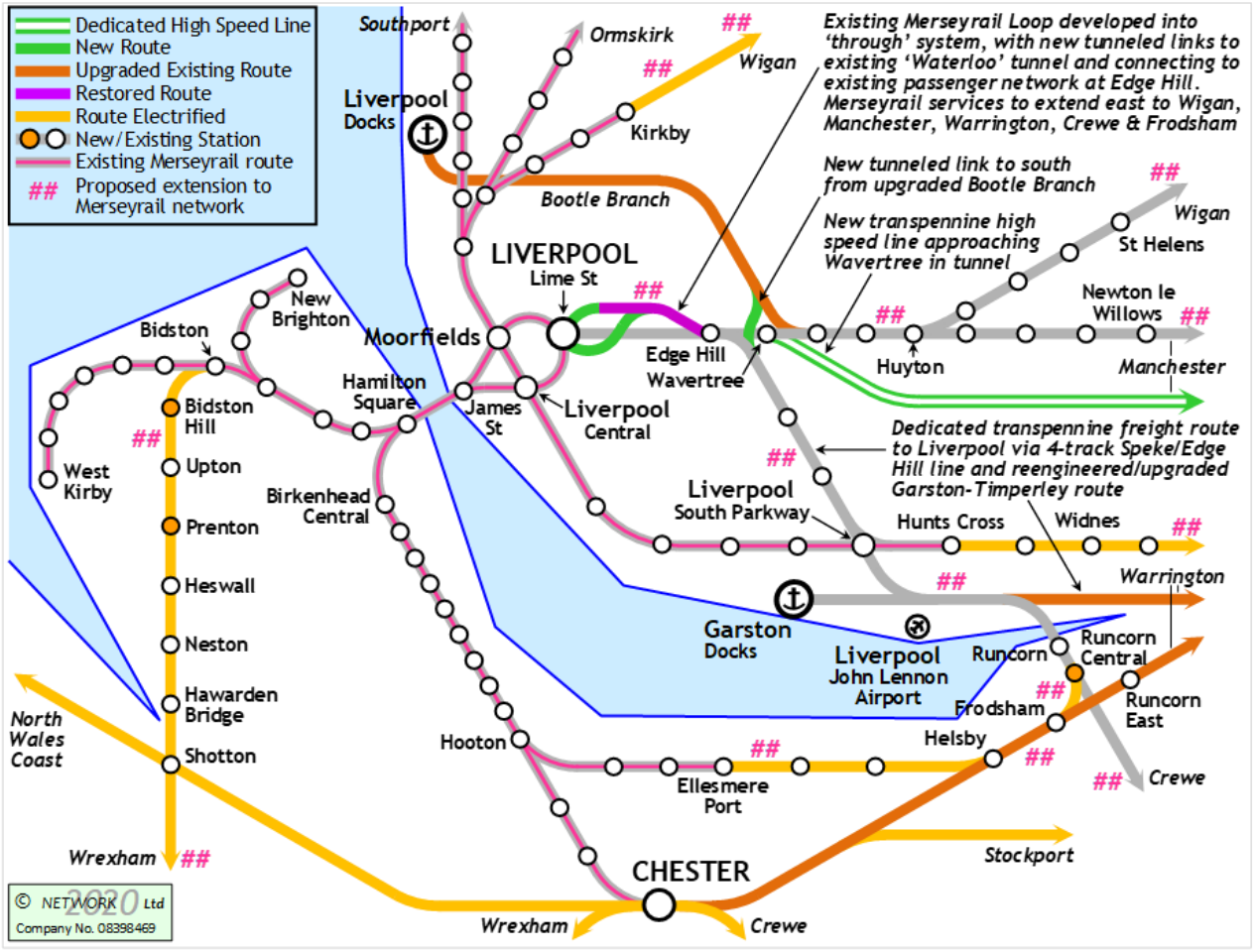


Figure 6.6H : HSUK proposed New Works & Upgrades in Liverpool City Region

In the absence of any worthwhile official proposals, it falls to the HSUK Exemplar Alternative to show the way forward. Figure 6.6H above sets out the key HSUK proposals in Liverpool City Region:

- A new high speed line approaching from the east along the corridor of the M62, comprising Liverpool's trunk route to all other UK primary cities;
- New high speed line joining the approaches to Liverpool Lime Street at Wavertree;
- Lime Street remodelled as Liverpool's intercity terminus, with sufficient platforms 275 metres long to accommodate hourly intercity services to all other UK primary cities;
- Existing underground Merseyrail Loop transformed into 'through' system allowing existing overhead-electrified suburban services to be diverted clear of the Lime Street terminus, and continue (via dual-voltage traction) to third-rail network in the Wirral;

- Same dual-voltage operation applied to other Merseyrail routes, to allow services to extend to Wrexham, to Frodsham, to Wigan Wallgate and to Preston;
- Existing 'Bootle Branch' freight route from Port of Liverpool to be upgraded and connected to Edge Hill/Speke line via new tunnel, as first stage of dedicated Transpennine railfreight route – for further details see Section 6.6.6.

The developments listed above will enable major enhancements across Liverpool City Region's suburban network, as depicted in Figure 6.6I below.

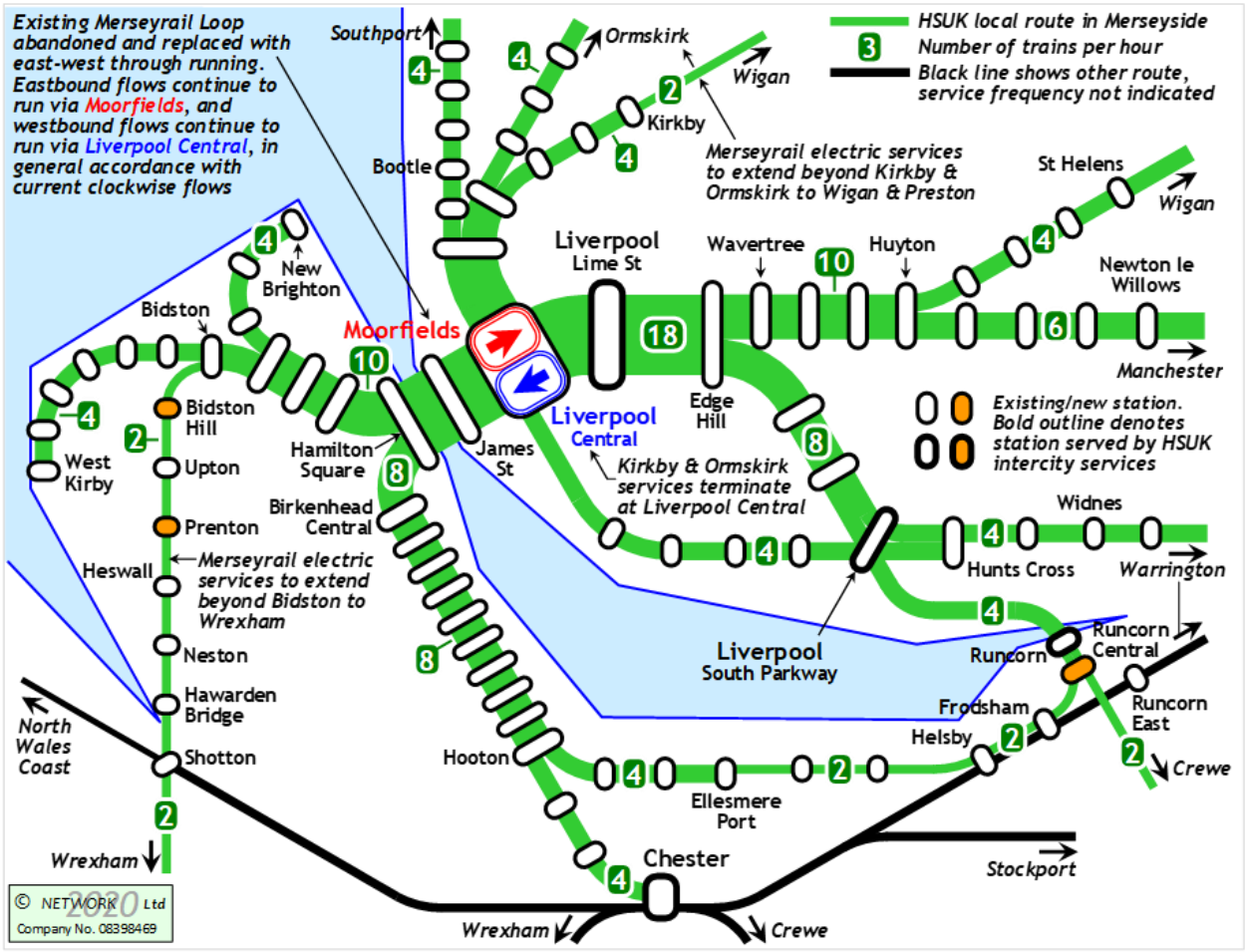


Figure 6.6I : HSUK proposed Suburban Services in Liverpool City Region

6.6.5 Test 6D – Network Development in Sheffield City Region

As with Manchester and Liverpool, no official scheme exists to set out how the Integrated Rail Plan might transform the railway network of Sheffield and its wider City Region. This is hardly surprising, given the general absence of significant IRP proposals for Sheffield – nothing more than on-line upgrades of the Midland Main Line from the south, and of the Hope Valley route from the west, as illustrated in Figures 4B and 6.3D.

These will deliver the journey time reductions set out in Table 6.1A (Journeys **07**, **10** and **11**) to Manchester, to London and to Birmingham – but to no other major UK city. Collectively the IRP's enhancements will do almost nothing to improve Sheffield's regional or national connectivity, and absolutely nothing to develop an enhanced suburban network around Sheffield.

Figure 6.6J : HSUK proposed new works & upgrades in Sheffield City Region

Figure 6.6J above shows the transformation that HSUK will effect upon the rail network of the Sheffield City Region:

- A new high speed line approaching Sheffield from the south-east, on a combination of new-build route and existing lines upgraded to 4 tracks;

- The new high speed line continuing to the north-west, and splitting near Penistone for Leeds, and for Manchester and Liverpool via the abandoned Woodhead Corridor;
- A new central station in Sheffield on the site of the former Sheffield Victoria, including interchange platforms on the existing approaches route into Sheffield Midland;
- Diversion of intercity services (Midland Main Line, Crosscountry and Transpennine) away from Sheaf Valley route south-west of Sheffield Midland, allowing new suburban stations;
- Development of new or reopened stations on other radial routes into Sheffield;
- Radically improved rail access to all designated Growth Areas in Sheffield City Region;
- Redevelopment of the abandoned Woodhead line as a new high-capacity freight route (in line with Transport for the North's ambition for a *"freight superhighway connecting Liverpool and the Humber"*) – see Section 6.6.6.
- Introduction of Channel Tunnel-style lorry shuttle services along the Woodhead route, linking the M60 and the M1, and eliminating any need for a new Trans-Peak motorway.

The developments listed above will enable the establishment of a hugely enhanced suburban network across Sheffield City Region, as depicted in Figure 6.6K below.

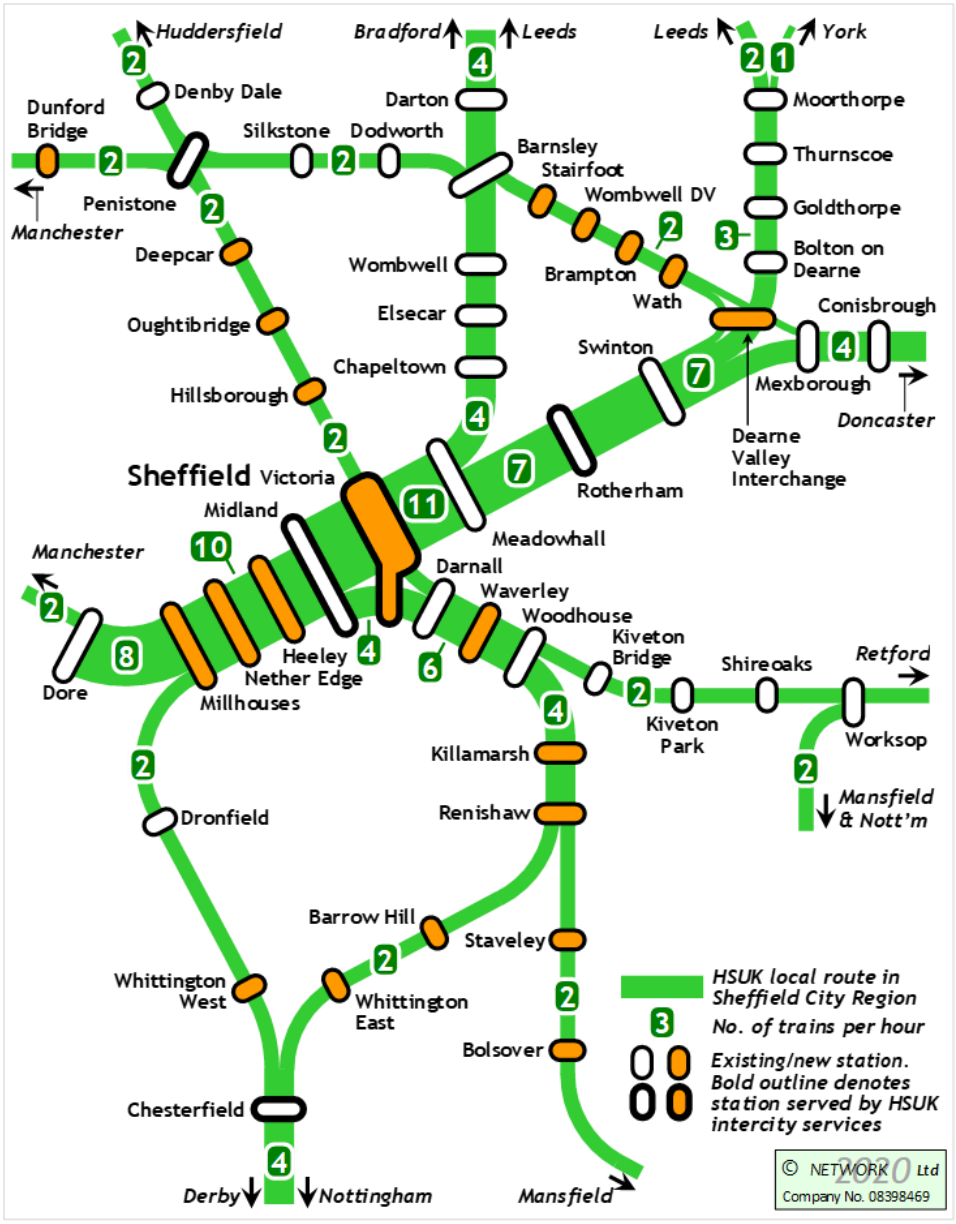


Figure 6.6K : HSUK proposed Sheffield City Region suburban services

6.6.6 Test 6E – Northern Powerhouse Transpennine Freight Route

The Integrated Rail Plan makes frequent reference to the need for improved capacity for railway freight traffic, but – like its proposals for improved passenger routes – the proposed improvements are corridor-specific, incremental and never displayed in graphical form to show their potential as any sort of strategic network. Collectively, the IRP initiatives can be best characterised as no more than incremental, and therefore unable to deliver the step-change enhancement in connectivity necessary to deliver either Levelling-up or Net Zero transport of freight.

The deficiencies of the Integrated Rail Plan's 'vision' for freight are best viewed from the perspective of Transport for the North's ambition, stated in its 2018 *Draft Strategic Transport Plan*, for a *"freight superhighway connecting Liverpool and the Humber"*.

A railway 'freight superhighway' for the Northern Powerhouse is an entirely legitimate ambition, given a) its 15 million citizens (greater than the majority of EU states), b) the need to bring imported goods from port to population, and c) the present difficulties experienced by Transpennine railfreight flows (as exemplified by the present Liverpool-Drax power station biomass flow, sometimes routed via Lichfield in the Midlands).

The scale of the challenge can be appreciated from the possibility of a 20,000 TEU post-Panamax container ship berthing at Liverpool, and requiring of the order of 150 freight trains 775 metres long to transport its load to the Northern Powerhouse hinterland. This is a massive potential demand that only a 'freight superhighway' can possibly deliver. This must comprise a route largely dedicated to railfreight, clear of other critical flows (in particular express passenger traffic), and capable of being reengineered to accommodate larger-profile freight wagons.

There is also a strong case to develop a Transpennine lorry shuttle between Greater Manchester and South Yorkshire. As noted in Section 2.5, the existing single-carriageway A628T Woodhead Road is grossly inadequate for even the small traffic flows that currently exist, and local communities are forced to endure huge traffic jams.

New motorway construction through the Peak District National Park is plainly impracticable and unacceptable, and a railway solution must be found to provide an attractive alternative to road haulage. For shorter-haul flows, a Channel Tunnel-style lorry shuttle operation would seem to comprise the best option to accommodate both existing Transpennine freight flows, and the potential for a major increase in flows as suppressed demand is released. This would require an especially large wagon profile, to accommodate the largest standard HGV on a rail wagon.

Accordingly, HSUK has developed its proposal for a dedicated Transpennine freight route from the Port of Liverpool to the Humber ports of Immingham and Hull, that will also enable the establishment of a lorry shuttle link between Greater Manchester and South Yorkshire. This involves 2 primary interventions:

- A restoration of the abandoned Woodhead line to create a new Transpennine route – complementing the HSUK scheme for a new high speed line via the Woodhead corridor;
- Upgraded and restored routes creating a freight bypass around the south side of Manchester, avoiding the congestion of rail routes through the centre of the city.

The coast-to-coast 'prime user' freight route is shown in magenta in Figure 6.6L below.

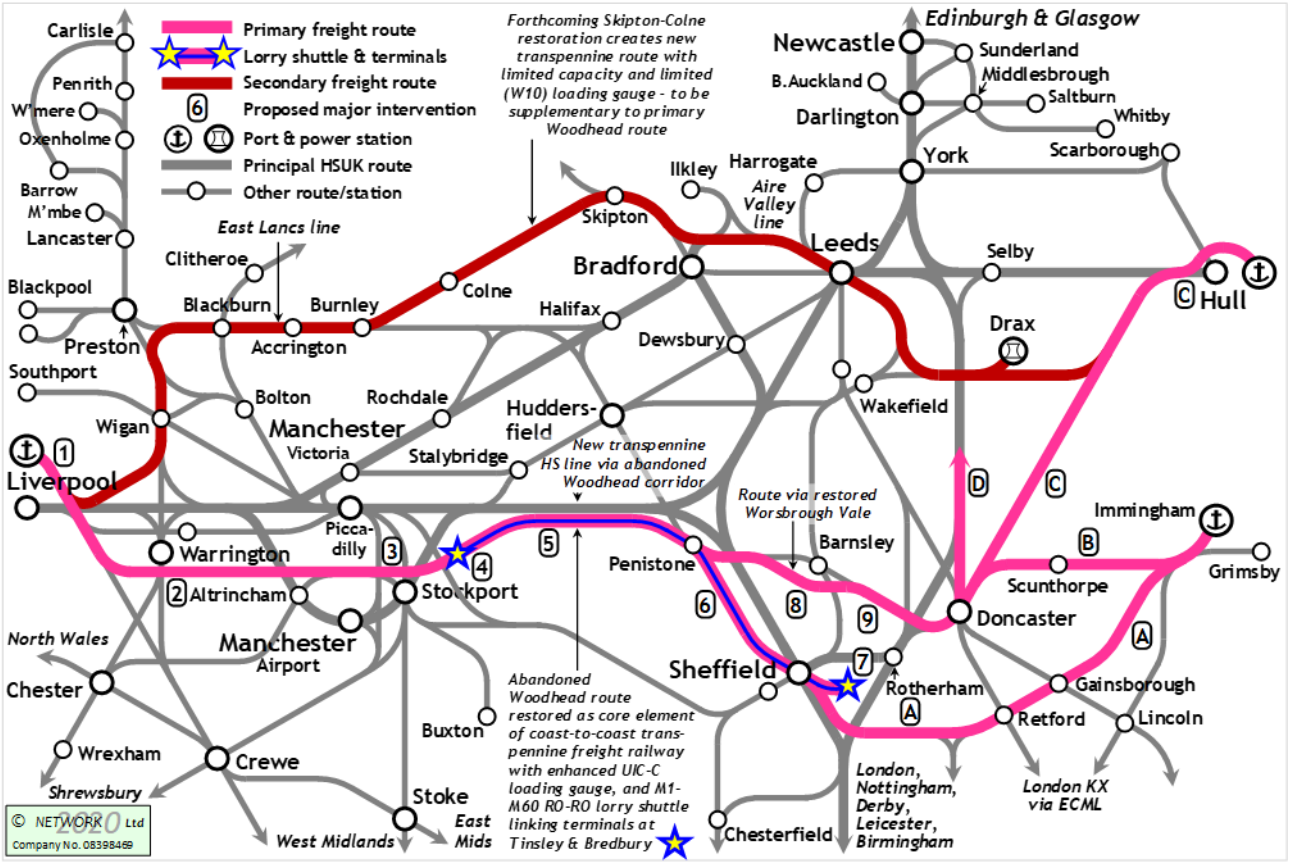


Figure 6.6L : HSUK Scheme for Transpennine 'Freight Superhighway' & Lorry Shuttle

Figure 6.6L illustrates the key features of the proposed HSUK Transpennine freight route:

1. Liverpool Docks branch upgraded, with new direct link to south at Wavertree – all to complement upgrading for higher container capacity within Liverpool Docks;
2. Fiddlers Ferry line upgraded, and Garston-Timperley line restored and reengineered east of Warrington to Timperley;
3. Mersey Valley route from Timperley to Cheadle Heath Junction upgraded, and Tiviotdale route through Stockport restored/reengineered as far east as Bredbury;
4. Existing rail-connected waste disposal site at Bredbury adjacent to M60 developed as lorry shuttle terminal;
5. Woodley-Godley line restored, existing Godley-Hadfield line upgraded and abandoned Woodhead line restored (with new Woodhead Tunnel to accommodate large-profile lorry shuttles) as far east as Penistone;
6. Penistone-Sheffield Woodhead line restored, continuing via Sheffield Arena to Tinsley;
7. Former Tinsley marshalling yard adjacent to M1 restored as lorry shuttle terminal;
8. Abandoned Worsbrough Vale line restored as primary freight route to east;
9. Dearne Valley line to Mexborough restored and reengineered.

