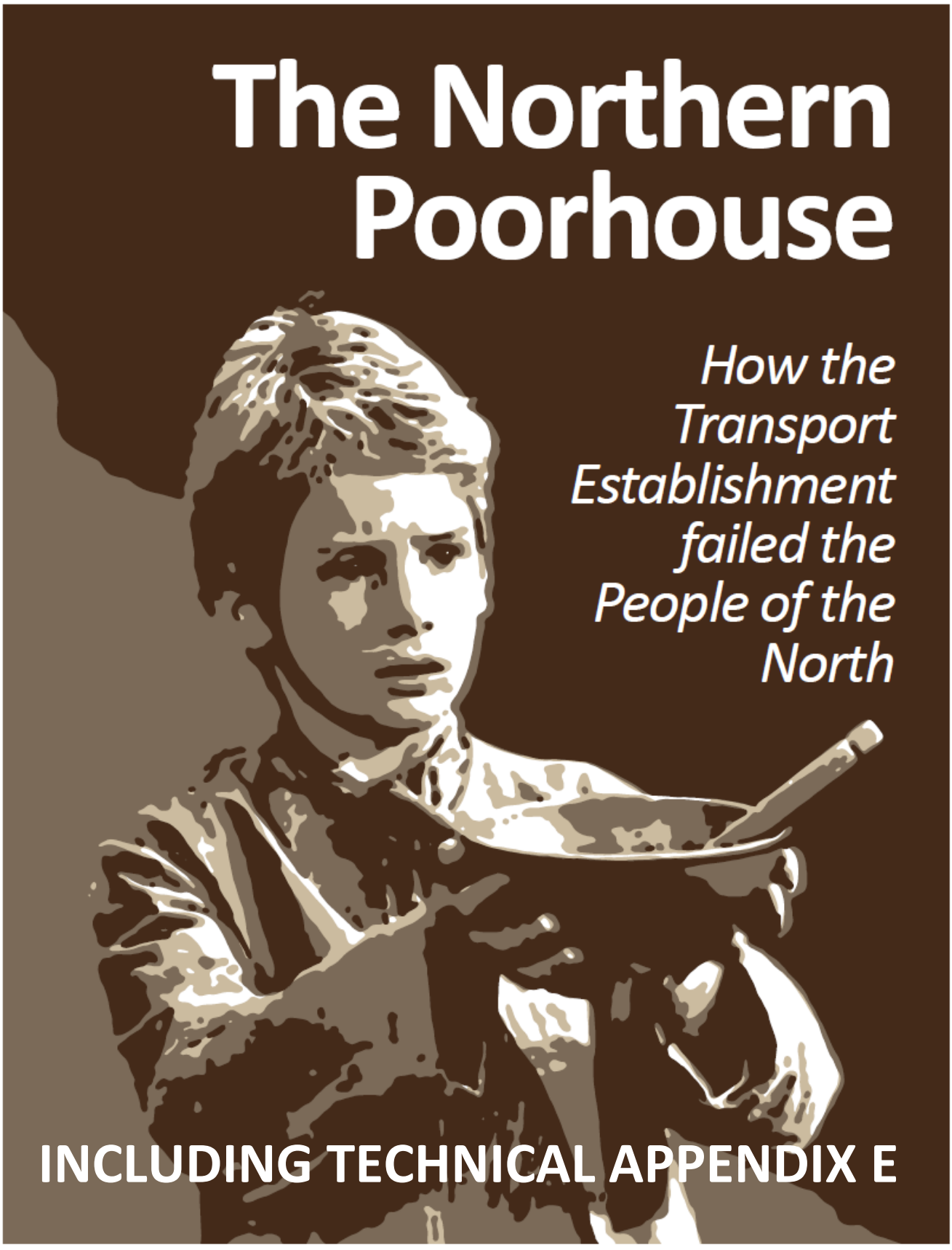
The Northern Poorhouse

How the Transport Establishment failed the People of the North



INCLUDING TECHNICAL APPENDIX E

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Issue	Date	Purpose
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1. Executive Summary

In June 2014, then-Chancellor George Osborne launched the Northern Powerhouse initiative. The aim of the Northern Powerhouse was to address the historically poor economic performance of the North by bringing together its major conurbations – Merseyside, Greater Manchester, South and West Yorkshire, Humberside and the North-East – to form a single aggregated unit of over 10 million population, capable of competing with Greater London and the Midlands, and also on a wider international stage.

The concept of improved 'HS3' transpennine high speed rail links, with a new transpennine route for passengers and freight, sprang from the Chancellor's initiative, and a specification for radically reduced intercity journey times was swiftly established. Since 2014, Transport for the North (TfN) has been working to develop proposals for improved rail links between Northern cities that will stimulate the region's economy, and redress the natural London-centricity of the Government's proposed 'Y-network' of HS2 high speed lines. In January 2018, TfN released its proposals for a 'Northern Powerhouse Rail' network of new routes linking the principal cities of the North.