Figure 6.6L also highlights in blue the sections of the HSUK Transpennine freight route that will be engineered to a taller and wider cross-section to accommodate the much larger profile of heavy goods vehicles standing on rail wagons – approximately 2 metres taller than the standard wagon height, and approximately 0.5 metres wider. The works necessary to achieve this enlargement,

including comprehensive raising of overbridges and lowering of tracks, would be hugely disruptive to railway operations, and the routes for the proposed 'lorry shuttle' operation have been carefully selected to avoid critical main line routes. Instead, the lorry shuttle route will either follow abandoned railway routes such as Woodhead which can be relatively easily reengineered to the required larger profile, or lightly-used existing lines where local services can be temporarily suspended during intensive 'blockade' working.

The HSUK Transpennine freight route will continue eastwards from South Yorkshire along existing routes to either Immingham or Hull (or to North-East ports) by means of a combination of the following lines, all appropriately upgraded:

A. Sheffield-Immingham line via Retford, Gainsborough and Barnetby;
B. Mexborough-Hull Docks line via Doncaster Avoiding Lines, Thorne and Hull Docks branch;
C. Thorne-Barnetby line via Scunthorpe;
D. Connection to East Coast Main Line for onward link to Teesport and Port of Tyne.

The HSUK scheme also allows for the establishment of a more northerly Transpennine freight route running via the restored Skipton-Colne line, as shown in brown in Figure 6.6L. This will be supplementary to the primary HSUK Transpennine freight route via Woodhead.

This is the restoration project that has been espoused by Transport for the North, other regional leaders and even former Transport Secretary Chris Grayling as the best option for a new Transpennine freight route. However, its capacity is greatly limited, not only on the lines that it shares with existing, often intense commuter flows, but also particularly at critical junctions with the West Coast Main Line, and at the western throat of Leeds station. These constraints are likely to limit the route's capacity to circa one freight train per hour in each direction.

A Transpennine freight route via a restored Skipton-Colne route may be ideal for 'bulk' flows such as the mooted Liverpool-Drax biomass flow; however, it is incapable of scaling up to meet the full railfreight needs of a 'Levelled-up' Northern Powerhouse, as discussed in Section 6.3.5 of this study. These needs can only be addressed through HSUK's proposed dedicated 'freight superhighway' for the Northern Powerhouse, routed via the currently abandoned Woodhead corridor.

6.6.7 Test 6F – Network Comparisons in the Midlands Engine

The need for a more integrated approach to the development of the UK rail network is exemplified by the abysmal performance of the HS2 'Y-network' (i.e. the Predecessor Scheme) in the Midlands. With only one city centre station proposed (at Birmingham Curzon Street), and with only an out-of-town parkway station at Toton proposed for the East Midlands, HS2 could not deliver any direct links between Midlands cities.

This led first of all to the supplementary 'Midlands Rail Hub' proposals to upgrade existing routes between West and East Midlands, and ultimately to the Integrated Rail Plan proposal to curtail HS2 Phase 2b (east) at East Midlands Parkway, thus enabling direct high speed services between Birmingham and Nottingham.

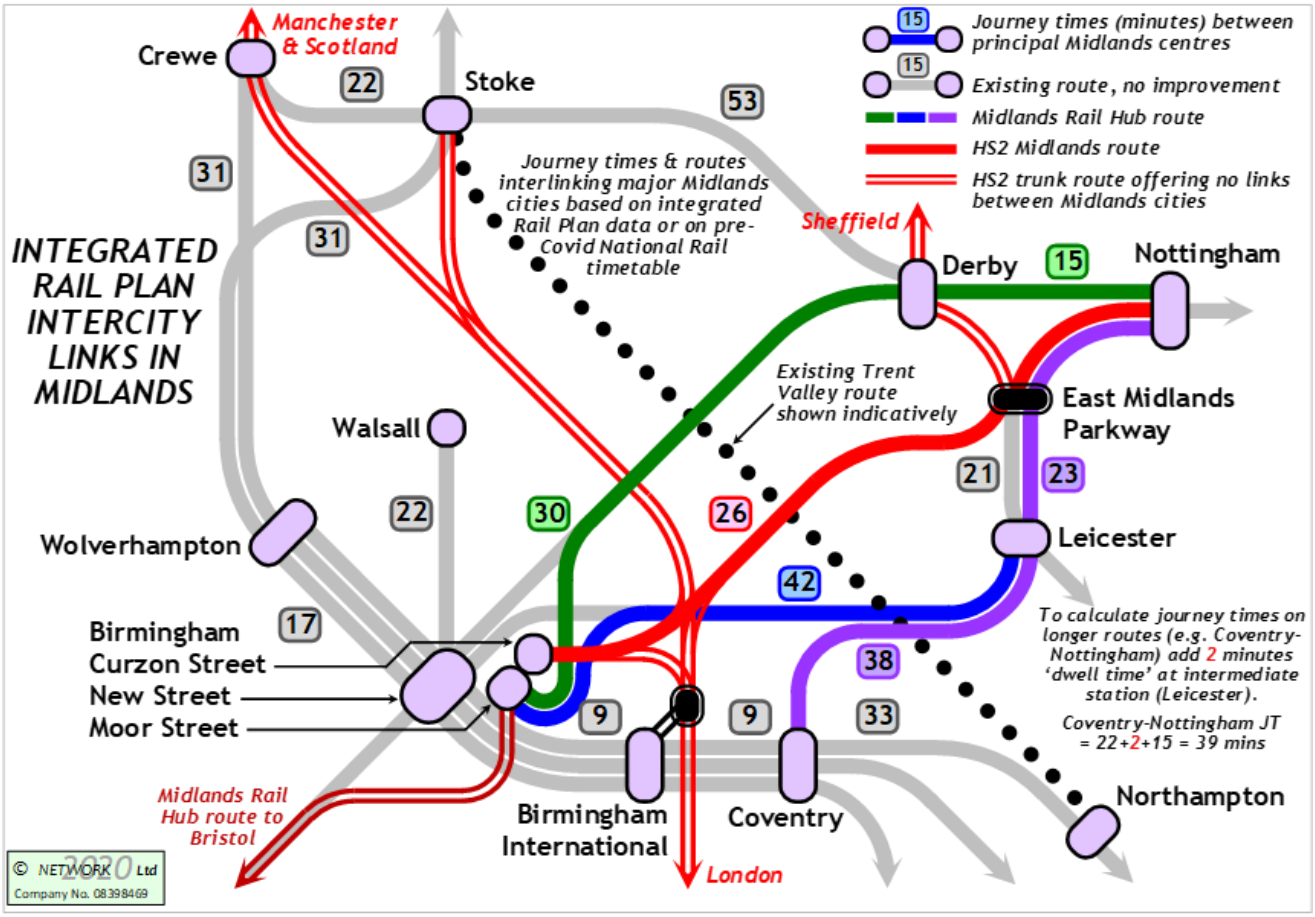


Figure 6.6M : Midlands 'Tube Map' illustrating principal HS2/MRH/IRP services

Coloured lines indicate improved intercity services, with journey times shown in the same colour; whereas journeys with no improvement are shown grey.

This might appear to be a welcome development – but this is the only intercity connection that the stand-alone HS2 can deliver within the Midlands. As shown in Figure 6.6LM, this results in very limited service improvements – one high speed intercity connection, and a range of minor Midlands Rail Hub enhancements – but nothing whatsoever for major communities such as Walsall and Wolverhampton.

Figure 6.6M also illustrates the fragmented performance of the Integrated Rail Plan in central Birmingham. While HS2 will serve the new Curzon Street terminus, and Midlands Rail Hub will serve the adjacent Moor Street station, local rail services will continue to be concentrated upon the existing New Street station, remote from both Curzon Street and Moor Street. This will leave the majority of West Midlands communities unable to derive any significant benefit from the Integrated Rail Plan.

A further issue arises with Crosscountry services. Traditionally these have run from the North-West and from Scotland, the North-East and Yorkshire to the South-West through Birmingham New Street; but with HS2/IRP services terminating at Curzon Street, and MRH services continuing to the South-West from Moor Street, luggage-laden passengers will be forced to make a walking transfer between the two terminus stations. As discussed in Sections 6.7.2 – 6.7.4, this severance threatens the fundamental integrity of the national rail network.

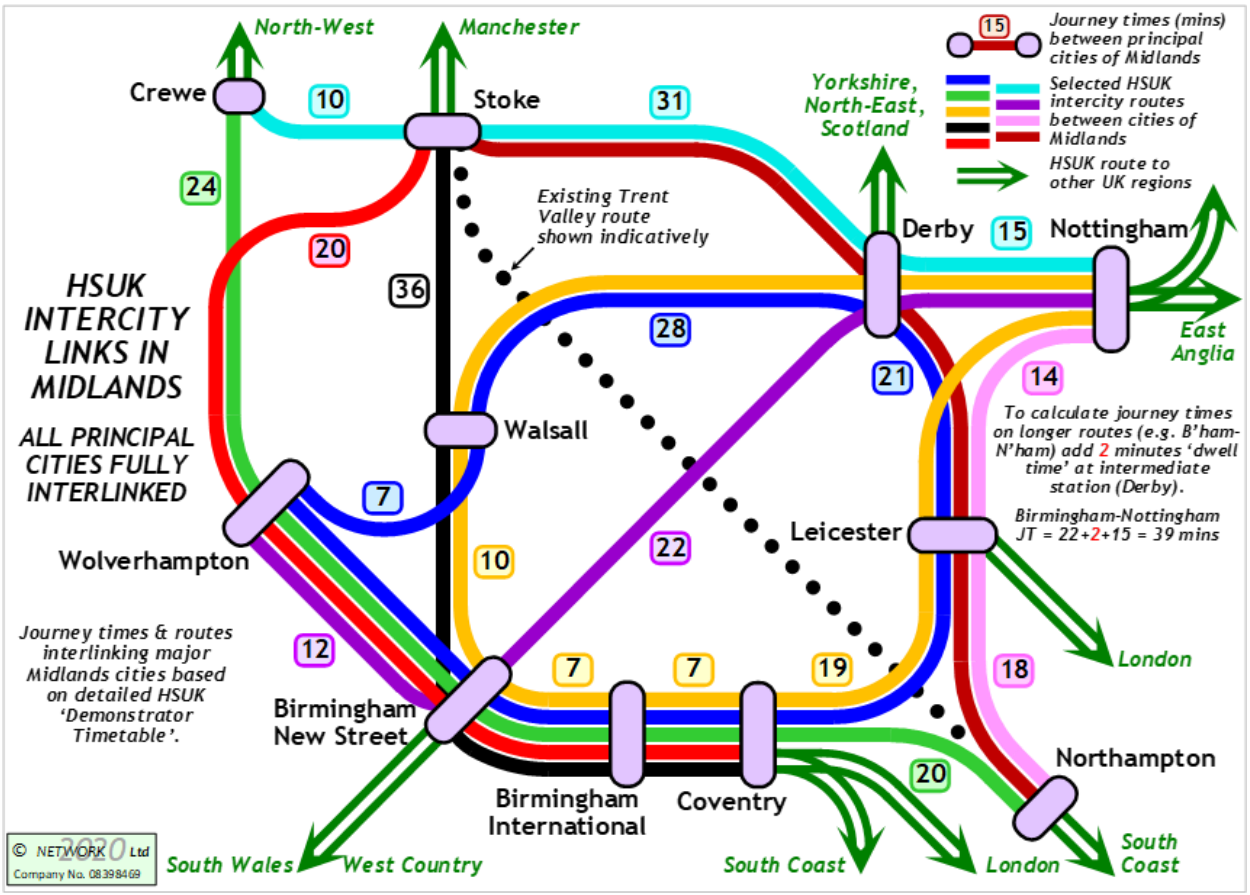


Figure 6.6N : Midlands 'Tube Map' illustrating principal HSUK services

The lost opportunity that the Integrated Rail Plan represents for the Midlands Engine is demonstrated in Figure 6.6N above. This shows the 'Midlands Ring' of HSUK routes encompassing Birmingham, Walsall, Derby, Leicester, Coventry and Birmingham Airport, that will transform the connectivity of Midlands cities. Rather than construct a new station in Birmingham, HSUK Midlands Ring services will be concentrated on Birmingham New Street, with 4-tracking of approach routes enabling a huge increase in capacity for both local and national services. Unlike HS2 and the Integrated Rail Plan, this will maintain and enhance the integrity of the Crosscountry intercity corridor that does more than any other to connect the nation.

This connectivity is exemplified in the proposed service HSUK01 (as documented in Table 6.7F). Running from Glasgow to Plymouth via Birmingham New Street, it will connect 7 of Great Britain's 11 primary cities outside London – Glasgow, Edinburgh, Newcastle, Leeds, Sheffield, Birmingham and Bristol. This quality of connectivity cannot be matched by the Integrated Rail Plan.

Figure 6.6O below summarises the contrasting direct connectivity offers of the Integrated Rail Plan and High Speed UK between 10 major centres within the Midlands Engine. Whereas the IRP improves only 7 links out of a possible 45, and leaves 20 'city pairs' disconnected, HSUK delivers improved direct connections on all but one of the 45 possible journeys.

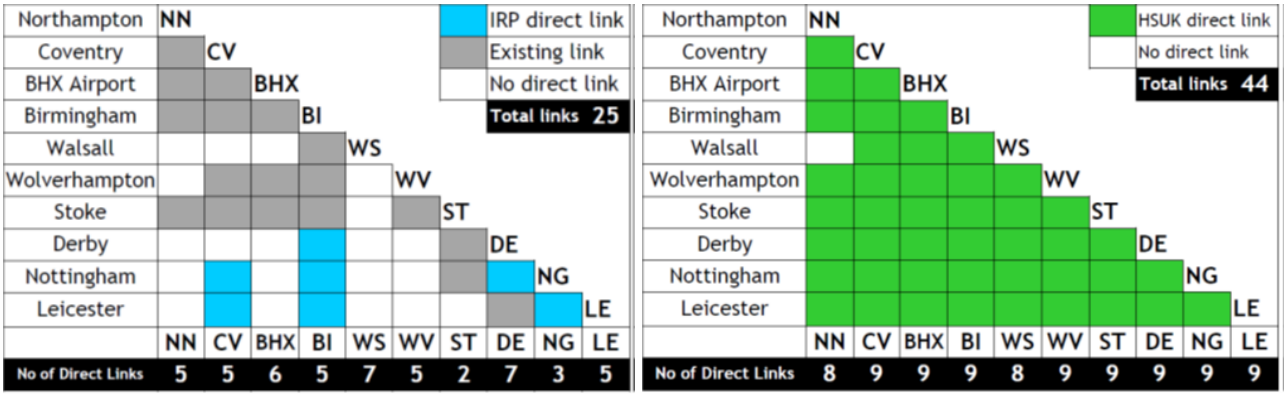


Figure 6.6O : Midlands Engine IRP/HSUK Direct Connectivity Comparisons

6.6.8 Test 6G – Capacity Improvements in West Midlands

The Integrated Rail Plan's failure to deliver significant local capacity improvements in Manchester, Sheffield and Leeds is matched by its failure to improve local services in Birmingham and the West Midlands. This failure is exposed by HSUK's vastly superior performance in the region.

Figure 6.6P on the following page shows the 5 primary proposed HSUK interventions in the West Midlands:

- 4-tracking of principal approach routes to Birmingham New Street from south-east **(1)**, north-west **(3)** and north-east **(5)** – the latter achieved by a new Soho Junction-Tame Bridge link, connecting to an upgraded Grand Junction line running via Darlaston and Willenhall;
- Operational rationalisation at Birmingham New Street **(2)**, with new grade separation at Grand Junction;
- Upgrades and restoration of other routes focussed upon Walsall to link towards Wolverhampton, Lichfield **(4)** and Birmingham Airport.

Together with 2 major interventions in the East Midlands – a new south-to-east 'teardrop' chord at Derby **(6)**, and a new-build line following the M1 south of Leicester, and linking to the West Coast Main Line at Rugby **(7)** – HSUK's primary Midlands interventions will establish the 'Midlands Ring' illustrated in Figure 6.6N.

The HSUK Midlands Ring will be instrumental in transforming the connectivity of Midlands cities. Restoration of the Walsall-Lichfield line **(4)** and building of the new Leicester-Rugby link **(7)** will create 2 new rail routes between West and East Midlands, additional to the existing Birmingham-

Derby and Birmingham-Leicester lines. This will establish new intercity routes between Wolverhampton, Walsall, Derby and Nottingham, and between Coventry and Leicester.

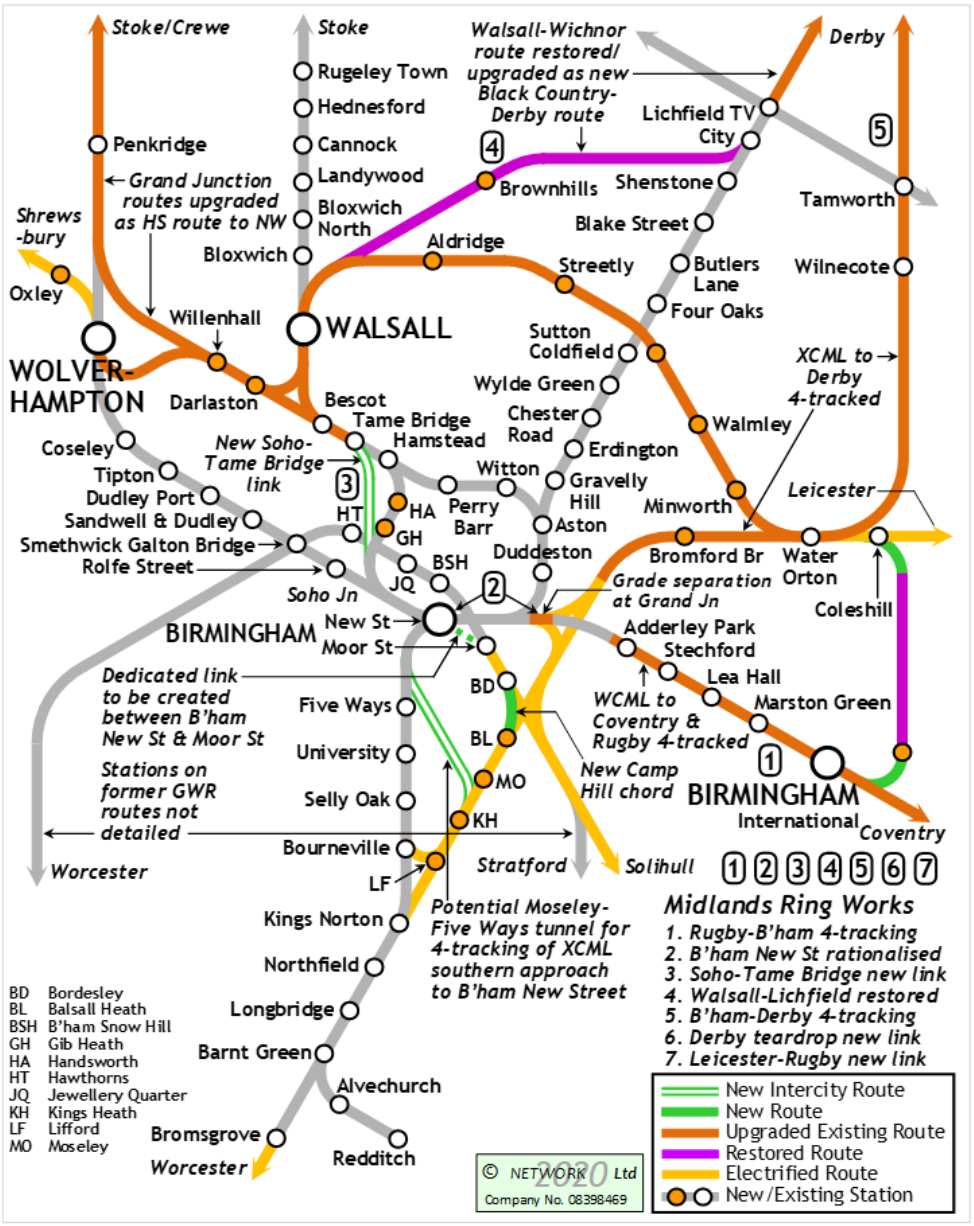


Figure 6.6P : HSUK proposed new works & upgrades in West Midlands

In quantitative terms, the HSUK Midlands Ring will more than double rail capacity between the two regions, and – as set out in Section 6.2 – it will deliver an overall improvement in connectivity over 9 times greater than that which the Integrated Rail Plan can deliver.

Within the West Midlands, the HSUK strategy of 4-tracking the principal approach routes to Birmingham New Street (at least as far as the final local station e.g. Adderley Park on the Coventry line) will eliminate the conflicts between non-stop intercity services and stopping suburban services. This will have the capability of dramatically increasing the capacity available for national services and local services, as shown in Figure 6.6Q – but only if the same transformation can be achieved at New Street, at the hub of the West Midlands rail network.

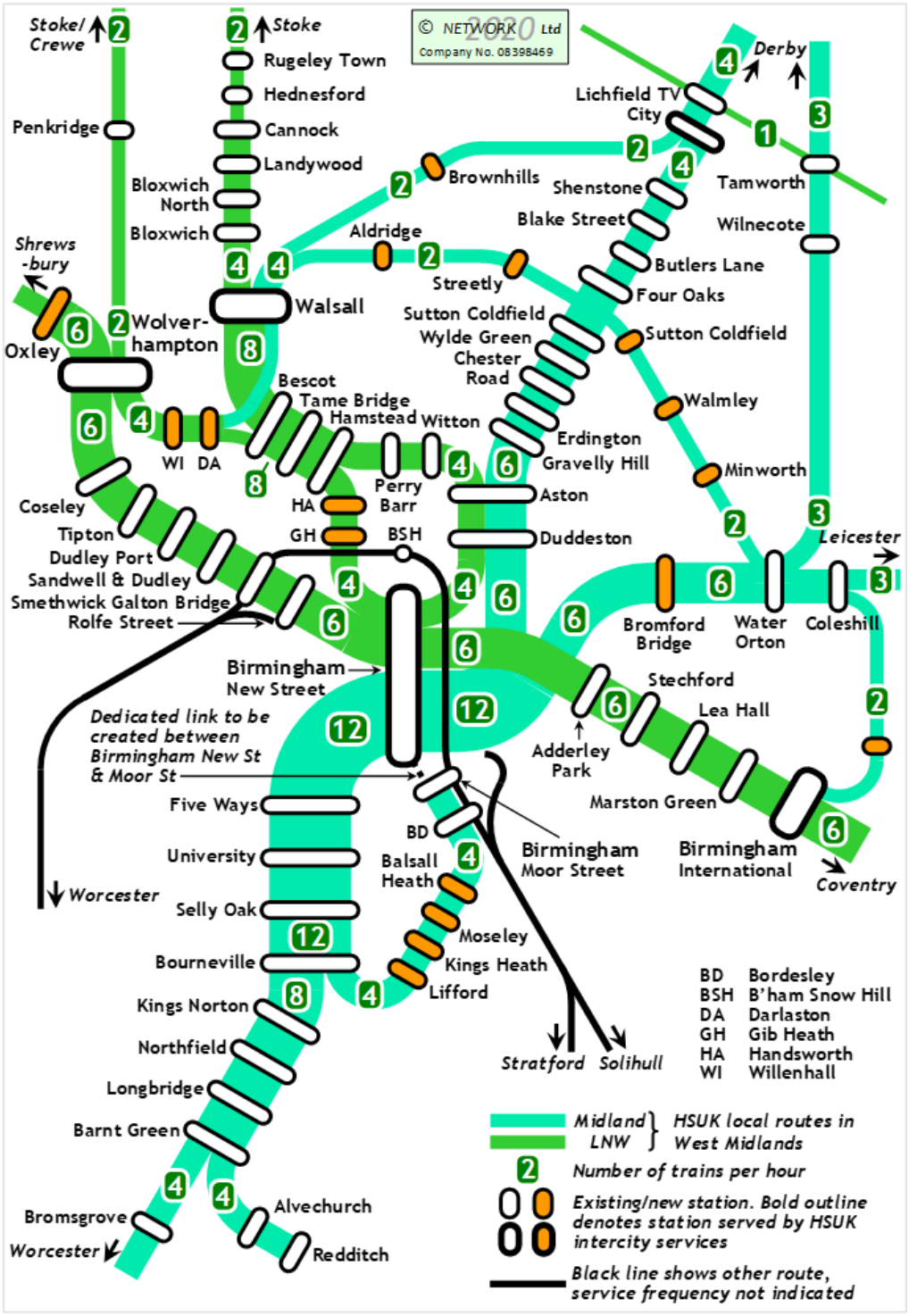


Figure 6.6Q : HSUK proposed West Midlands suburban services

At Birmingham New Street, there is no practicable physical intervention, equivalent to 4-tracking of an existing 2-track railway, by which a step-change increase in capacity might be achieved. Instead, it is necessary to address the inefficiencies in present rail operations at New Street which have so far gone unchallenged, and which have led the railway establishment to deem the station to be 'full', with no capacity to accommodate any major increase in services. This is the unthinking and uncritical mindset that has led to the regressive official proposals to develop terminus stations at Curzon Street and Moor Street, both remote and disconnected from New Street.

Currently, capacity at Birmingham New Street is massively compromised by the services that terminate there, and stand at the platforms for long periods. This congestion can be attributed in part to inefficiencies and fragmentation introduced through the franchising of passenger services subsequent to privatisation in the 1990s. However, this congestion is greatly exacerbated by the limited capacity of:

- existing 2-track approach routes – *often making it impracticable for services to continue through New Street to less congested potential terminating points elsewhere in the Midlands;*
- existing 'level' junctions on approach routes – *creating conflicts between opposing train movements.*

These issues will be resolved through HSUK's proposed 4-tracking of the key approach routes to Birmingham New Street, by its proposed grade separation at Grand Junction (east of New Street) and Soho Junction (west of New Street), and by its holistic network design, including the elimination of any service patterns requiring termination or reversal at New Street. This makes it possible to greatly simplify operations and also greatly simplify the layout, as shown in Figure 6.6R. These measures will allow station capacity to be increased to unprecedented levels.

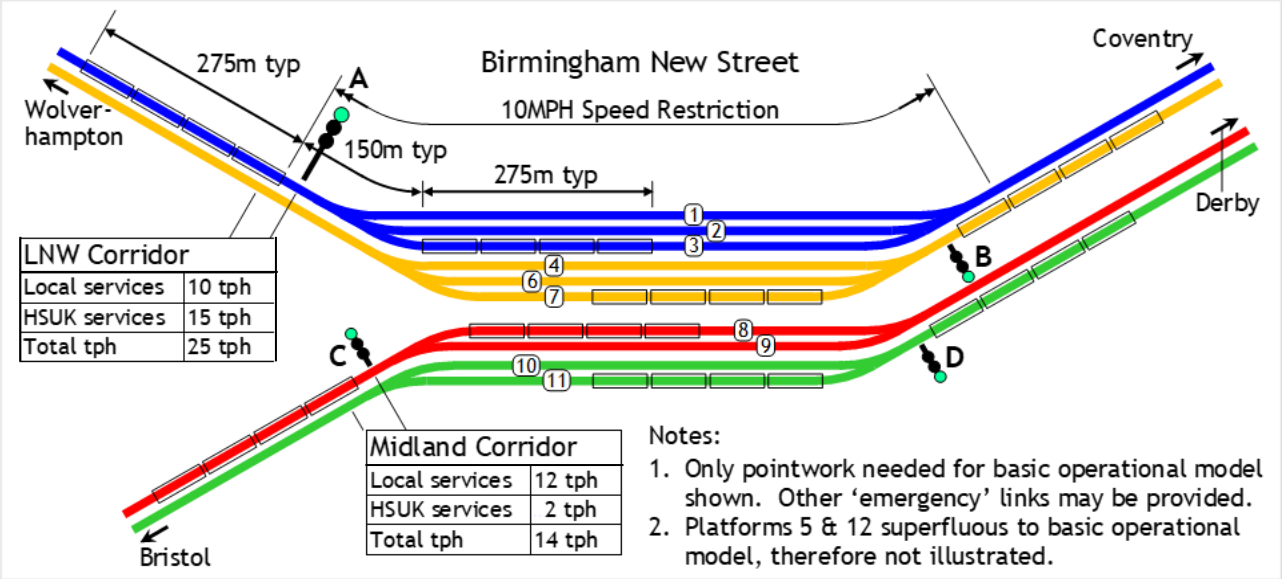


Figure 6.6R : HSUK Basic Operational Model for Birmingham New Street

Under the HSUK proposals, the operation of Birmingham New Street would reduce to the essence of the original 'joint' station opened in 1854 by the London North-Western (LNW) Railway and the Midland Railway:

- Eastbound LNW/West Coast flows feeding Platforms 1, 2 & 3 (A/blue);
- Westbound LNW/West Coast flows feeding Platforms 4, 6 & 7 (B/yellow);
- Eastbound Midland/Crosscountry flows feeding Platforms 8 & 9 (C/red);
- Westbound Midland/Crosscountry flows feeding Platforms 10 & 11 (D/green).

This is a fundamentally conflict-free arrangement, and the principal operational questions that need to be resolved are the capacity of the station throat, and the capacity of the platforms to handle the greatly increased traffic flows, both local and national, that will be directed through

Birmingham New Street. As shown in Figure 6.6R, the HSUK initiative anticipates 25 trains per hour each way on the LNW tracks and 14 trains per hour each way on the Midland tracks.

25 trains per hour translates as a train every 2.4 minutes or 144 seconds. In this time, a train must advance from Signal A (or B) protecting the station throat to a position within the platform where the rear of the train is sufficiently clear of the points at the platform ends, a forward movement of approximately 425 metres (allowing a train length of 275 metres and a station 'throat' length of 150 metres); at this point the following train (standing at a signal at a nominal 500 metres in the rear of Signal A (or B)) can safely be released to enter an adjacent platform. Outline calculations demonstrate that even at the permitted speed of 10MPH (4.44m/s), and both trains starting from stationary at their respective signals, the desired headway interval of 144 seconds (2.4 minutes) can be maintained.

With 3 platforms available on the LNW tracks, a train would enter each platform every 7.2 minutes. This would easily support a platform 'dwell time' of up to 5 minutes, appropriate for a hub station such as Birmingham New Street where high volumes of passengers can be anticipated.

On the Midland side of the station, the situation is similarly comfortable. 14 trains per hour translates as a train every 4.3 minutes or 257 seconds, and with 2 platforms available, a train would enter each platform every 8.6 minutes. Again, this would appear to pose no fundamental problem.

The foregoing reasoning is not intended in any way to constitute detailed or expert signalling design, but rather, to challenge the accepted 'wisdom' that Birmingham New Street is 'full', and incapable of development. By this logic multi-station 'solutions' have been adopted, which fail to work efficiently for the West Midlands, and which can only fragment the national network – as documented in Sections 6.7.2 – 6.7.4 of this study.

Instead, the preceding paragraphs demonstrate the clear potential for a step-change improvement in the capacity of the existing Birmingham New Street station, that can be achieved with sensible rationalisation of the station throats, and no need for further major reconstruction of the station concourses or platforms. Although much detailed design work will be necessary to develop a scheme that will optimise train speeds and station capacity, it seems clear that Birmingham New Street can support the huge enhancement in local, regional and national connectivity necessary to deliver on the Government's Levelling-up agenda, far better than any other practicable option for station development in Birmingham.

It is perhaps appropriate at this point to recall that the 'through' Birmingham New Street station was opened in 1854 to replace the terminus stations of the London and North-Western Railway (LNWR) and the Midland Railway at Curzon Street and Lawley Street respectively. Belying its grandiose architecture that still survives, the LNWR's Curzon Street station was always inadequate and unfit for its role as a primary hub of the West Midlands railway system[32], and it operated for only 16 years from 1838 to 1854. It is valid to speculate how long HS2's 21st Century Curzon Street terminus will survive, before it too is found to be unfit for purpose, and no longer capable of efficient or effective operation.

As the 18th Century philosopher Edmund Burke observed: "Those who fail to understand history are doomed to repeat it."

6.6.9 Test 6H – Network Development in Potteries Region

The Integrated Rail Plan's offer for Stoke on Trent and the wider Potteries region provides a perfect exemplar of its total inadequacy as a plan for an integrated railway system, that might address current connectivity deficiencies.

Stoke has suffered from poor rail network connectivity since the dawn of the railway age, with the national trunk route that ultimately developed as the West Coast Main Line being routed via Stafford and Crewe, therefore bypassing Stoke and the entire Potteries region. This undesirable situation has been replicated in the HS2 Phase 2a proposals, which will see the trunk HS2 route from London and Birmingham via Crewe to Manchester also bypassing the Potteries. Stoke will enjoy only a token hourly HS2 service to London, with no high speed services to any other UK city; and no improvement whatsoever is proposed for local services. See Figure 6.6S below.

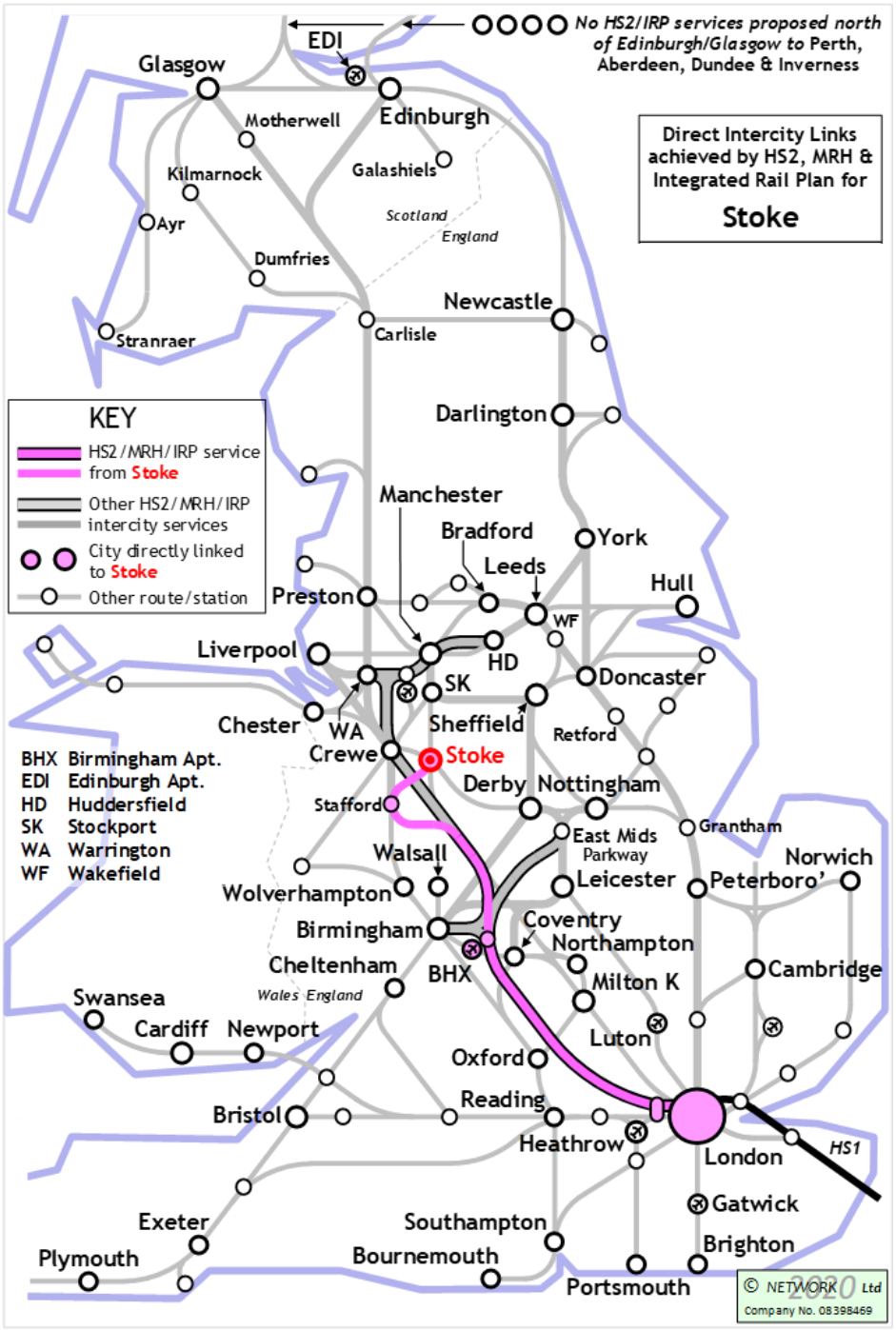


Figure 6.6S : HS2/IRP proposed services to Stoke

The Integrated Rail Plan should have provided the perfect opportunity to re-examine the HS2 Phase 2a route between the West Midlands and Greater Manchester, and to select an alternative alignment that could serve the 400,000 population of the Potteries conurbation either at Stoke station, or at an appropriate alternative central location. Yet any such review was specifically excluded from the IRP's Terms of Reference (see Appendix A); instead, the Integrated Rail Plan was remitted to be based upon the established HS2 Phase 2a route which – through its bypassing of the entire Potteries conurbation – was plainly designed without any worthwhile integration.

This self-evident contradiction, repeated many times along the route of HS2, has made the failure of the Integrated Rail Plan inevitable, and predictable from the outset. It demonstrates the basic truth, that it is never possible to retrofit integration to an established scheme – it has to be designed into any scheme or system from the start.

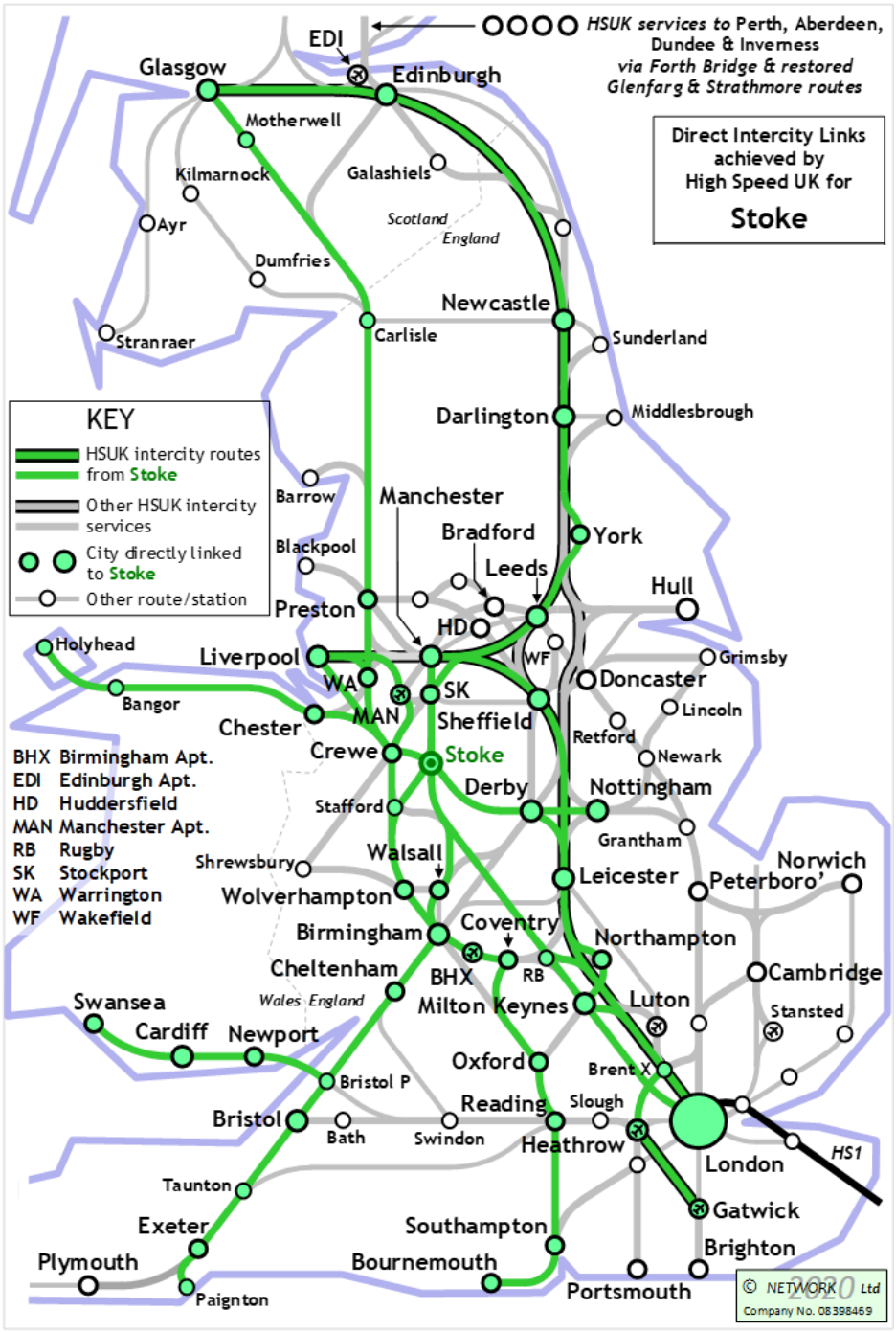


Figure 6.6T : HSUK proposed services to Stoke

The imperative for full integration between new high speed line and existing network is proved beyond doubt by the vastly superior connectivity and capacity that the High Speed UK Exemplar Alternative will deliver for Stoke and the Potteries region. As demonstrated in Section 6.2 of this study, and in Figure 6.6T on the previous page, Stoke will enjoy:

- Direct links to 9 out of 9 principal centres of the Midlands Engine;
- Direct links to 13 out of 17 principal centres of the Northern Powerhouse;
- 41% average journey time reductions across the national network.