The purpose of this report is to determine whether the TfN proposals:

- meet the 'HS3' journey time specification (see **Section 3.2**);
- satisfy a wider 'Requirements Statement' (see **Appendix D**) developed to ensure efficient and effective performance of an enhanced Northern Powerhouse rail network;
- represent an optimised scheme, delivering the greatest gains in rail network connectivity and capacity for the least cost.

To determine this last point, the performance of TfN's proposals on all aspects of the Requirements Statement has been contrasted against the performance of the 'Exemplar Alternative' of the High Speed UK (HSUK) scheme. Details of the HSUK proposals for a national system of high speed lines, fully integrated with the existing railway network, are presented in **Appendix B**.

This report concludes that TfN's Northern Powerhouse Rail proposals fail every test for a well-performing rail network; and the primary reason for this failure is Transport for the North's misplaced priority upon developing proposals that conform with the established HS2 scheme, rather than comply with the core specification for radically reduced intercity journey times set out in **Section 3.2**. TfN's proposals:

- fail to meet TfN's own specification for reduced intercity journey times **(see Section 7.1.1)**;
- fail to provide the new track capacity necessary for increased intercity, local and freight services **(7.1.2)**;
- offer no vision for how the Northern Powerhouse's principal stations can be developed to meet the capacity challenges of the anticipated step-change increase in rail services **(7.1.3)**;
- are compromised by inadequate station proposals, especially for Manchester and Manchester Airport **(7.1.4)**;
- offer poor interconnectivity between the many smaller Northern Powerhouse cities **(7.1.5)**;
- are hugely compromised by HS2's inadequate links from Northern cities to other regions **(7.1.6)**;
- fail to provide the specified new transpennine route essential for improved freight connections between ports, industry and population centres **(7.1.7)**;
- are effectively predetermined by proposed HS2 routes, and as a result fail to achieve the required benefits of improved capacity, improved connectivity or radically reduced journey times **(7.1.8)**;
- fail to offer the vision for a better-connected and more prosperous Northern Powerhouse **(7.1.9)**.

The failure of the TfN scheme is proven by HSUK's massive superiority on every one of the above points.

High Speed UK is not simply technically superior to the TfN Northern Powerhouse Rail proposals. It also meets all of the fundamental political goals set by the 'One North' group in their 2014 *Proposition for an Interconnected North*[1]:

- ***Passenger Services:*** HSUK will deliver the 'One North' requirement for radically improved intercity journey times between the principal cities of the North, and from these principal cities to Manchester Airport, with services focussed on city centre 'hub' stations.
- ***Freight Services:*** HSUK will realise the 'One North' ambition for a transformation of the region's railfreight network, to efficiently connect its industry, its ports and its major population centres.
- ***New Transpennine Rail Route:*** HSUK will deliver the 'One North' requirement for a new transpennine rail route for both passengers and freight. This will connect Merseyside and Greater Manchester to South and West Yorkshire, and also to the North East.

On any objective analysis of Transport for the North's *Strategic Transport Plan*, it is clear that over the past 4 years, the Northern Powerhouse Rail project has regressed, rather than progressed:

- The journey time targets set by 'One North' have been abandoned.
- No vision is put forward for a transformation of freight services in the Northern Powerhouse region.
- The new transpennine rail route proposed by TfN is hugely suboptimal in terms of its cost and connectivity performance, and it makes no provision for freight.

The abandonment of the HS3 journey time specification established by 'One North' raises particular concern. No explanation has been offered for its omission, and it seems fair to state that during the development of its proposals over the past 4 years, it must have become increasingly obvious to Transport for the North that – as shown in **Section 7.1.1** – their proposals would fail to meet many aspects of the HS3 Specification, or the wider political objectives of the 'One North' group.

The primary reason for Transport for the North's failure appears to be the mistaken core assumption that Northern Powerhouse Rail routes should be based upon the established HS2 proposals (see **Section 3.6**, **Section 7.1.8** and **Appendix E8**). The fundamental illogicality of basing new transpennine rail routes upon the northern sections of HS2, which were designed with no thought for transpennine connectivity, appears to have gone completely unrecognised by TfN's experts. It can only be speculated as to whether the presence of an HS2 Ltd representative on the TfN 'Partnership Board' (see **Appendix C**) has contributed to this myopia.

Whatever the case, it is plain that the priorities of Transport for the North's experts have been entirely misplaced. Rather than develop the integrated railway network that is essential to deliver the Northern Powerhouse and all of its promised economic benefits for the people of the North, their first priority has been to develop proposals that conform with the established HS2 scheme.

[1] *One North : A Proposition for an Interconnected North*, 'One North' group of city councils, July 2014

2. Introduction

There has been a long-standing and widespread perception that the Government's HS2 scheme, configured as a London-centric 'Y-network'[2], was unlikely to offer meaningful benefit to the North of England, or indeed any other UK region. Instead, HS2 seemed far more likely to suck wealth and economic activity towards the South and thus reinforce, rather than remedy the North-South Divide.