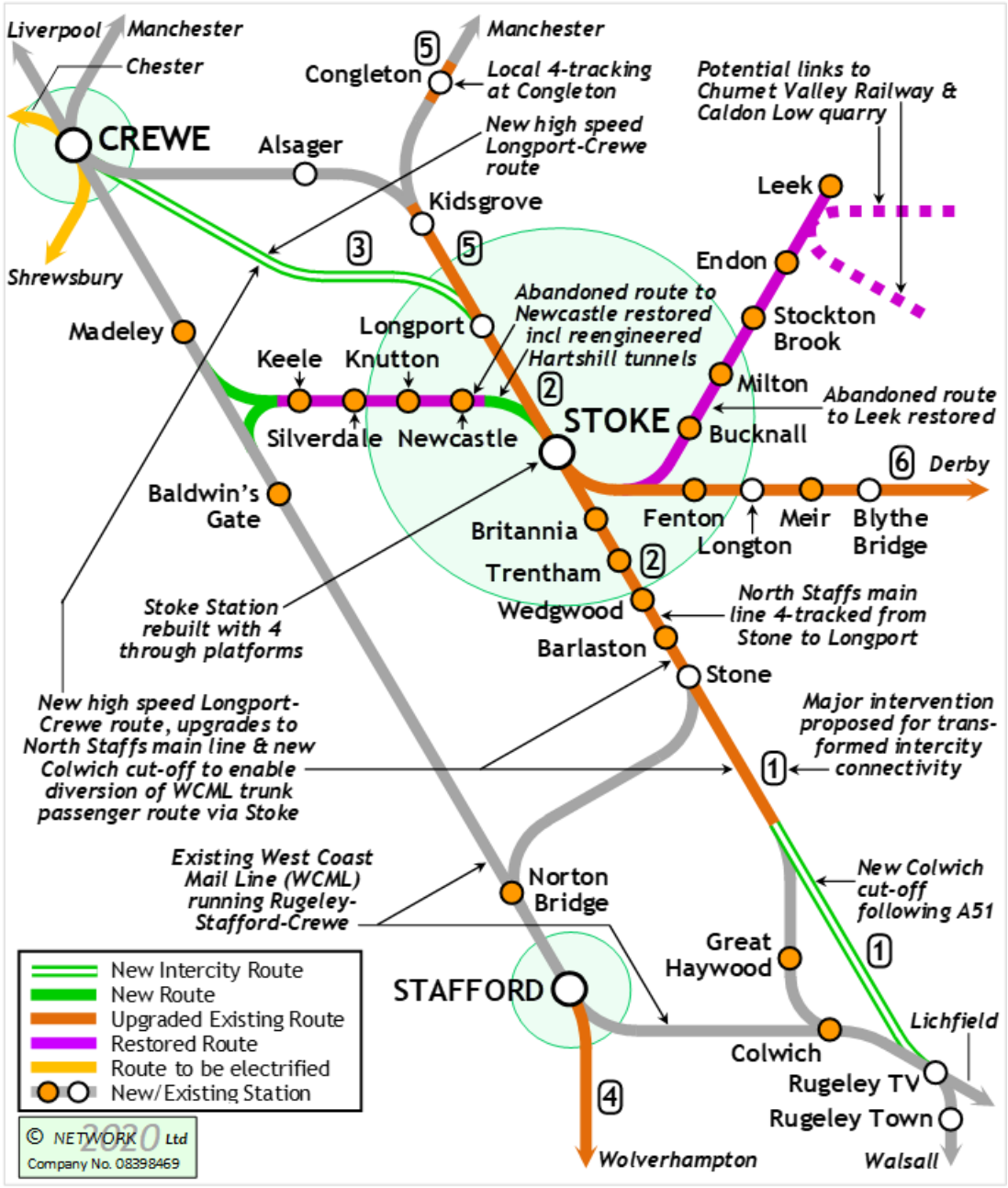


Figure 6.6U : HSUK proposed new works & upgrades in Potteries Region

HSUK's radical connectivity enhancements rely on a fundamental transformation of the rail network in the Potteries region, with new lines constructed and major upgrades undertaken to a) enable primary West Coast Main Line passenger flows to be diverted via Stoke, and b) reduce Birmingham-Stoke-Manchester journey times to below 1 hour. As illustrated in Figure 6.6U above, the following primary interventions are proposed:

1. Upgrade of North Staffordshire Main Line, with new cut-off route bypassing Colwich Junction;
2. 4-tracking of North Staffordshire Main Line from Stone through Stoke to Longport, with major remodelling and reconstruction of Stoke station;
3. New line from Longport to Crewe following A500T;
4. Upgrade of Grand Junction/Crosscountry route from Birmingham to Stafford;
5. Selective 4-tracking of Crosscountry route north of Potteries to Manchester;
6. Upgrade of existing route to Derby.

The proposed 4-tracking of the North Staffordshire Main Line from Stone to Longport, together with the proposed transformation of Stoke station, is necessary to enable the greatly increased intercity flows through Stoke anticipated under the HSUK initiative. However, the step-change in capacity delivered by these enhancements will also enable the transformation of the local rail network focussed upon Stoke, with new stations on existing routes, and abandoned routes (to Leek, and via Newcastle under Lyme to Keele and Madeley) restored. Proposed HSUK local services in the Potteries region are shown in Figure 6.6V below.

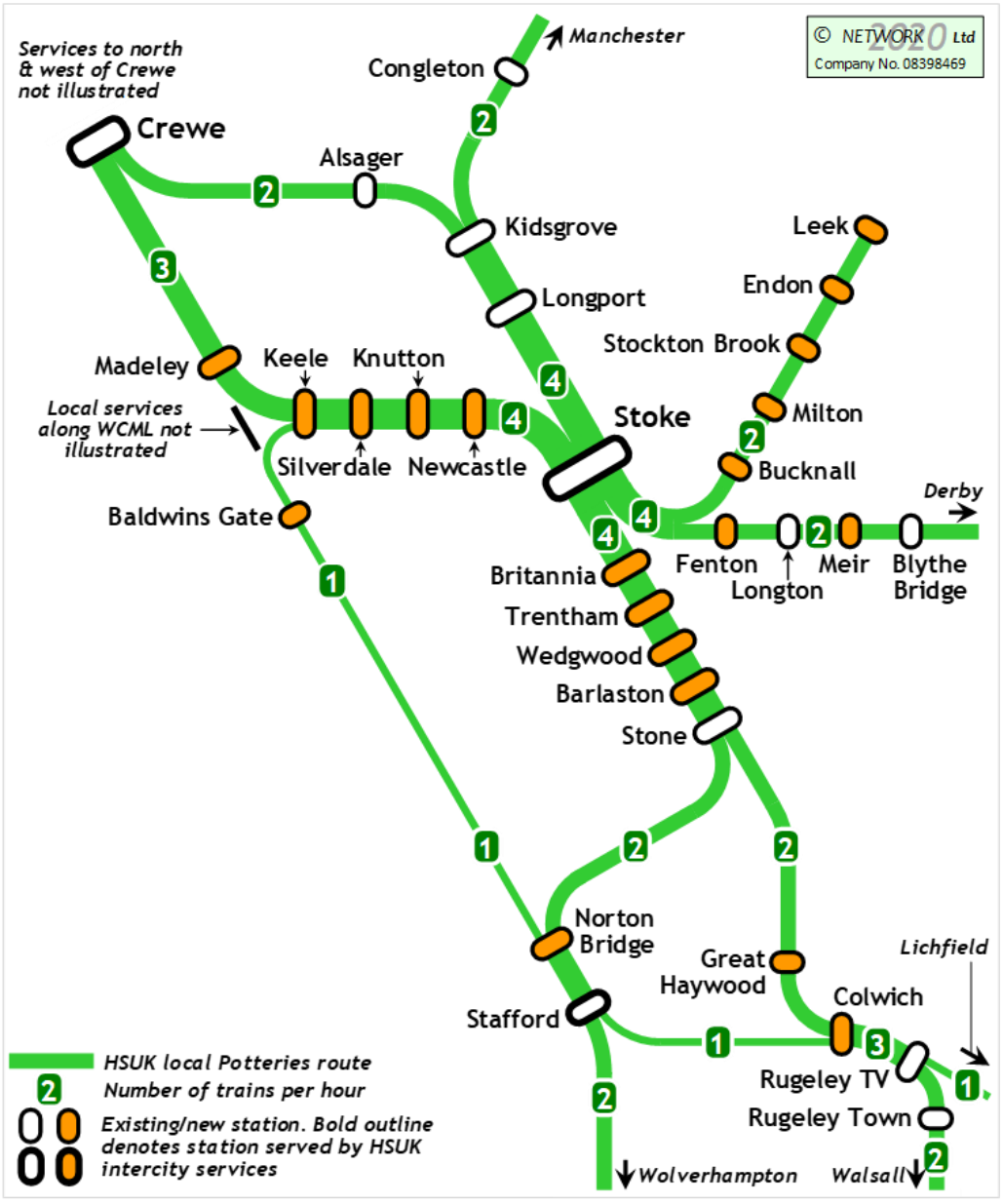


Figure 6.6V : HSUK proposed Potteries Region suburban services

The vastly superior performance of the High Speed UK Exemplar Alternative in the Potteries Region must, of itself, raise huge concerns as to the integrity of the processes underpinning the Integrated Rail Plan.

A simple 'word-search' of the published IRP document offers a clear indication of how the connectivity needs of the 400,000 population of Stoke and the wider Potteries conurbation appear to have been neglected – just 2 references to 'Stoke' and 0 (zero) references to 'Potteries' in all of its 162 pages. This contrasts starkly with 45 references to Sheffield (1.4 million conurbation population), 94 references to Birmingham (2.6 million) and 249 references to Manchester (2.8 million). Stoke is undisputably a major community either of the Midlands or the North, the two regions that are the ostensible focus of the Integrated Rail Plan; it is therefore valid to question why the Government has so clearly ignored its connectivity needs.

6.6.10 Test 6 – Finding

The Integrated Rail Plan provides no evidence to demonstrate that it will deliver the transformation of the railway network and the 'local capacity dividend' necessary to drive regional 'powerhouse' economies in the Midlands and the North, and thereby support the Government's Levelling-up agenda.

If the 'Integrated Rail Plan' were to justify its name, it would present detailed diagrams to demonstrate how a suite of specific IRP interventions would combine with the established HS2 proposals to create a transformed and fully integrated network for passengers and freight in all UK regions and conurbations. It would also display a clear ambition for a network that would see all principal centres within a UK region directly interconnected with high quality, high speed and high frequency intercity services, and it would demonstrate how high speed rail's 'local capacity dividend' i.e. massively increased capacity for local services in all the major conurbations, would come about.

Regrettably, the Integrated Rail Plan does nothing of the kind, and it fails to demonstrate any conception that such an integrated network, capable of supporting Government's Levelling-up agenda, and capable of bringing about the desired 'powerhouse' economies, might even be possible. Instead, the Integrated Rail Plan promotes the development of multi-station 'solutions' in cities such as Birmingham, that can only fragment the national network, and threaten the radical improvement of interregional *and* intraregional connectivity that is necessary for Levelling-up.

The comprehensive local, regional and national connectivity delivered by the High Speed UK Exemplar Alternative, and illustrated in all the maps presented in this study, provides *prima-facie* proof of the failure of the Integrated Rail Plan. The challenge is on the Government to present an alternative narrative, and to demonstrate that its proposals can deliver equivalent, or superior connectivity, not only across the whole of the Midlands and the North, but also across the entire United Kingdom. Given the resources available to the Government, this is a challenge that it should easily be able to meet. But on all available evidence, the Government seems certain to fail this challenge.

6.7 Assessing the IRP's Impact on Integrity of National Rail Network

Test 7 poses the question: ***"Will the IRP maintain and enhance the integrity of the national railway network?"***

6.7.1 Test 7 – Assessment Rationale and Methodology

As noted in Section 4 of this study, the Government has substantially modified the original recommendation of the 2020 Oakervee Review for the development of an 'Integrated Rail Plan for the Whole GB Network'. Instead, the remit of the IRP has been scaled back to cover just the Midlands and the North, and the wider national dimension is ostensibly covered by the ambition for a strategic UK transport network ('UKNET'), as set out in the Government's 2021 Union Connectivity Review.

There is a clear imperative for active coordination between Integrated Rail Plan and UKNET, to ensure the outcome of an efficient national rail network, capable of optimising connections between all UK regions and nations; and there is an equally clear risk that the regionalised focus of the Integrated Rail Plan, upon the Midlands and the North, may act to the detriment of UKNET's longer-distance interregional links.

This risk is most evident in the proposals set out in the Integrated Rail Plan for a multi-station 'solution' for Birmingham, as described in the preceding Sections 6.6.7 and 6.6.8, which would appear to threaten the integrity of the Crosscountry rail corridor that is focussed upon Birmingham New Street station.

It is fair to describe Birmingham New Street as the pre-eminent hub of the present UK railway network. It is the single point at which Crosscountry services from the South Coast, the South-West and South Wales converge, intersect with intercity, regional and local services along the West Coast corridor, and continue further north via the Potteries to Greater Manchester, and via the East Midlands to Yorkshire, the North-East and Scotland.

There is currently no practicable alternative route by which the cities of these regions to the south and north of Birmingham can be linked, either directly or by a single change of trains. It is therefore vital that the Integrated Rail Plan maintains and enhances rail connectivity through Birmingham along the Crosscountry corridor; if it cannot, the high-quality interregional connectivity necessary for Levelling-up will become impossible to achieve.

There are similar concerns regarding the focus of the Government's UK high speed rail project upon the corridor of the West Coast Main Line, and its implicit requirement for a Crossborder high speed line through the mountains of the English Lake District and the Scottish Southern Uplands, to connect the principal cities of England and Wales to Edinburgh and Glasgow, with sub-3-hour journey times that would compete with domestic aviation and the private car.

13 years after the HS2 project's launch in 2009, no viable proposals for such a dedicated route have yet emerged, and instead, initiatives aimed at improving Anglo-Scottish connectivity remain reliant upon as-yet-undefined upgrades of the existing West Coast Main Line which would appear unable to deliver the necessary step-change improvements in connectivity and capacity.

This study will therefore focus upon 2 critical corridors of the UK rail network:

- Crosscountry links from South Wales, South-West and South Coast via Birmingham to Northern and Scottish cities – *assessing direct links from Southampton, Bristol and Cardiff to Sheffield, Manchester, Liverpool, Leeds, Newcastle, Edinburgh and Glasgow*;
- Crossborder links to Scotland via either West Coast or East Coast corridors – *assessing the number of English and Welsh primary network hubs (as defined in Figure 2E) with direct links to Edinburgh and/or Glasgow*.

3 scenarios will be considered:

- Existing (pre-Covid) Network;
- Integrated Rail Plan;
- High Speed UK Exemplar Alternative.

6.7.2 Test 7A – Quantifying Existing Crosscountry Connectivity

The Crosscountry connectivity offered by the existing network is defined in Table 6.7A, and illustrated in Figures 6.7B and 6.7C. Prior to the Covid-19 pandemic this comprised 6 separate service strands, listed as XC01 – XC06 (designations by HSUK); and it must be noted that post-pandemic, the Crosscountry service offer is substantially reduced:

- XC01 (Plymouth Edinburgh) curtailed at Edinburgh, no onward running to Glasgow;
- XC02 (Bristol-Manchester) currently suspended in its entirety;
- XC04 (Newcastle-Reading) curtailed at Birmingham, no onward running to Reading.

Service	Via	**Principal Calling Points** (primary cities indicated in **bold**)
XC01	Birmingham New Street	Plymouth/Exeter/**Bristol** TM/**Birmingham** New Street/Derby/**Sheffield**/**Leeds**/ York/Darlington/**Newcastle**/**Edinburgh**/**Glasgow** *(2-hourly service to Glasgow)*
XC02	Birmingham New Street	**Bristol** TM/**Birmingham** New Street/Wolverhampton/Stoke/Stockport/ **Manchester**
XC03	Birmingham New Street	Bournemouth/Southampton/Winchester/Reading/Oxford/Banbury/Leamington/ Coventry/**Birmingham** New Street/Wolverhampton/Stoke/Stockport/**Manchester**
XC04	Birmingham New Street	Reading/Oxford/Banbury/Leamington/**Birmingham** New Street/Derby/ **Sheffield**/Doncaster/York/Darlington/**Newcastle**
XC05	Birmingham New Street	**Cardiff**/Newport/**Birmingham** New Street/Derby/**Nottingham**
XC06	Shrewsbury	Swansea/**Cardiff**/Newport/Hereford/Shrewsbury/Crewe/Stockport/**Manchester**

Table 6.7A : Existing (pre-Covid) Crosscountry Services *(XC01 etc designation by HSUK)*

The service offer embodies many 'gaps', including no direct links from Cardiff to any Northern or Scottish cities (except service XC06 to Manchester), and no Crosscountry services at all to Liverpool. It is particularly significant that all routeings are via Birmingham New Street, with the single exception of the Cardiff-Manchester route (XC06) via the Welsh Marches and Shrewsbury.

An ideal connectivity offer would comprise comprehensive direct links between the principal cities of the conurbations to the south and the north – from Southampton, Bristol and Cardiff to Sheffield, Manchester, Liverpool, Leeds, Newcastle, Edinburgh and Glasgow. This would be represented in the grid in Figure 6.7B with all 21 squares coloured. However, as matters stood pre-pandemic, only 8 direct links were available – a network efficiency of just 38%.

Comprehensive Crosscountry connectivity should deliver major Levelling-up benefits – but this only seems possible with a major increase in services through the congested Birmingham New Street.

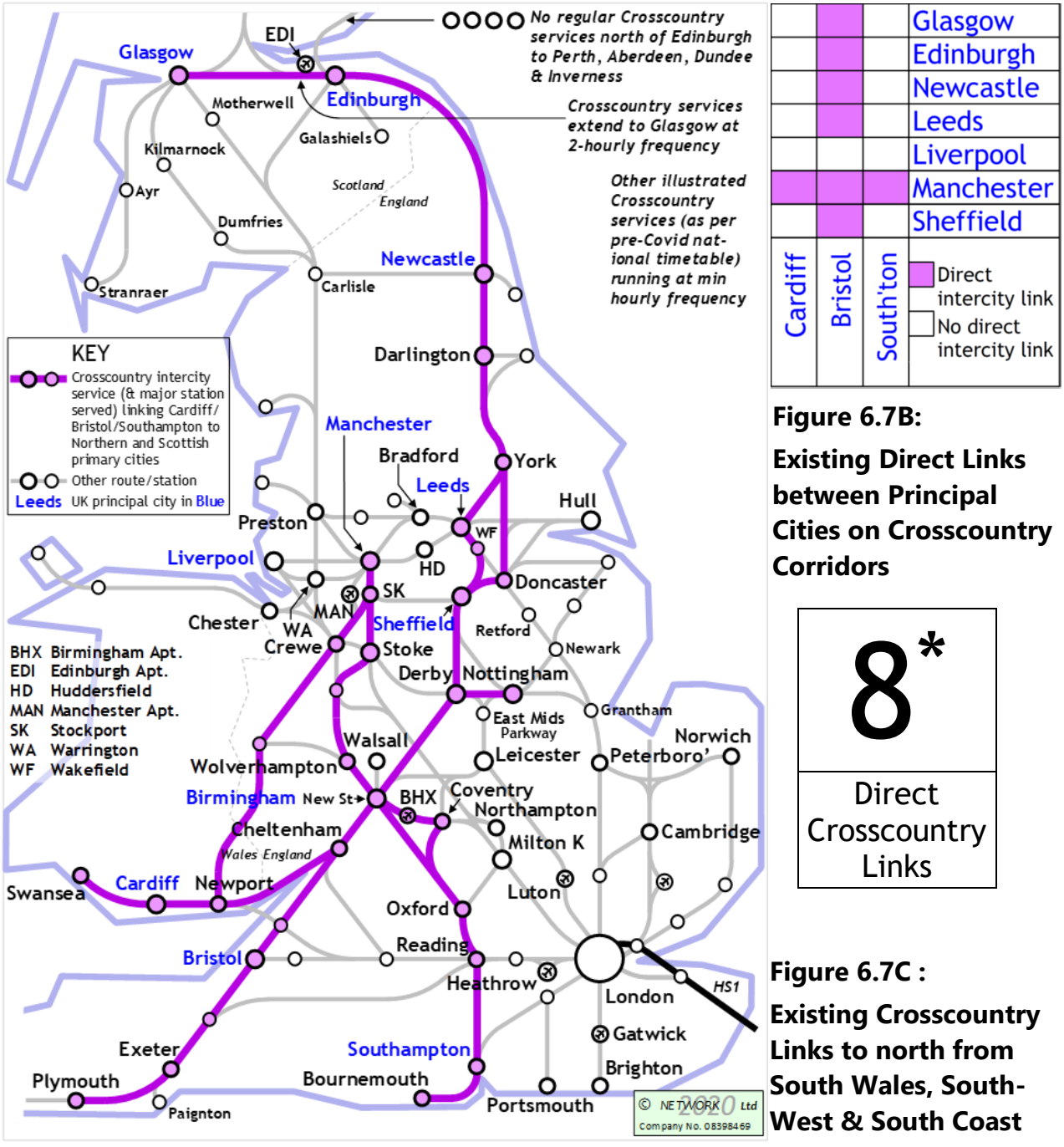


Figure 6.7B: Existing Direct Links between Principal Cities on Crosscountry Corridors

8*

Direct Crosscountry Links

Figure 6.7C : Existing Crosscountry Links to north from South Wales, South-West & South Coast

**** Note that Manchester-Bristol Crosscountry service is currently suspended post-pandemic***

6.7.3 Test 7A – IRP Severance of Crosscountry Connectivity

It should be a primary aim of any Integrated Rail Plan to build upon the connectivity offered by the present (pre-Covid) Crosscountry system, and achieve the closest possible approach to the ideal of comprehensive interregional connectivity, with all principal regional cities directly interlinked by high speed, high frequency intercity services. This would seem to be a prerequisite for any scheme intended to Level-up the economies of the UK regions. Yet the Integrated Rail Plan displays no such ambition, and the same criticism applies to the UKNET project envisaged under the Government's Union Connectivity Review.

Instead, the signs point clearly towards an opposite, regressive trajectory. As set out in Section 4.4.5 of this study, the Integrated Rail Plan describes in some detail its concept of 'improved onward connectivity' between Manchester and the South-West, whereby passengers arriving at the new Birmingham Curzon Street HS2 terminus station would be required to walk with their luggage to the nearby Moor Street terminus to catch a Midland Rail Hub train to Bristol (or Cardiff) – and change there for destinations further south and west.

It is difficult to see how this 3-stage journey can be represented as any sort of improvement, when – at least until the start of the Covid-19 pandemic – it was possible to travel on a single through train from Manchester via Birmingham New Street through Bristol to Exeter and Paignton. Yet, as HS2 and its Birmingham Curzon Street terminus are configured, through running to destinations further south and west is simply not possible. Consequently, the Crosscountry corridor is left effectively severed in Birmingham, as demonstrated in Table 6.7D and Figure 6.7E below.

			Glasgow
			Edinburgh
			Newcastle
			Leeds
			Liverpool
			Manchester
			Sheffield
Cardiff	Bristol	South'ton	Direct IRP intercity link / No direct intercity link

Figure 6.7D : IRP – No Direct Links between Principal Cities on Crosscountry Corridor

0
Direct Crosscountry Links

Figure 6.7E: HS2/IRP/MRH Crosscountry Links to north from South Wales, South-West & South Coast

The effective severance of the Crosscountry rail corridor in Birmingham leaves no prospect whatsoever of improved direct services from Northern and Scottish cities to the South-West, to South Wales or to the South Coast. It is hard to conceive of a greater failure of railway integration, and it can be directly attributed to the Integrated Rail Plan's fragmented proposals for station development in Birmingham, whereby:

- HS2 services from Northern and Scottish cities will arrive at the proposed Birmingham Curzon Street terminus.
- Midlands Rail Hub services to Bristol and Cardiff will depart from the adjacent Birmingham Moor Street terminus.
- 'Through' passengers from the North and from Scotland to the South-West and South Wales will be compelled to make a walking transfer between Curzon Street and Moor Street.
- Residual National Rail services will continue to operate at reduced frequency, reduced range of destination and (probably) increased journey time via the congested Birmingham New Street station, remote from both Curzon Street and Moor Street stations.

These proposals of course long pre-date the Integrated Rail Plan; ultimately, they can be traced back to the overriding desire of HS2 Ltd and the Government for a new station in Birmingham, free of the constraints and congestion of New Street, and capable of operating to the HS2 new works standard of 400 metre long, double-decker super-sized trains. Whether such trains are either essential or desirable for operation along HS2's highly selective routes is highly debatable; but it is unquestionably the case that these trains are incapable of being operated on the lines and stations of the wider UK network, and in particular, along the full length of the Crosscountry corridor.

At the very least, this would dictate a change of trains wherever passengers wish to continue their journeys along non-HS2 routes; but more dangerously for UK network operation, this will also lead to fragmentation whereby HS2 and residual 'classic' services operate from different stations, and interchange between high speed and classic systems becomes effectively impossible.

It is plain that official thinking has failed to recognise the crucial importance of Birmingham New Street as the pre-eminent hub of the national rail network – vital to maintain the integrity of the Crosscountry route, and thus vital to maintain the integrity of the entire national railway network. This has resulted in the uncritical acceptance of the simplistic and false notion that New Street is 'full' – and instead, the adoption of the fragmented Curzon Street/Moor Street proposal as the 'solution' for Birmingham and West Midlands connectivity.

The consequences of this deeply flawed approach are now exposed in the Integrated Rail Plan's total failure both to offer any direct Crosscountry links through Birmingham, and also, to offer any worthwhile connectivity and capacity improvement within the West Midlands.

6.7.4 Test 7A – HSUK Enhancement of Crosscountry Connectivity

High Speed UK has taken an entirely opposite approach in its initiative to transform the Crosscountry rail corridor. This approach is founded upon the basic principle of comprehensive intercity connectivity, whereby all principal cities should ideally be directly interlinked with no need to change trains.

The service pattern set out in Table 6.7F, comprising 11 services operating at hourly frequency, has been designed to meet this goal of comprehensive connectivity between the principal cities of the South Coast, the South-West and South Wales, and the principal cities of the North-West, Yorkshire, the North-East and Scotland. Only 9 of these services need to be routed via Birmingham New Street – services from the South Coast to Northern and Scottish primary cities are more advantageously routed via Milton Keynes and Leicester.

HSUK Service	Via	Principal Calling Points *(primary cities indicated in* **bold***)*	HSUK Module
HSUK01	Birmingham New Street	Plymouth/Exeter/**Bristol** TM/**Birmingham** New Street/Derby/ **Sheffield**/ **Leeds**/York/Darlington/**Newcastle**/**Edinburgh**/**Glasgow**	**1**, **2**, **3**, **4**
HSUK02	Leicester	Bournemouth/Southampton/Winchester/Reading/Oxford/Milton Keynes/Northampton/Leicester/**Nottingham**/**Sheffield**/**Leeds**/York/ Darlington/**Newcastle**/**Edinburgh**/**Glasgow**	**1**, **2**, **3**, **4**
HSUK03	Leicester	Southampton/Winchester/Reading/Oxford/Milton Keynes/ Northampton/ Leicester/**Sheffield**/**Manchester**/**Liverpool**	**2**, **3**, **4**
HSUK04	Birmingham New Street	Swansea/**Cardiff**/Newport/**Bristol** Parkway/**Birmingham** New Street/ Stoke/**Manchester**/**Leeds**/York/Darlington/**Newcastle**/**Edinburgh**/ **Glasgow**	**1**, **2**, **4**
HSUK05	Birmingham New Street	**Cardiff**/Newport/**Bristol** TM/**Birmingham** New Street/Derby/ **Nottingham**/Newark/Doncaster/York/Darlington/**Newcastle**	**2**, **3**, **4**
HSUK07	Birmingham New Street	Wolverhampton/**Birmingham** New Street/Derby/**Nottingham**/ Grantham/Peterborough/Cambridge/Stansted	**2**, **3**
HSUK08	Birmingham New Street	**Cardiff**/Newport/**Bristol** Parkway/**Birmingham** New Street/Walsall/ Derby/**Sheffield**/Bradford	**2**, **3**, **4**
HSUK09	Birmingham New Street	Reading/Oxford/Banbury/Leamington/**Birmingham** New Street/ Walsall/ Derby/Chesterfield/**Sheffield**/Wakefield/**Leeds**	**2**, **3**
HSUK11	Birmingham New Street	Bournemouth/Southampton/Winchester/Reading/Oxford/Coventry/ **Birmingham** New Street/Wolverhampton/Stoke/Stockport/ **Manchester**	**2**, **4**
HSUK12	Birmingham New Street	Paignton/Exeter/**Bristol** TM/**Birmingham** New Street/ Wolverhampton/Stoke/Stockport/**Manchester**	**2**, **4**
HSUK13	Birmingham New Street	**Cardiff**/Newport/**Bristol** TM/**Birmingham** New Street/ Wolverhampton/Crewe/Warrington/**Liverpool**	**2**, **4**

Table 6.7F : Proposed HSUK Crosscountry Services ***(HSUK Modules as defined in Figure 5C)***

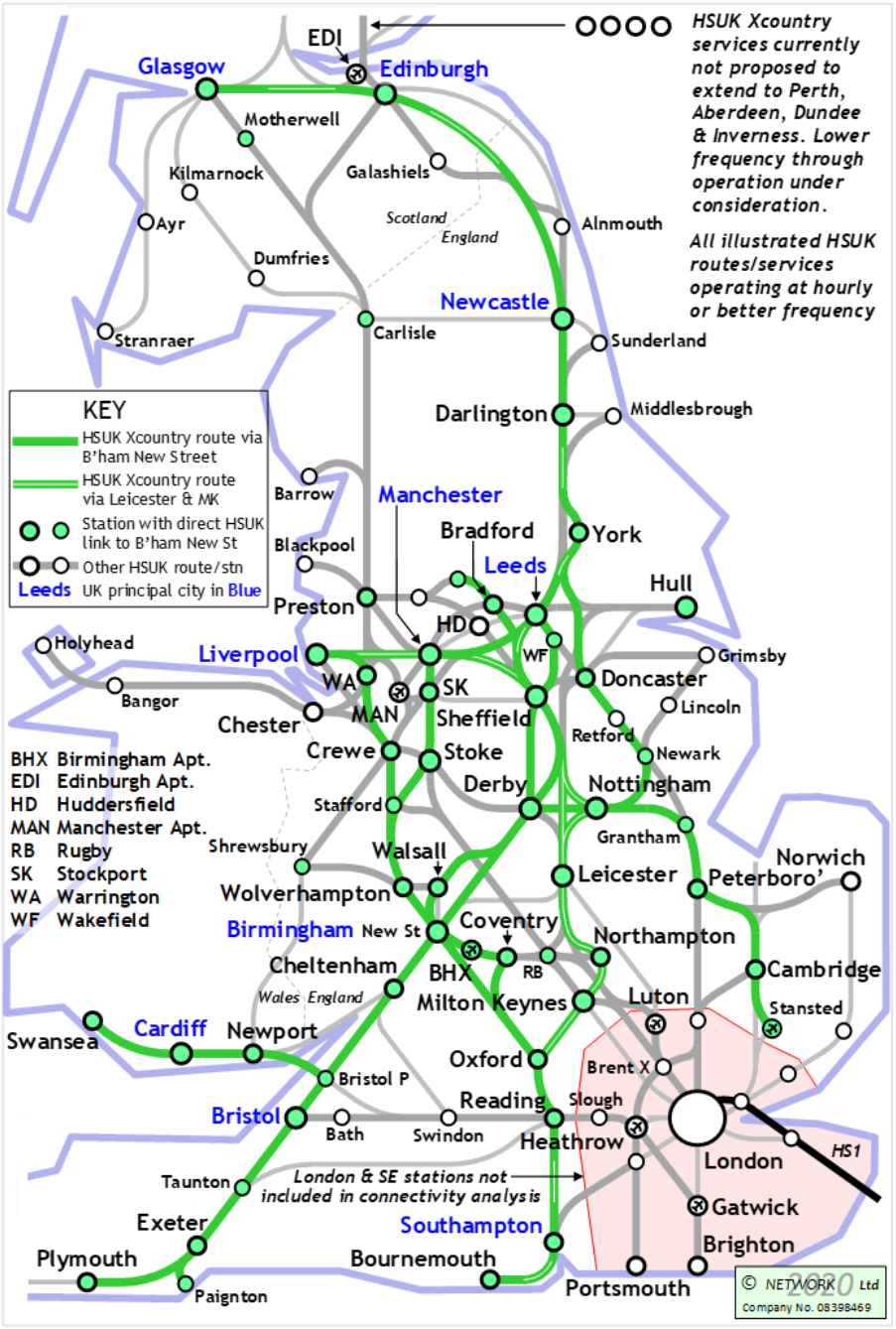
Table 6.7F also defines the HSUK construction modules (as described in Section 5.4 and Figure 5C) that each proposed HSUK Crosscountry services relies upon. It is particularly significant to note that HSUK's entire Crosscountry proposition is independent of the M1 Corridor and Heathrow construction modules (5 and 6), that might be compromised by the ongoing construction of HS2 Phase 1.

HSUK's Crosscountry services are set out in graphical form in Figure 6.7H, and their achievement of comprehensive interconnectivity, between the principal cities of the South Coast, the South-West and South Wales, and the principal cities of the North-West, Yorkshire, the North-East and Scotland, is illustrated in Table 6.7G.

HSUK's proposed 9 Crosscountry services per hour through Birmingham New Street are included in the allowances for 'HSUK services' set out in Figure 6.6R. Along with the improvement in local services illustrated in Figure 6.6Q, this establishes the likely demand for local and national flows through Birmingham New Street. This then becomes the basis on which appropriate railway

engineering solutions at and around Birmingham New Street can be developed, to enable the station to accommodate the required step-change increase in train flows.

This is a very simple 'predict and provide' engineering approach which recognises the value of the original asset of Birmingham New Street, and then takes the necessary steps to rationalise and enhance this asset to meet the assessed need. Much work is still required to develop detailed engineering solutions to streamline operations at New Street deliver the required step-change increase in capacity; but this work is fully justified by the prize, of a fully connected local, regional and national railway network offering a level of performance that is an order of magnitude greater than anything that the Integrated Rail Plan can possibly deliver.



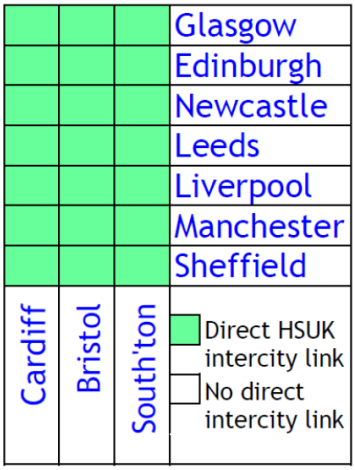


Figure 6.7G : HSUK Direct Links between Principal Cities on Crosscountry Corridor

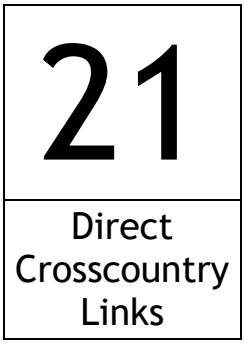
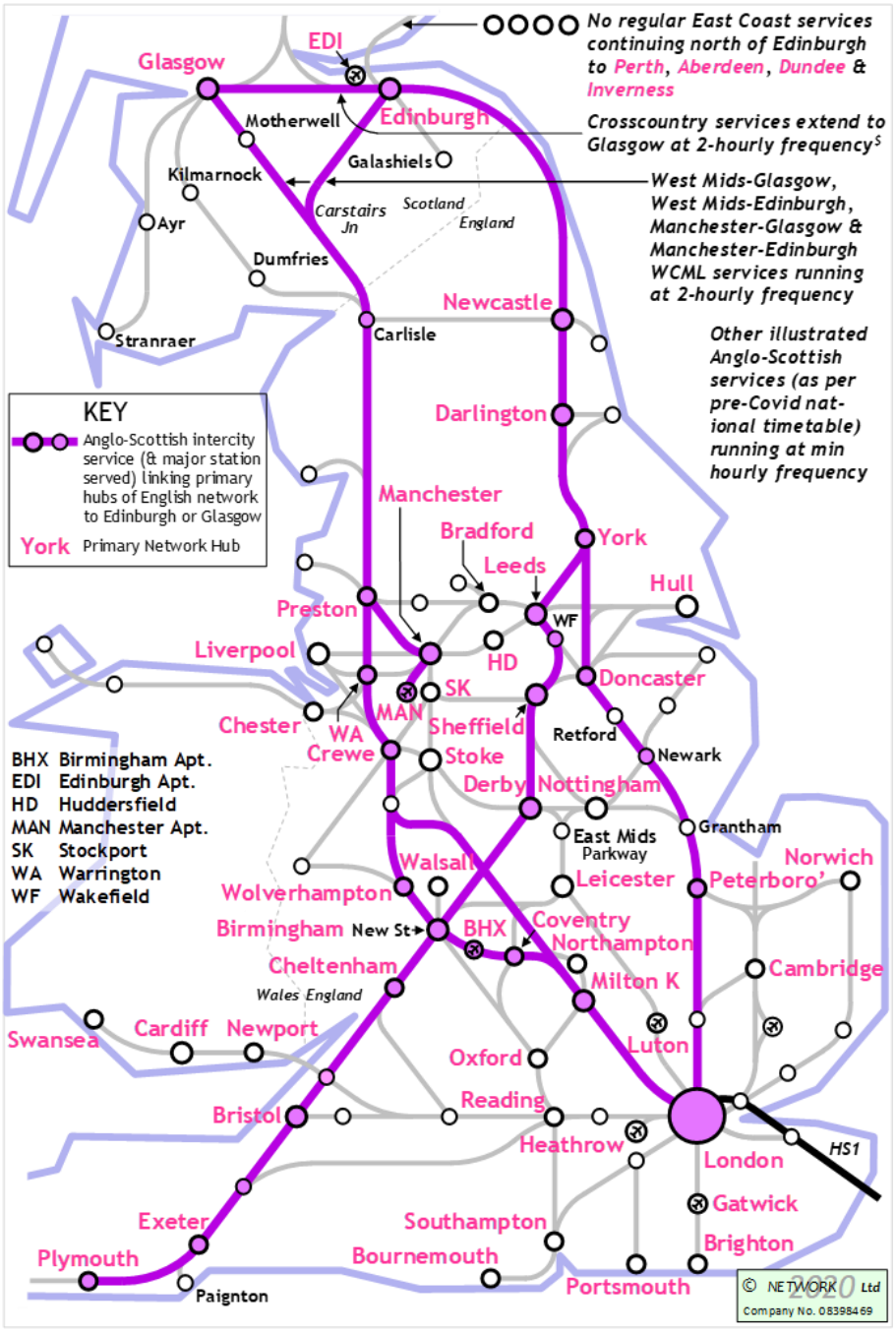


Figure 6.7H: HSUK Direct Crosscountry Links to north from South Wales, South-West & South Coast

6.7.5 Test 7B – Quantifying Existing Crossborder Connectivity



No. of English & Welsh Primary Network Hubs directly linked to Glasgow (GL) & Edinburgh (EH):	
GL	21*
EH	23

**** 11 Direct Links post-pandemic with extension of Cross-Country services to Glasgow @ 2-hourly frequency currently suspended***

Figure 6.7I : Existing Links from English and Welsh Primary Network Hubs to Scotland

The Crossborder connectivity offered by the existing network is illustrated in Figure 6.7I, and is quantified in terms of the direct links available to Glasgow and Edinburgh from the 48 English and Welsh 'Primary Network Hubs' defined in Figure 2E. Key points are as follows:

- Anglo-Scottish intercity services enter Scotland via either the West Coast Main Line (WCML) running via Preston/Carlisle/Carstairs Junction or via the East Coast Main Line (ECML) running via York/Newcastle/Berwick/Dunbar.
- The WCML follows a mountainous route through the fringes of the English Lake District (Shap Summit) and the Scottish Southern Uplands (Beattock Summit), and it splits at Carstairs Junction to access both Glasgow and Edinburgh.
- The 'Carstairs split' means that WCML services running at hourly frequency across the Scottish border can only offer a 2-hourly service to either Glasgow or Edinburgh.

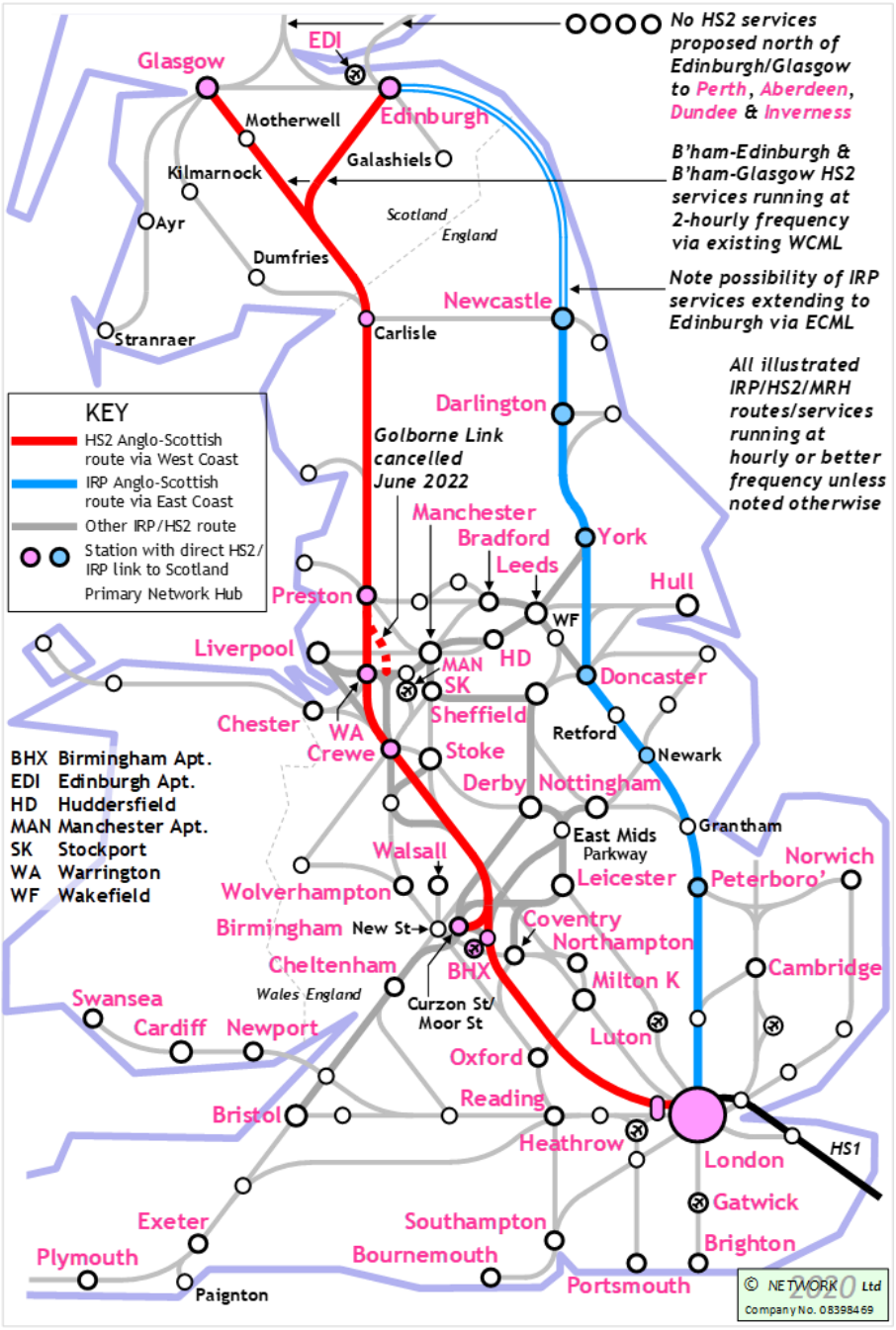
- Hence many communities along the WCML corridor (e.g. Milton Keynes, Coventry, Wolverhampton and Manchester only enjoy 2-hourly services to Glasgow and Edinburgh.
- The ECML follows a coastal route across the border, accessing Edinburgh from the east.
- Although onward running to Glasgow is possible via electrified routes, only very infrequent East Coast services now continue beyond Edinburgh; it should be noted that the 2-hourly extension of the Plymouth-Edinburgh Crosscountry service XC01 (see Table 6.7A) to Glasgow is presently suspended in the wake of the Covid-19 pandemic.
- Infrequent East Coast and Crosscountry services extend to Dundee, Aberdeen, Perth and Inverness.
- The uniaxial nature of the ECML route to Edinburgh means that communities along East Coast and Crosscountry corridors generally enjoy hourly (or more frequent) services to Edinburgh.
- With Edinburgh served by West Coast and East Coast routes to Scotland, and with Glasgow only served by the West Coast route (after post-pandemic suspension of Crosscountry services through-running to Glasgow), Edinburgh currently has more than twice the number of direct links to English cities.
- With 2 primary intercity routes to Scotland, and with the West Coast route compromised by the 'Carstairs split', the service offer to English cities is inevitably fragmented.
- Major cities along East Coast and Crosscountry corridors e.g. Newcastle, York, Leeds, Sheffield, Derby, Bristol, only enjoy direct services to Edinburgh.
- Manchester and Birmingham enjoy services to Edinburgh and Glasgow along the premium West Coast corridor, but only at 2-hourly frequency due to the 'Carstairs split'.
- Only one English city (London) enjoys hourly services to both Edinburgh and Glasgow.
- Edinburgh's 23 direct links out of 48 possible represent a 48% network efficiency.
- Glasgow's 21 direct links (pre-pandemic) out of 48 represent a 44% network efficiency.
- Glasgow's 11 direct links (post-pandemic) out of 48 represent a 23% network efficiency.

It can readily be appreciated that the current level of Crossborder connectivity is far from perfect. Not only does the service offer fall well short of the ideal of comprehensive hourly direct links between major cities to north and south of the border, but also, journey times along sinuous Crossborder routes compare poorly with the alternatives, either the private car or domestic aviation.

The potential for major economic, environmental and social benefits is clear – but these benefits will only come about if the Integrated Rail Plan delivers the necessary transformation in Crossborder connectivity, with viable proposals for a new Crossborder high speed line.

6.7.6 Test 7B – Integrated Rail Plan Impact on Crossborder Connectivity

It might well be argued that the required improvement of Crossborder links falls outside the remit of the Integrated Rail Plan, and that a 'UKNET' intervention stemming from the Union Connectivity Review will instead bring about the necessary transformation. However, detailed study of the Union Connectivity Review indicates no realistic prospect of anything more than on-line upgrades of existing West Coast and East Coast main lines; and it therefore seems appropriate to base this review on the projected IRP/HS2 services along upgraded existing routes to Scotland that are set out in the Integrated Rail Plan.



No. of English & Welsh Primary Network Hubs directly linked to Glasgow (GL) & Edinburgh (EH):	
GL	5
EH	5*

**** 10 Direct Links if IRP improvement of East Cost Main Line extended to Scotland***

Figure 6.7J : HS2/IRP Links from English and Welsh Primary Network Hubs to Scotland

Figure 6.7J highlights the Anglo-Scottish services that are predicted to see significant improvement (but note extra journey times due to cancellation of Golborne Link) under the Integrated Rail Plan:

- HS2 services from London to Edinburgh and Glasgow, routed via the WCML with trains splitting at either Carlisle or Carstairs, and running at hourly or better frequency;
- HS2 services from Birmingham to Edinburgh and Glasgow, routed via the WCML but only offering 2-hourly frequency to either Edinburgh or Glasgow due to the 'Carstairs Split';
- IRP services from London to Newcastle potentially extended to Edinburgh.

No improvement of Crosscountry services along the existing South-West/North-East/Scotland route (Plymouth/Bristol/Birmingham New Street/Sheffield/Leeds/Newcastle/Edinburgh service XC01 as defined in Table 6.7A) is shown. The future of this service seems uncertain, given the concerns set out in Section 6.7.3 regarding cross-Birmingham connectivity, and given also the predictions in HS2 Ltd's own reports for Crosscountry services to be truncated north of Newcastle (the latter a logical consequence of projections for a much faster HS2 service between Birmingham

and Edinburgh via the WCML). Whatever the case, there seems no prospect whatsoever of improved Crosscountry services to Scotland under the Integrated Rail Plan.

Figure 6.7J sets out the limited improvements that the Integrated Rail Plan will bring to Crossborder journeys – just 10 improved direct journeys out of 96 possible, and the key route from Birmingham to either Edinburgh or Glasgow only operating at 2-hourly frequency. This poor performance should be highly concerning in its own right; however, the limited service offer (expressed in terms of primary cities, just London and Birmingham linked to Edinburgh and Glasgow) reveals a much deeper concern as to the efficiency of any national IRP network based upon an HS2 high speed line routed along the corridor of the West Coast Main Line.

It would clearly be desirable for all of the primary cities of the North i.e. Sheffield, Liverpool, Manchester, Leeds and Newcastle to be linked by frequent and direct high speed services to the primary cities of Scotland. But Sheffield, Leeds and Newcastle are on the opposite side of the Pennines to a west-sided HS2, and Manchester and Liverpool, while relatively close to HS2, would still require their own separate high speed services to Scotland, each running separately to Edinburgh and Glasgow at the same 2-hourly frequency as for Birmingham's Scottish services.

It is significant that neither the Department for Transport nor HS2 Ltd have ever advanced the prospect of such a multi-stranded service offer, of 4 different trains to link Liverpool and Manchester to Edinburgh and Glasgow. It is presumed that none of the individual 'city-pair' connections were deemed sufficiently attractive to provide the necessary train load of passengers, just as no official proposals have ever been put forward for a similar 'buffers-to-buffers' HS2 service between Birmingham and Liverpool.

These inefficiencies, of poorly filled trains each making only a 'single city pair' connection, effectively destroy the economic case for a new-build Crossborder HS2 route along the corridor of the West Coast Main Line. Moreover, costs would be prohibitive, with mountainous terrain and sensitive environments making surface construction impracticable and instead dictating tunnelled sections of unprecedented length.

This leaves the existing West Coast Main Line as the only practicable routeing option for Crossborder HS2 services. This route – already operating close to capacity due to the competing demands of intercity passenger traffic, local passenger traffic and freight traffic – only has limited surplus capacity to accommodate the proposed additional HS2 services from London and Birmingham. Even if services from Manchester and Liverpool to Edinburgh and Glasgow were deemed viable, the WCML would still lack the necessary capacity.

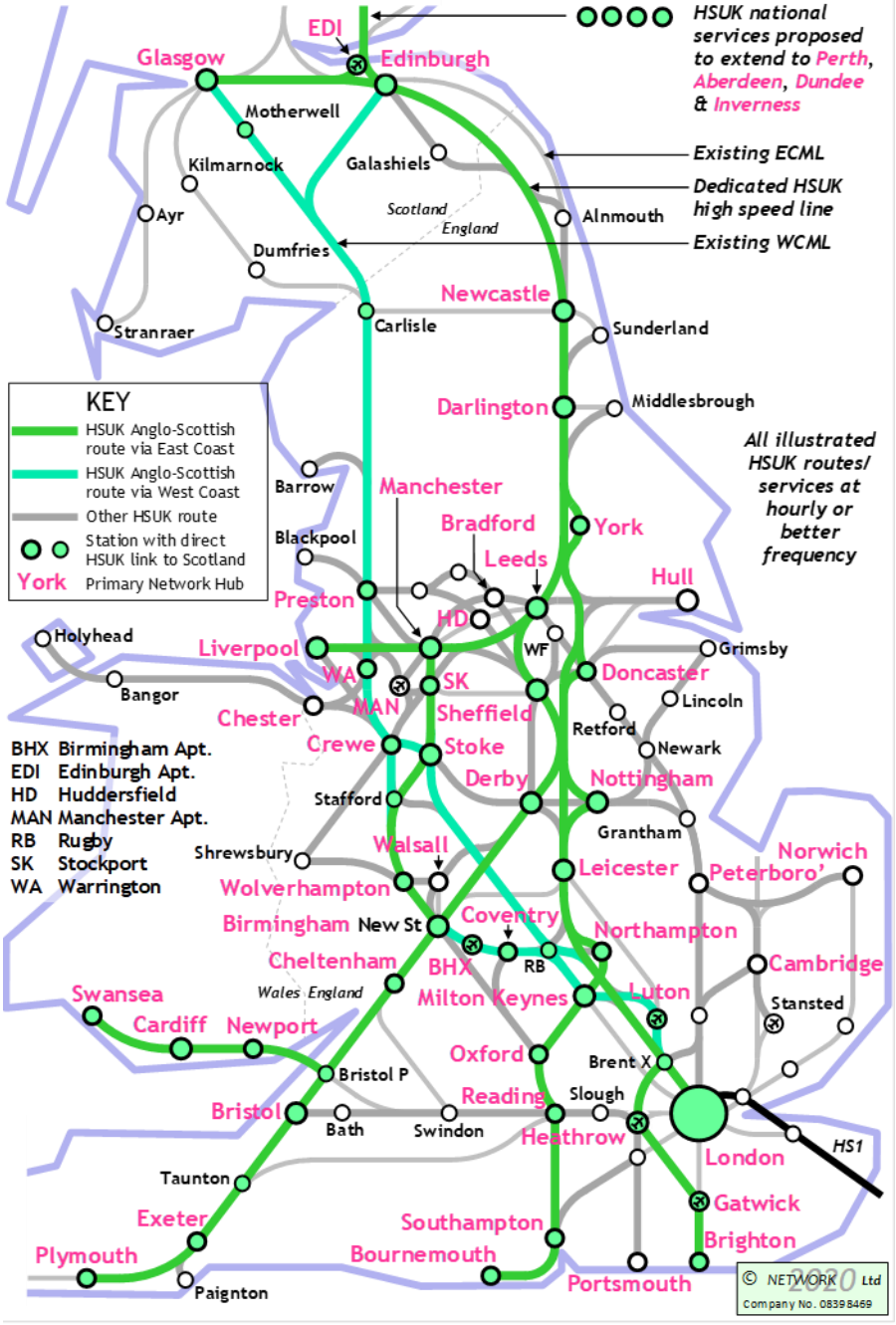
There has been considerable discussion of upgrading the West Coast Main Line to achieve greater capacity and higher line speed. However, the reality is that the extensive 4-tracking necessary to deliver the required step-change improvements in capacity would certainly be deemed both economically unviable and environmentally unacceptable; and there are no feasible options to achieve improvements in line speed that would significantly reduce journey times. Instead, journey times seem likely to increase, with HS2's rigid-bodied rolling stock unable to match the speeds of the tilting 'Pendolino' trains that currently operate premium WCML services. This problem can only be exacerbated by the cancellation (announced 7th June 2022, see Sections 4.8 and 6.2.7) of the HS2 'Golborne Link' to the WCML, adding a further 8 minutes to London-Glasgow journey times.

The failure of HS2 and the wider Integrated Rail Plan, to bring about the necessary comprehensive improvements in Crossborder connectivity to Scotland, should not be surprising. They merely replicate and reinforce all the divisions and dysfunctionalities of the existing railway network, with its 2 separate main line routes to Scotland, as described in Section 6.7.5; they do nothing to transform the network into anything more efficient, and more capable of delivering comprehensive links between English and Scottish cities.

This is of course not merely a connectivity failure – it also leaves the IRP unable to support the Government's Levelling-up agenda across the wider United Kingdom.

6.7.7 Test 7B – HSUK Enhancement of Crossborder Connectivity

High Speed UK's hugely superior performance in enhancing Crossborder connectivity is set out in Figure 6.7K below.



No. of English & Welsh Primary Network Hubs directly linked to Glasgow (GL) & Edinburgh (EH):	
GL	35
EH	38

Figure 6.7K : HSUK Links from English and Welsh Primary Network Hubs to Scotland

Key features of the HSUK Crossborder proposition are as follows:

- A single national 'high speed spine' extending north from London through the East Midlands, Yorkshire and the North-East, and, by means of an inland route through Northumberland and the Borders Region, continuing through Edinburgh to Glasgow;
- A new 'route to the north' in Scotland, connecting to northern Scottish cities via a restored and reengineered Glenfarg route (from the Forth Bridge to Perth) and a restored Strathmore route (north-east from Perth towards Aberdeen);
- Connection in Yorkshire to the HSUK Transpennine route;
- Connection in the East Midlands to the HSUK Crosscountry route via Birmingham;
- Connection near Northampton to the HSUK route to the South Coast via Milton Keynes.

HSUK's east-sided approach to Scotland avoids the fragmentation of the HS2/IRP proposition, whereby separate routes from the south are required to serve Newcastle, Edinburgh and Glasgow; and each 'withered arm' is incapable of supporting either comprehensive or frequent services from major cities further south. Instead, the coordinated HSUK initiatives listed above will concentrate all primary intercity services to Scotland onto a single line of route, passing through the principal population centres of the (English) North-East, en route to Scotland's principal population centres of Edinburgh and Glasgow.

Table 6.7L below lists the 10 planned HSUK Anglo-Scottish services that will provide hourly direct links from Edinburgh and Glasgow to approximately three-quarters of the English and Welsh Primary Network Hubs set out in Figure 2E, and will do so with massively reduced journey times. This represents an unprecedented level of connectivity between Scottish and English/Welsh cities, and it would seem certain to deliver huge economic and environmental benefits.

HSUK Service	**Via**	**Principal Calling Points** *(primary cities indicated in* **bold***)*	**HSUK Module**
HSUK01	East Coast	Plymouth/Exeter/**Bristol** TM/**Birmingham** New Street/Derby/**Sheffield**/ **Leeds**/York/Darlington/**Newcastle**/**Edinburgh**/**Glasgow**	**1**, **2**, **3**, **4**
HSUK02	East Coast	Bournemouth/Southampton/Winchester/Reading/Oxford/Milton Keynes/ Northampton/Leicester/**Nottingham**/**Sheffield**/**Leeds**/York/Darlington/ **Newcastle**/**Edinburgh**/**Glasgow**	**1**, **2**, **3**, **4**
HSUK04	East Coast	Swansea/**Cardiff**/Newport/**Bristol** Parkway/**Birmingham** New Street/Stoke/ **Manchester**/**Leeds**/York/Darlington/**Newcastle**/**Edinburgh**/**Glasgow**	**1**, **2**, **4**
HSUK21	East Coast	**Liverpool**/**Manchester**/**Leeds**/York/Darlington/**Newcastle**/**Edinburgh**/ Edinburgh Airport/**Glasgow**	**1**, **2**
HSUK31	East Coast	**London**/**Newcastle**/**Edinburgh**/**Glasgow**	**1**, **2**, **3**, **4, 5**
HSUK32	East Coast	**London**/York/Darlington/**Newcastle**/**Edinburgh**/Edinburgh Airport/Perth (**SPLIT 1**) Forfar/Aberdeen (**SPLIT 2**) Dundee or Inverness	**1**, **2**, **3**, **4, 5**
HSUK34	East Coast	**London**/Leicester/Doncaster/York/Darlington/**Newcastle**/**Edinburgh**/ Edinburgh Airport/**Glasgow**	**1**, **2**, **3**, **4, 5**
HSUK52	West Coast	**London**/Brent Cross/Stoke/Crewe/Warrington/Preston/Lancaster/ Oxenholme/Penrith/Carlisle/Motherwell/**Glasgow**	**2**, **4, 5**
HSUK61	West Coast	**London**/Luton/MK/Coventry/**Birmingham**/Wolverhampton/Crewe/Warrington/Preston/Lancaster/Oxenholme/Penrith/Carlisle/ Lockerbie/**Edinburgh**	**4, 5**
HSUK91	East Coast	Brighton/Gatwick/Heathrow/Brent Cross/York/Darlington/**Newcastle**/ **Edinburgh** (**SPLIT 1**) **Glasgow** (**SPLIT 2**) Edinburgh Airport/Perth/Aberdeen	**1**, **2**, **3**, **4, 5, 6**

Table 6.7L : Proposed HSUK Crossborder Services *(HSUK Modules as defined in Figure 5C)*

Table 6.7L also clarifies the construction modules that each Crossborder HSUK service is reliant upon. It should be noted that the services focussed upon London and the South-East (i.e. HSUK31, 32, 34, 52, 61 and 91) would require Module 5 (the HSUK London-Midlands route following the M1 Corridor); in view of the ongoing progress of HS2 Phase 1, some adjustments to the routeing of these proposed services (in terms of journey time, rather than fundamental connectivity) may be required, at least in the short term.

However, the services on Crosscountry and Transpennine axes (i.e. HSUK01, 02, 04 and 21) will be of much greater value in improving links between the UK regions and thereby helping to Level-up the UK economy. These services only require Modules 1, 2, 3 and 4 (Crossborder, Northern Powerhouse, Yorkshire-East Midlands and Midlands Engine) and they are therefore independent of current HS2 works.

6.7.8 Test 7C – Liverpool-Glasgow Connectivity Comparisons

Service HSUK21 from Liverpool to Glasgow provides the perfect demonstration of the advantages of High Speed UK's network-based design approach. This will enable Liverpool to Glasgow (both UK primary cities) to be directly linked for the first time by frequent intercity services.

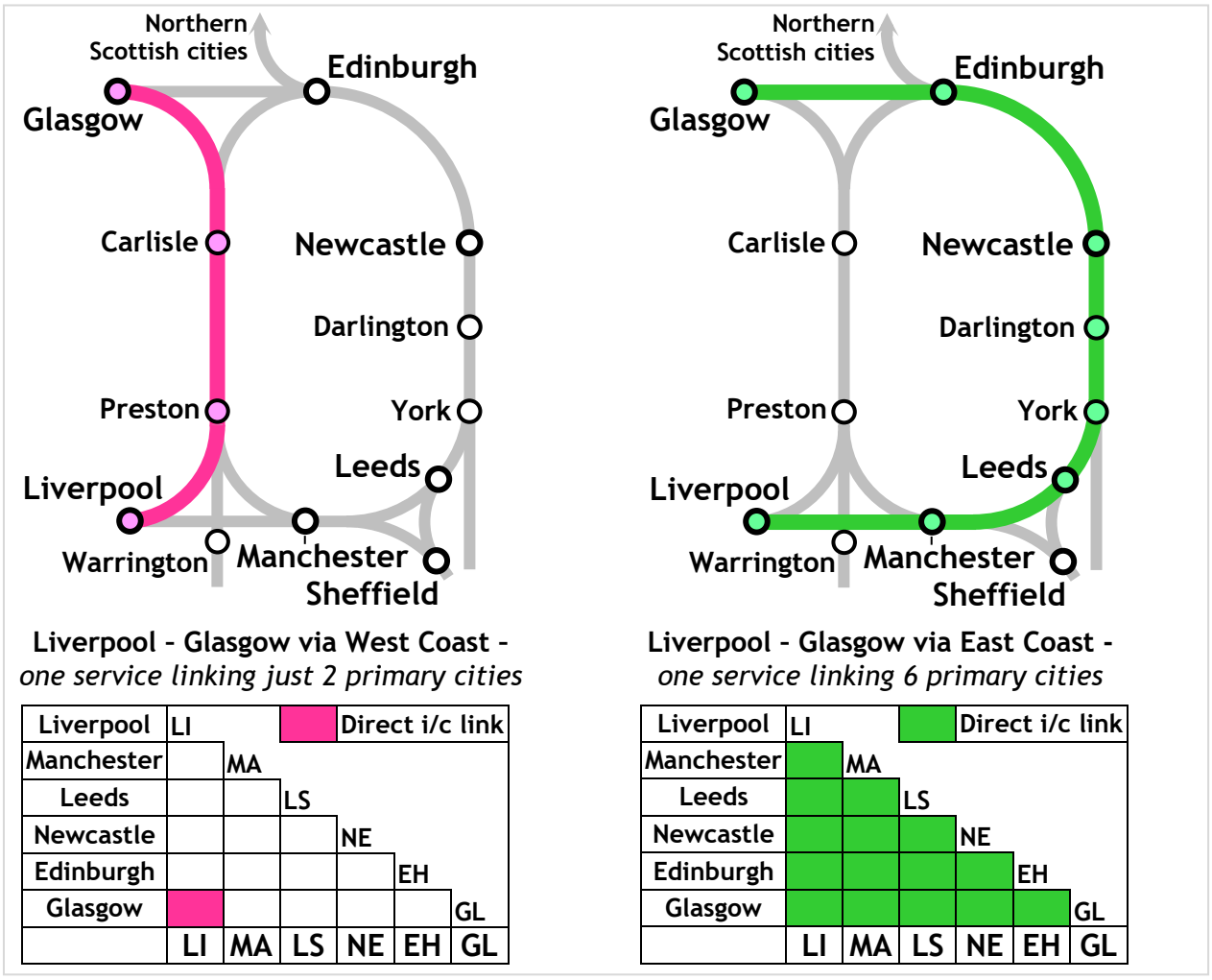


Table 6.7M : Comparison of West and East Coast Links between Liverpool & Glasgow

As noted in Table 6.7L and set out in Figure 6.7M above, service HSUK21 will run eastwards from Liverpool to Manchester and across the Pennines to Leeds, before turning northwards to York,

Darlington, Newcastle and Edinburgh, and finally turning west towards Edinburgh Airport and Glasgow.

HSUK21's semi-circular route might seem inefficient and circuitous, a highly indirect route linking 2 west coast cities, that runs close to Great Britain's east coast. However, it succeeds not only in interlinking Liverpool and Glasgow, but 4 other UK primary cities of the North and Scotland – i.e. Manchester, Leeds, Newcastle and Edinburgh – plus York and Darlington, on a single line of route. This greatly increases potential passenger volumes, which in turn better fills the trains and supports higher service frequencies, which then has the potential attract even more passengers.

As noted in Section 6.7.6, this 'single line of route' efficiency cannot be achieved along any west-sided route, either the existing West Coast Main Line or any new high speed line running along the WCML corridor. Instead, 4 separate trains would be required to link Liverpool and Manchester to Edinburgh and Glasgow, and it is highly doubtful whether any of these 'single (primary) city pair' links could generate viable passenger loadings to support high frequency operation. Put simply, while the trains would fill the line, it would be impossible to fill the trains.

It is also significant that with no economic case either for a new-build high speed line or for on-line upgrades delivering significant journey time savings, a Liverpool-Glasgow journey time via the West Coast Main Line (either in its existing condition, or upgraded as envisaged by either Integrated Rail Plan or Union Connectivity Review) would be longer than via HSUK's proposed routeing via new-build Transpennine and (east-sided) Crossborder high speed lines.

The routeing efficiencies of the HSUK proposition will establish the 'virtuous circle' necessary to support the construction of a new Crossborder high speed line:

- The superior connectivity of the HSUK single spine route directly linking most English (and Welsh) population centres via the English North-East to Edinburgh and Glasgow will naturally attract much greater passenger volumes.
- These high passenger volumes will in turn fill the trains and support the high service frequencies that will maintain rail's market-leading position, and attract more passengers.
- This profitable operation will generate the revenues necessary to finance the construction of the new high speed line.
- The revenues are broadly proportional to the populations connected along the line of route.
- The intermediate population is concentrated in the more favourable topography along the east side of the island of Great Britain.
- Construction costs in this more favourable topography will be greatly reduced compared with the mountainous and sensitive terrain along a west-sided route.

All these factors will combine to establish a far superior business case for an east-sided Crossborder high speed route to Scotland.

6.7.9 Test 7D – A Controlling Mind guiding Rail Network Development?

There is a self-evident need for an active process, a 'controlling mind' to coordinate the development of all major railway initiatives, variously HS2, Midlands Rail Hub, Northern

Powerhouse Rail, the Integrated Rail Plan and UKNET (stemming from the Union Connectivity Review, see Section 4.5.1). As noted in Section 6.7.1, this process is vital to ensure that these initiatives collectively deliver the desired outcome i.e. an efficient national rail network, capable of optimising connections between all UK regions and nations. It is vital also that this process is applied in a timely fashion, before ill-informed decisions become entrenched and irreversible.

However, no such process of optimisation can be detected in any of the outputs of the Integrated Rail Plan. As noted in Section 4.2, the IRP was remitted with no technical criteria against which its performance could be optimised. Instead, its primary requirement was to conform with established railway projects, in particular HS2 Phases 1 and 2a. This essentially means that the Integrated Rail Plan is subsidiary to HS2, and that decisions taken in the development of HS2 will ultimately predetermine the configuration and performance of the entire national network covered by the Integrated Rail Plan and (potentially) by UKNET.

This should have demanded, at the outset of the HS2 project, a determined effort by the Government (and therefore, by their professional advisors within HS2 Ltd and the Department for Transport) to ensure that HS2 would be designed to form the core element of a future optimised and integrated national network. Yet no indication of such a serious and structured process can be found anywhere in the mountainous documentation supporting the HS2 project.

Instead, HS2 Ltd's *Report to Government*[33] (DfT, March 2010) provides compelling evidence that issues of national network were essentially ignored when the HS2 concept was first developed. Section 3.5 (pp93-96) confirms that engineering feasibility, cost, environmental impact and journey time were the primary factors considered in the design of the HS2 Phase 1 route from London to the West Midlands; its performance in the context of a wider national network was not considered.

However, HS2 Phase 1 was then used as the basis for all configurations of 'national network' that were subsequently considered in Section 6.1 (pp217-222).

The risks in this deeply flawed process are self-evident. There were never any checks and balances to ensure that the chosen route of HS2 Phase 1 through the Chilterns Area of Outstanding Natural Beauty was the logical and optimum first step in creating a national network that would efficiently interconnect all regions of the United Kingdom. There was never any consideration either, that the predication upon a route through the Chilterns AONB would preclude proper consideration of alternative routes and network configurations which might prove to be superior in the core task of connecting the nation – in particular, the M1-aligned 'spine and spur' configuration adopted in the development of High Speed UK.

All this provides the clearest possible indication that at no time during the 13 years of the Government's UK high speed rail project, has there been a 'controlling mind' to guide the optimal development of the UK railway network.

Instead, it seems simply to have been assumed that the desired outcome of an optimised national network would come about through the magisterial act, of building a new stand-alone high speed line with no worthwhile links to the existing railway system.

6.7.10 Test 7 – Finding

The Integrated Rail Plan will fail to improve Crossborder journeys to Scotland, and it will compel passengers on Crosscountry journeys to make a walking transfer between adjacent terminus stations in central Birmingham. It has largely ignored questions of how it will perform as a network, and this neglect threatens the fundamental integrity of the national railway network.

This study has examined 2 key aspects of national rail network performance:

- the integrity of the Crosscountry route through Birmingham;
- the efficiency of the Crossborder connection to Scotland.

In both cases it has identified that the Integrated Rail Plan will catastrophically underperform relative to the High Speed UK Exemplar Alternative, and it has uncovered a clear neglect of issues that are critical to the integrity and efficiency of the national network. It cannot possibly be the intention of Government that passengers on Crosscountry journeys will be forced to detrain at one terminus station in Birmingham, and walk to another terminus station from which they will continue their journey. It cannot possibly be the intention of Government that Edinburgh and Glasgow will only enjoy enhanced intercity links to Birmingham and London, and not to any of the primary cities of the Northern Powerhouse, or any other major UK city. Yet these are the outcomes that the Government's Integrated Rail Plan will inevitably bring about.

It is plain that the authors of the Integrated Rail Plan have failed to question key aspects of the HS2 project, and as a result they have failed to:

- protect the interests of the wider national railway network; or
- guide the optimal development of this network; or
- understand the fundamental value of the 'through' Birmingham New Street station to the integrity of this network; or
- challenge the simplistic and false notion that Birmingham New Street station was 'full', and a new, remote terminus station (i.e. Birmingham Curzon Street) was therefore required.

Instead, the Integrated Rail Plan endorses the decision, taken very early in the HS2 project, to develop the new Curzon Street terminus in Birmingham that cannot possibly accommodate through Crosscountry services. This now threatens the fundamental integrity of the UK rail network.

The consequences of this ill-informed decision, by which the nation's most important rail corridor will be effectively severed at its midpoint (see Figures 6.7D and 6.7E), are highlighted by the vastly superior network performance of the HSUK Exemplar Alternative. These proposals (as set out in Figures 6.7G, 6.7H and 6.6R) fully recognise Birmingham's critical position at the fulcrum of the national railway network, they will transform connectivity between the UK regions/nations, and (unlike the Integrated Rail Plan) they will support the Government's agenda for a Levelled-up, Net Zero and 'Built Back Better' United Kingdom.

6.8 Information developed for Appendices C, D & E

The quantified comparisons set out in this report are only possible through the detailed modelling of a new national railway network, combining the new-build and upgrading projects described in the Integrated Rail Plan with the routes of the existing network. This essentially matches the detailed design work that has, over more than a decade, been invested in the development of the High Speed UK Exemplar Alternative.

With the network of new, upgraded and existing routes assembled, it is then possible to develop a 'Demonstrator Timetable' for the entire national system presaged by the Integrated Rail Plan. This is based on information set out in the IRP for both predicted journey times and intended service patterns; with necessary validation and extrapolation, journey times for all 1,485 possible journeys in a 55-centre network have been calculated and collated.

With the same effort already undertaken for HSUK, accurate comparisons of network performance can be undertaken. These comparisons of course comprise the substance of this study; but at their simplest, these are based upon the direct links and the journey time reductions that either the Integrated Rail Plan or High Speed UK could achieve for each UK community.

It is not appropriate or necessary to include these comparisons in the main text of this study, and instead, they have been compiled into:

- Appendix C – principal cities and airport of the Midlands Engine;
- Appendix D – principal cities and airport of the Northern Powerhouse;
- Appendix E – Edinburgh, Glasgow and London i.e. the primary cities at each end of any Anglo-Scottish high speed route.

In the Figures 6.8A – 6.8E set out on the following pages, Wolverhampton has been selected as the exemplar location to illustrate the scope of the research that has been undertaken in support of this study:

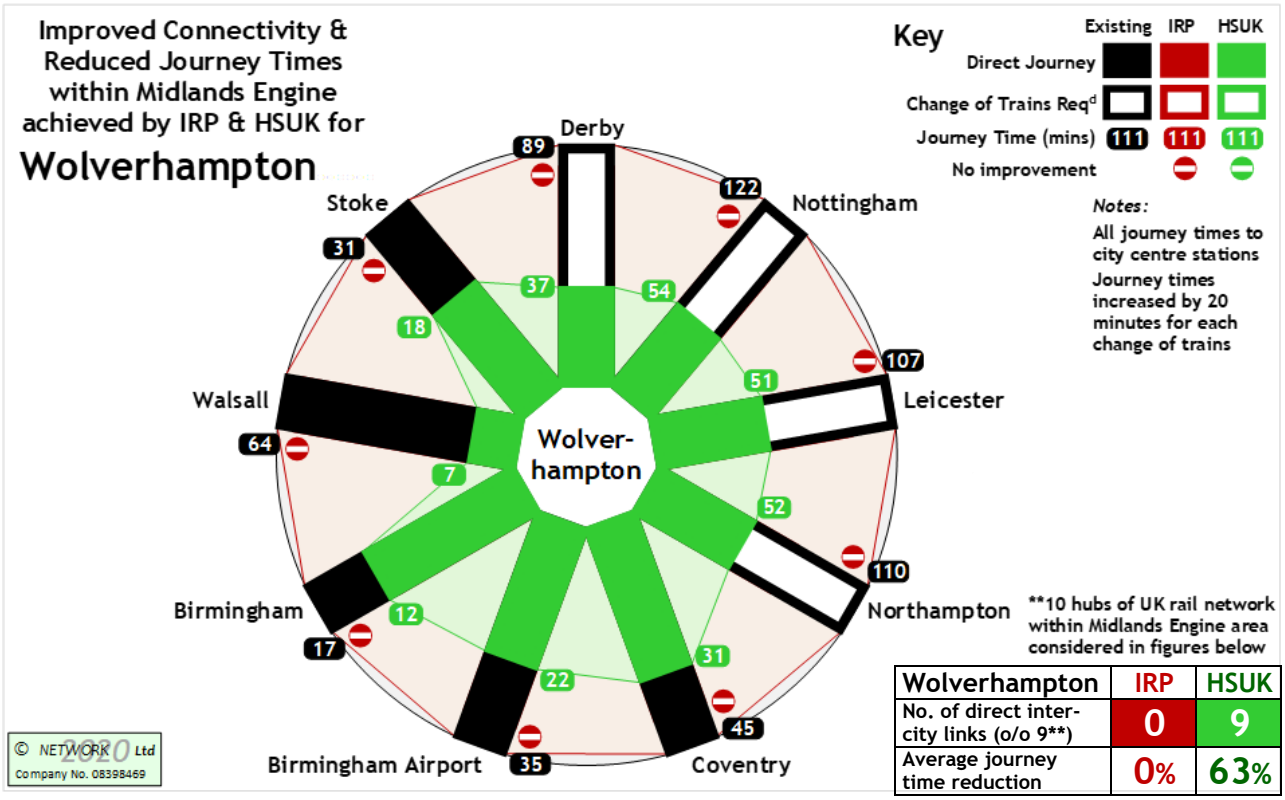
- Map of direct links from Wolverhampton to other UK cities offered by existing national railway network (Figure 6.8A);
- With Integrated Rail Plan in place, map of direct HS2/IRP links (if any) from Wolverhampton to other UK cities (Figure 6.8B); *(diagram amended to reflect June 2022 cancellation of Golborne Link)*
- With High Speed UK in place, map of direct HSUK links from Wolverhampton to other UK cities (Figure 6.8C);
- Existing network vs IRP vs HSUK journey time comparisons within local region (i.e. Midlands Engine in the case of Wolverhampton) (Figure 6.8D);
- Existing network vs IRP vs HSUK journey time comparisons outwith local region (i.e. Midlands Engine in the case of Wolverhampton) (Figure 6.8E). *(journey times still to be recalculated where necessary to reflect June 2022 cancellation of Golborne Link)*

For each of the 29 other cities and airports considered in this study alongside Wolverhampton, similar information is presented in Appendices C, D and E.

Figure 6.8A : Direct Links from Wolverhampton offered by Existing Network

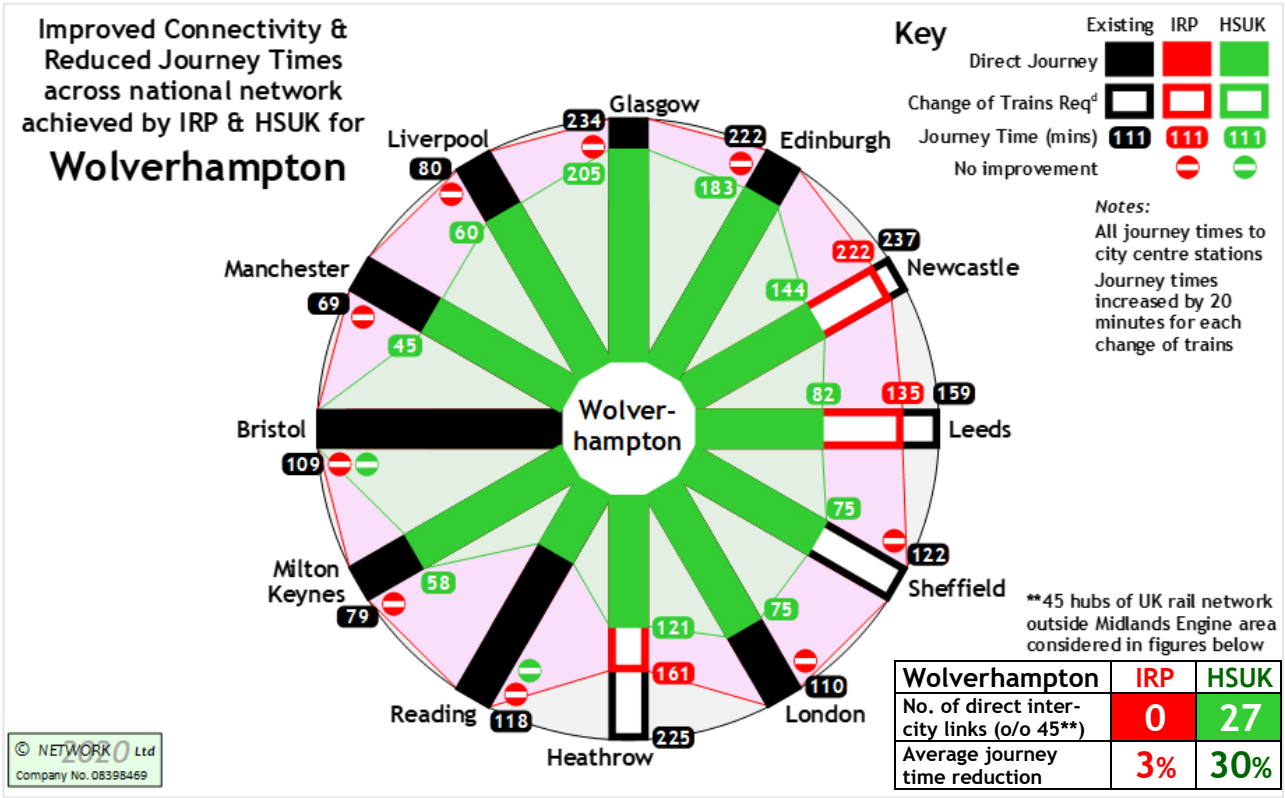
Figure 6.8B : Direct Links from Wolverhampton offered by Integrated Rail Plan

Figure 6.8C : Direct Links from Wolverhampton offered by High Speed UK



Wolverhampton	IRP	HSUK
No. of direct inter-city links (o/o 9**)	0	9
Average journey time reduction	0%	63%

Figure 6.8D : Wolverhampton : Journey Time Comparisons within Midlands Engine



Wolverhampton	IRP	HSUK
No. of direct inter-city links (o/o 45**)	0	27
Average journey time reduction	3%	30%

Figure 6.8E : Wolverhampton : Journey Time Comparisons across National Network

7 Conclusions

7.1 Logic Path of *Dissecting the Integrated Rail Plan*

This study's technical examination of the Government's Integrated Rail Plan (IRP) is founded upon a very simple logic path, which can be represented in three incontrovertible statements:

- The ambition of the Government and the wider public for a Levelled-up, Net Zero and 'Built Back Better' nation relies on many major interventions; but it cannot happen without huge enhancement of the national railway network, to create a better-connected and higher-capacity system.
- A railway network is a design product little different from a car or a washing machine; through a superior combination of ingenuity, good practice and professionalism on the part of its designers, it is possible to create a railway network (or car or washing machine) that on a rational and measurable basis of comparison outperforms any other, delivering (in the case of a railway network) the greatest possible transformation in connectivity and capacity between all major communities, in every region of the nation.
- It is therefore incumbent upon the Government's professional advisors to ensure that their Integrated Rail Plan does comprise the best possible railway network, an optimised system that will best deliver the Government's vision of a Levelled-up, Net Zero and 'Built Back Better' nation.

7.2 Tests and Outcomes of the *Dissecting the Integrated Rail Plan*

Accordingly, the Tests set out in this study have been designed to provide answers to the following three fundamental questions, all key issues of public and national interest:

- Will the IRP deliver the required transformation in rail network connectivity and capacity?
- Does the IRP demonstrate the scientific and structured processes necessary to deliver the greatest possible transformation?
- Does the IRP offer optimal performance as a local, regional or national network?

Every Test applied to the Integrated Rail Plan demonstrates essentially the same basic outcomes:

- Little quantifiable improvement in connectivity, either locally, regionally or nationally;
- No demonstration of technical performance, and no discernible process of optimisation;
- Comprehensive outperformance by an alternative proposal, developed to radically different principles.

7.3 The Integrated Rail Plan – a Technical and Political Failure

The extent of the Integrated Rail Plan's technical failure is made clear by the vastly superior performance of the High Speed UK Exemplar Alternative, as set out in Table 7A on the following page. However, the IRP's failure is not merely technical. If it cannot deliver transformed connectivity, then it cannot bring about the Levelled-up, Net Zero and 'Built Back Better' nation promised by politicians; and its failure also becomes a political matter.

Chancellor Rishi Sunak correctly states that *"Infrastructure connects our country, drives productivity and Levels-up"*; and if the Integrated Rail Plan were to achieve this, its planned expenditure

(potentially rising to triple-digit billions of pounds) might possibly be worthwhile. But this study has found (see Sections 6.2 and 6.5) that the Integrated Rail Plan will not succeed – to use the Chancellor's own favoured metric – in *"dramatically improving journey times between our towns and cities"*. Moreover – as demonstrated in Table 7A, and throughout this study – it fails on every other conceivable metric.

Test	Ref.	Test Description	Winner
1A	6.1.2/3	Comparison of Journey Times on 16 Key Routes	HSUK
1C	6.1.4	Disparities in Journey Times to Leeds and Manchester	HSUK
2A	6.2.2	Midlands Engine Connectivity Improvements	HSUK
2B	6.2.3	Northern Powerhouse Connectivity Improvements	HSUK
2C	6.2.4	National Intercity Connectivity	HSUK
2D	6.2.2/5	Nationwide Assessment of Levelling-up Potential	HSUK
3A	6.3.2/3	Performance against Northern Powerhouse Specification	HSUK
3B	6.3.4	Provision of New Transpennine Capacity	HSUK
4A	6.4.2/6	Integration with West Yorkshire Mass Transit System	HSUK
5A	6.5.2	Small Town Connectivity along Main Line Corridors	HSUK
5B	6.5.3	Small Town Connectivity across National Network	HSUK
5C	6.5.4	Small Town Connectivity Improvements	HSUK
6A	6.6.2	Network Comparisons in the Northern Powerhouse	HSUK
6B	6.6.3	Capacity Improvements in Central Manchester	HSUK
6C	6.6.4	Network Development in Liverpool City Region	HSUK
6D	6.6.5	Network Development in Sheffield City Region	HSUK
6E	6.6.6	New Transpennine Railfreight Route	HSUK
6F	6.6.7	Network Comparisons in the Midlands Engine	HSUK
6G	6.6.8	Capacity Improvements in West Midlands	HSUK
6H	6.6.9	Network Development in Potteries Region	HSUK
7A	6.7.2/4	Integrity of National Network/Crosscountry Corridor	HSUK
7B/C	6.7.5/8	Integrity of National Network/Crossborder Corridor	HSUK

Table 7A : Summary of Test Outcomes

The Chancellor – and indeed every other politician who has supported the IRP's development, including Prime Minister Boris Johnson and Secretary of State for Transport Grant Shapps – must bear their share of culpability for an Integrated Rail Plan that so demonstrably fails to deliver the best possible railway network for the people of the United Kingdom.

7.4 The Integrated Rail Plan – an unprecedented Professional Failure

However, it is fair also to state that these politicians are fully entitled to expect better from their professional advisors who have developed the Integrated Rail Plan as a detailed proposition. It would be reasonable to hope that these advisors would have recognised from the outset that the challenge was not simply to validate the established HS2 proposals and build a network around them, but to create the best possible national railway network, most capable of connecting communities and thereby bringing about Levelling-up, Net Zero and Building Back Better.

Yet the Government's advisors, supposedly expert in matters of line capacity, network connectivity and railway project development, have comprehensively failed to:

- make any quantified assessment of national network performance, with HS2 and the various proposed Integrated Rail Plan interventions in place;
- demonstrate the processes necessary to optimise this network performance, and therefore optimise the performance of the Integrated Rail Plan;
- assess alternative schemes that might offer superior performance.

Most crucially, the Government's advisors appear to have failed to comprehend the central contradiction on which the Integrated Rail Plan is founded. Its ostensible purpose was to create an improved and integrated national rail network capable of supporting the Government's Levelling-up, Net Zero and Building Back Better agendas – yet by its own Terms of Reference its design was to be based upon the established HS2 proposals (Phases 1 and 2a) which were designed with no worthwhile consideration either for integration or for national network.

7.5 No 'Controlling Mind' guiding Development of UK Rail Network

The absence of any 'controlling mind' to guide the development of the national railway network has been a readily auditable fact (see Section 6.7.9 of this study) from the outset of the HS2 project, fully documented in the copious reports prepared for the Government by HS2 Ltd. Regrettably, despite repeated warnings[34], the Government and the wider transport establishment have proved unwilling to look beyond the delusional vision of a stand-alone high speed rail megaproject to the practical realities of operating a national railway system for the benefit of all.

This ostrich-like attitude is becoming increasingly unsustainable, as this study sets out for the first time the necessary rigorous and quantified examination of the Integrated Rail Plan; and in every Test, in every comparison of network performance, its catastrophic failures of integration and network planning are laid bare by the demonstrably and vastly superior performance of the HSUK Exemplar Alternative.

7.6 Historical Failures of Integration and Network Design

It must be recognised that the Integrated Rail Plan is only the latest symptom of a much deeper and longer-standing malaise. The basic fault lies with the original conception of HS2 as a stand-alone, super-fast railway, lacking any meaningful integration with the existing network; and so far, neither the Government nor the IRP's developers (or indeed the Transport Select Committee, the Oakervee Review or any other responsible technical body) have got to grips with the fundamental truth of the matter. If the Government desires an integrated and efficient national railway network, as its Integrated Rail Plan initiative surely demands, then all component elements, in particular Phases 1 and 2a of HS2, must be designed to bring about this integrated and efficient network.

7.7 HS2 & Integrated Rail Plan – Fragmentation of National Network

This imperative is most evident, and most pressing, in the ongoing works to construct HS2's new terminus at Birmingham Curzon Street. This station is remote from the established primary West Midlands hub at Birmingham New Street, and – by its very nature as a terminus – it is functionally

incapable of accommodating 'through' high speed Crosscountry services, running (for instance) from Leeds or Manchester via Birmingham to Bristol or Cardiff. Instead, as the text of the Integrated Rail Plan confirms, passengers arriving from the North at Curzon Street will be forced to make a walking transfer to the adjacent Moor Street terminus, to continue their journeys to the South-West and South Wales.

This fragmentation – as documented in Sections 6.7.2 – 6.7.4 and Figure 6.7E of this study – will effectively sever the Crosscountry rail corridor that is the most crucial in connecting the nation. It runs completely counter to every ideal of integration, on which the Integrated Rail Plan must by definition be based. It is the direct consequence of an unfounded and lazy assumption, dating back to the very start of the UK high speed rail project, that Birmingham New Street was 'full', and that development must be focussed elsewhere. No-one ever took the trouble to understand the crucial importance of Birmingham New Street to maintaining links between outlying UK regions, and the result is an 'Integrated Rail Plan' that now threatens the fundamental integrity of the national rail network, and hence the Government's entire Levelling-up agenda.

7.8 HS2 & Integrated Rail Plan – Integration cannot be retro-fitted

The failure of the IRP strategy for Birmingham, and indeed for the whole nation, is difficult to comprehend in isolation. The true folly of the Integrated Rail Plan's effective severance of the crucial Crosscountry corridor can only be appreciated through understanding what can be achieved with by the radically different approach of the High Speed UK Exemplar Alternative. HSUK's comprehensive Crosscountry connectivity is achieved through a fully integrated suite of upgrades across the West Midlands (see Figures 6.7G, 6.7H, 6.6P and 6.6R) – which then allows Birmingham New Street to be developed to its full potential as the primary rail hub of the West Midlands for local, regional and national services.

A very simple lesson emerges from the success of the HSUK Exemplar Alternative, not only in Birmingham and the West Midlands but across the entire national railway system. This success stems directly from its design from the outset as an integrated and efficient national network, exactly what is now belatedly demanded in the IRP initiative. The corresponding failure of the Integrated Rail Plan demonstrates clearly that it is simply not possible to retrofit integration onto a project – it has to be designed into all elements from the start.

7.9 Questions of Cost and the all-consuming HS2 Budget

This study has deliberately avoided any detailed consideration of cost, either of HS2 and the Integrated Rail Plan, or of the High Speed UK Exemplar Alternative. Not only is this a matter beyond the direct expertise of the author, there is also a major risk that excessive focus upon the mind-boggling triple-digit billion pound IRP costs may tend to obscure the question of whether HS2 and the Integrated Rail Plan will perform effectively and optimally as a national network.

This is the fundamental issue that must be resolved, to determine whether these public mega-projects are fit for their purpose of Levelling-up the UK economy, achieving Net Zero emissions and Building Back Better. By contrast, cost is a subsidiary issue, greatly influenced by the quality

and the appropriateness of the design; it is almost invariably true, that bad and inappropriate design costs far more than design that is both high quality and fit for its purpose.

However, when issues of limited budget come into play, the question of cost becomes impossible to ignore. The ever-increasing costs of HS2's new-build high speed lines are now threatening to consume all of the Integrated Rail Plan's available budget. This would ultimately leave no money for the smaller and more worthwhile local projects set out in the Integrated Rail Plan, with the outcome that the Integrated Rail Plan might comprise just the 'Telegraph Pole' of new HS2 high speed lines, and absolutely nothing else.

This is the supreme irony of the HS2 project – not only does its bad and inappropriate design cripple any scheme built upon it, it also robs these schemes of the funds needed to build them.

All this provides yet another compelling argument for a truly Integrated Rail Plan whose logical priority is the end – i.e. the network – rather than the means – i.e. the high speed line.

7.10 A Challenge to the UK Transport Consultocracy

The vast and demonstrable superiority of the High Speed UK Exemplar Alternative poses a critical challenge to every professional advisor, every consultant of whatever discipline involved in the development of the Government's Integrated Rail Plan and all its predecessor projects. These professionals as individuals are members of a variety of Institutions obliged by their Royal Charters to serve the public interest; yet collectively they form a sprawling 'consultocracy' that has developed a public project which manifestly fails to serve the public interest.

This consultocracy must explain how all the rigorous and detailed assessments presented in this study are wrong, and how the Integrated Rail Plan is the optimised scheme that it is claimed to be, capable of fully delivering on the Government's Levelling-up, Net Zero and Building Back Better agendas. In particular, they must explain how Levelling-up can happen when (as this study demonstrates) the Integrated Rail Plan will deliver its greatest connectivity gains in London.

If they cannot provide this explanation, they must stand aside. The public interest, and indeed the national interest, allow no other option.

7.11 The Responsibility of Government

But wherever and however blame for the IRP fiasco might be precisely allocated, one fact remains indisputable. Development of a truly Integrated Rail Plan is essential to ensure a Levelled-up, Net Zero and 'Built Back Better' United Kingdom, and it is the Government's fundamental responsibility to make this happen, for the good of all UK citizens. A responsible Government has no choice but to face up to the mistakes of the past, and to develop an Integrated Rail Plan that is capable of delivering the desired results; it cannot hide behind the failures and probable misconduct of its professional advisors.

Given the failures of HS2 and the Integrated Rail Plan, as set out in this study, the High Speed UK Exemplar Alternative would now appear to be the only option available to any Government that is serious about achieving a Levelled-up, Net Zero and 'Built Back Better' United Kingdom.

Introducing… ***Dissecting the Integrated Rail Plan***

The Government has made 3 crucial pledges – to Level-up the UK economy, to move towards Net Zero greenhouse gas emissions, and to Build Back Better after the Covid-19 pandemic. But it can only meet these pledges through a radical upgrade of the UK's transport network. This is the logic for the Government's Integrated Rail Plan – to create a hugely enhanced national rail network that will transform connections between towns and cities in all the UK regions.

The Government published its Integrated Rail Plan (IRP) in November 2021 – but it has presented no evidence to show that the IRP will drive the transformations necessary to deliver Levelling-up, Net Zero and Building Back Better. It has also failed to demonstrate that the IRP's published proposals represent the best and most cost-effective way towards the integrated and optimised railway network that the nation so clearly needs. Instead, the Government, and all its legions of professional advisors, appear to have assumed that by building the Integrated Rail Plan around the established HS2 proposals, this integrated and optimised network will somehow come about.

The future of the national rail network, and of all the Government's cherished policy agendas – for Levelling-up, for Net Zero and for Building Back Better – now hang on this extraordinarily dangerous assumption.

Dissecting the Integrated Rail Plan presents for the first time a structured assessment of how the Government's IRP proposals will perform as a national network, with rigorous comparisons against the performance of both the existing system and the High Speed UK (HSUK) Exemplar Alternative. It looks far beyond the few headline journeys between principal UK cities on which the Government has based its claims for HS2/IRP; it examines all of the 1,000-plus intercity journeys that make up the UK network. For each, it assesses journey time, quality of interchange and quality of service – the key components of network performance that determine whether connectivity is improved, and whether Levelling-up, Net Zero and Building Back Better can actually happen.

Dissecting the Integrated Rail Plan reaches the stark conclusion that the Integrated Rail Plan is fundamentally unfit for purpose, failing to deliver on any of its core political requirements:

- The IRP's network-wide connectivity gains are an order of magnitude smaller than those of HSUK, certainly insufficient to deliver Levelling-up, Net Zero or Building Back Better.
- The IRP's proposed upgrading of Transpennine routes will fail to meet every requirement of the Northern Powerhouse journey time specification established in 2015/16.
- The IRP's proposed Transpennine upgrades are fundamentally incompatible with the IRP's own aspiration for a West Yorkshire Mass Transit System.
- The IRP cannot deliver significant improvements for the Small Towns whose connectivity needs it has espoused; again, it is hugely outperformed by the HSUK Exemplar Alternative.
- The IRP lacks the integration necessary to deliver any significant 'local capacity dividend'.
- The IRP/HS2 proposals for the new Birmingham Curzon Street terminus will sever the Cross-country rail corridor at its midpoint, threatening the integrity of the entire national network.

Dissecting the Integrated Rail Plan identifies the primary cause of the IRP's catastrophic failure to perform as a network – its predication upon the established HS2 proposals, which were designed as a largely stand-alone system with no worthwhile consideration of national network. The gargantuan scale of this failure is proved in every comparison by the vastly superior network performance of the HSUK Exemplar Alternative, which – unlike HS2 and the Integrated Rail Plan – was designed from the outset as a fully integrated national network.

End Notes

[1] https://www.gov.uk/government/publications/integrated-rail-plan-for-the-north-and-the-midlands.

[2] A comprehensive review of HS2 Ltd documentation, in particular Chapters 3 and 6 of the 2010 *HS2 Report to Government* reveals no structured attempt to design HS2 to form the core element of a future national network. This issue is discussed in greater detail in Section 6.7.9 of this study. Refer also: http://www.highspeeduk.co.uk/D02%20UU%20report%20to%20government%20chapter%203b%202010.pdf http://www.highspeeduk.co.uk/D03%20UU%20report%20to%20government%20chapter%206%202010.pdf

[3] Further details of the HSUK proposals can be found on www.highspeeduk.co.uk.

[4] Existing national network journey times can be found on www.nationalrail.co.uk.

[5] For predicted reductions in intercity services on existing routes, refer to Table 23, pp91-92, HS2 Regional Economic Impacts, http://www.highspeeduk.co.uk/D07%20UU%20hs2-regional-economic-impacts%202013.pdf

[6] https://en.wikipedia.org/wiki/Northern_Powerhouse_Rail

[7] Details of the Midlands Rail Hub can be found on https://www.midlandsconnect.uk/media/1571/midlands-rail-hub-summary-report-final-june-2019.pdf

[8] Doncaster Metropolitan Borough Council submission to TfN can be found on HSUK website as Document D24.

[9] The publication *One North – A proposition for an Interconnected North* can be found on https://www.centreforcities.org/wp-content/uploads/2014/09/14-08-07-One-North.pdf or http://www.highspeeduk.co.uk/D11%20One_North%20-%20a%20proposition%20for%20an%20interconnected%20North%202014.pdf

[10] *The Northern Transport Strategy, Spring 2016 report*, Transport for the North, March 2016

[11] https://www.lexico.com/definition/connectivity

[12] P34/98, *Draft Strategic Transport Plan*, Transport for the North, January 2018. This document can be found on http://www.highspeeduk.co.uk/D14%20TfN%20Strategic%20Transport%20Plan%202018.pdf

[13] The Oakervee Review can be found on https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/870092/oakervee-review.pdf

[14] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1036027/union-connectivity-review-final-report.pdf

[15] Section 1.8, P30, *Integrated Rail Plan*, DfT, November 2021.

[16] Executive Summary, P12-P17, *Integrated Rail Plan*, DfT, November 2021.

[17] https://www.midlandsconnect.uk/media/1571/midlands-rail-hub-summary-report-final-june-2019.pdf

[18] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1052046/Executive_Summary.pdf

[19] P9/17, *Levelling-up White Paper (Executive Summary)*, HMG, February 2022.

[20] The National Policy Statement for National Networks can be found on: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf

[21] Section 2 boxed note, Items 2.6 & 2.10, pp9-11, *National Policy Statement for National Networks*, DfT, Dec. 2014.

[22] https://hansard.parliament.uk/commons/2021-10-27/debates/0B8990CB-67B6-403F-BD6D-838F5985D368/FinancialStatement

[23] Refer HSUK website www.highspeeduk.co.uk.

[24] https://www.networkrail.co.uk/industry-and-commercial/information-for-operators/national-electronic-sectional-appendix/

[25] Item 3.91, P110, Integrated Rail Plan, DfT, November 2021.

[26] P31, *One North - A Proposition for an Interconnected North*, One North, July 2014.

[27] https://www.westyorks-ca.gov.uk/improving-transport/connectivity/

[28] The 'Mass Transit Vision' can be found on https://www.westyorks-ca.gov.uk/improving-transport/connectivity/

[29] The 'Rail Vision' can be found on https://www.westyorks-ca.gov.uk/improving-transport/connectivity/

[30] P16, *Integrated Rail Plan*, DfT, November 2021.

[31] A variety of images of Harry Beck's original map of the London Underground network, and subsequent versions, can be found by Googling 'Harry Beck Tube Map'.

[32] https://www.networkrail.co.uk/who-we-are/our-history/iconic-infrastructure/the-history-of-birmingham-new-street-station/

[33] See Endnote 2.

[34] See HS2 – High Speed Trains, Slow Speed Brains, available as Document A12 on www.highspeeduk.co.uk.