Political pressure from Northern communities led ultimately to the launch in June 2014 of George Osborne's Northern Powerhouse initiative. This included an 'HS3' concept for a transpennine high speed line that would connect the principal cities of the North, and thus redress the London-centricity of the HS2 'Y'. The HS3 concept was rapidly augmented by more detailed proposals from the 'One North' group of Northern city councils which established a specification for reduced journey times between the principal cities of the North, and from these cities to Manchester Airport.

Compared with HS2, proposals for HS3 (or Northern Powerhouse Rail/NPR) have been slow to advance towards a meaningful level of detail. Transport for the North's (TfN) January 2018 *Strategic Transport Plan*, setting out proposals for its Northern Powerhouse Rail network of new and enhanced rail routes is still essentially at conceptual stage. However, sufficient detail now exists to allow:

- Definitive assessment of the TfN proposals' performance in meeting the HS3 journey time specification.
- Definitive assessment of the TfN proposals' broader performance as a railway network.
- Comparison with alternative high speed rail proposals to determine whether TfN's Northern Powerhouse Rail represents an optimised scheme that is best for the North, and best for the UK.

These questions can only be resolved through the establishment of a balanced specification, or 'Requirements Statement', which should define all aspects of how the railway network of the North should perform, in order to deliver maximised benefits for the people of the North. This Requirements Statement would naturally incorporate the specification for reduced intercity journey times originally put forward by the 'One North' group.

The aim of this report is to:

1. Formulate a Requirements Statement (see Appendix D) for Northern Powerhouse Rail.
2. Assess the performance of the TfN proposals against this Requirements Statement.
3. Determine whether the TfN proposals represent the optimal scheme that its promoters claim.

This third criterion, of optimal performance, cannot be determined in isolation. Any judgment upon optimal performance can only be made through comparing the TfN proposals against an equivalent 'exemplar alternative', another high speed rail proposal that connects the key cities of the North. To this end, all of this report's technical assessments of the TfN Northern Powerhouse Rail scheme are accompanied by a parallel assessment of the High Speed UK (HSUK) scheme. Details of HSUK are given in Appendix B.

Given the resources so far devoted to the development of TfN's Northern Powerhouse proposals, it would be reasonable to expect these proposals to perform well on any technical comparison…….

[2] A more detailed description of the proposed HS2 'Y-network' is given in Appendix A.

3. Background to Launch of TfN's *Strategic Transport Plan*

3.1. George Osborne Initiative for Northern Powerhouse

In June 2014, then-Chancellor George Osborne launched the Northern Powerhouse initiative. The aim of the Northern Powerhouse was to address the historically poor economic performance of the North by bringing together its major conurbations – Merseyside, Greater Manchester, South and West Yorkshire, Humberside and the North-East – to form a single aggregated unit of well over 10 million population. This would be capable of competing with Greater London and the Midlands, and also on a wider international stage.

However, if the Northern Powerhouse was to perform effectively as a single economic unit, transport links between its major cities would have to be radically improved. The existing links, especially across the Pennines – either by road or rail – were slow and congested, and were clearly hampering economic performance. The imperative for improved links between the Northern cities was already self-evident; but it was greatly amplified by the developing plans for HS2[3] which would see Northern cities' north-south rail links to Birmingham and London radically enhanced. With no equivalent improvement of links between Northern cities, or indeed to other UK regional cities, HS2 seemed likely to suck economic activity out of the North unless it was complemented by equivalent links between the Northern cities.

These concerns, of unbalanced development of the national rail system, gave rise to the sustained political pressure from regional political and business groups which ultimately led to George Osborne's initiative for the Northern Powerhouse.

3.2. Launch of 'One North' Initiative

The Chancellor's June 2014 Northern Powerhouse initiative included the concept of an 'HS3' transpennine link, but gave no supporting detail. One month later, in July 2014, the 'One North' group (comprising the city councils of Liverpool, Manchester, Sheffield, Leeds and Newcastle) published a more detailed scheme[4] for improved rail links across the North.

The 'One North' initiative, depicted in graphic form in Figure 1, comprised 4 essential requirements:

- Radically improved intercity journey times between the principal cities of the North, and from these principal cities to Manchester Airport.
- Improvements to be focussed on existing city centre 'hub' stations.
- A transformation of the region's railfreight network, to efficiently connect its industry, its ports and its major population centres.
- A new transpennine rail route for both passengers and freight, connecting Merseyside and Greater Manchester to South and West Yorkshire, and a new rail route connecting Yorkshire to the North East.

These requirements – which represent the core political goals of the city councils that formed the original 'One North' group – are discussed in further detail in Sections 3.2.1, 3.2.2, 3.2.3 and 3.2.4.

[3] The London-centric layout of HS2 is described in Appendix A.

[4] *One North : A Proposition for an Interconnected North*, 'One North' group of city councils, July 2014

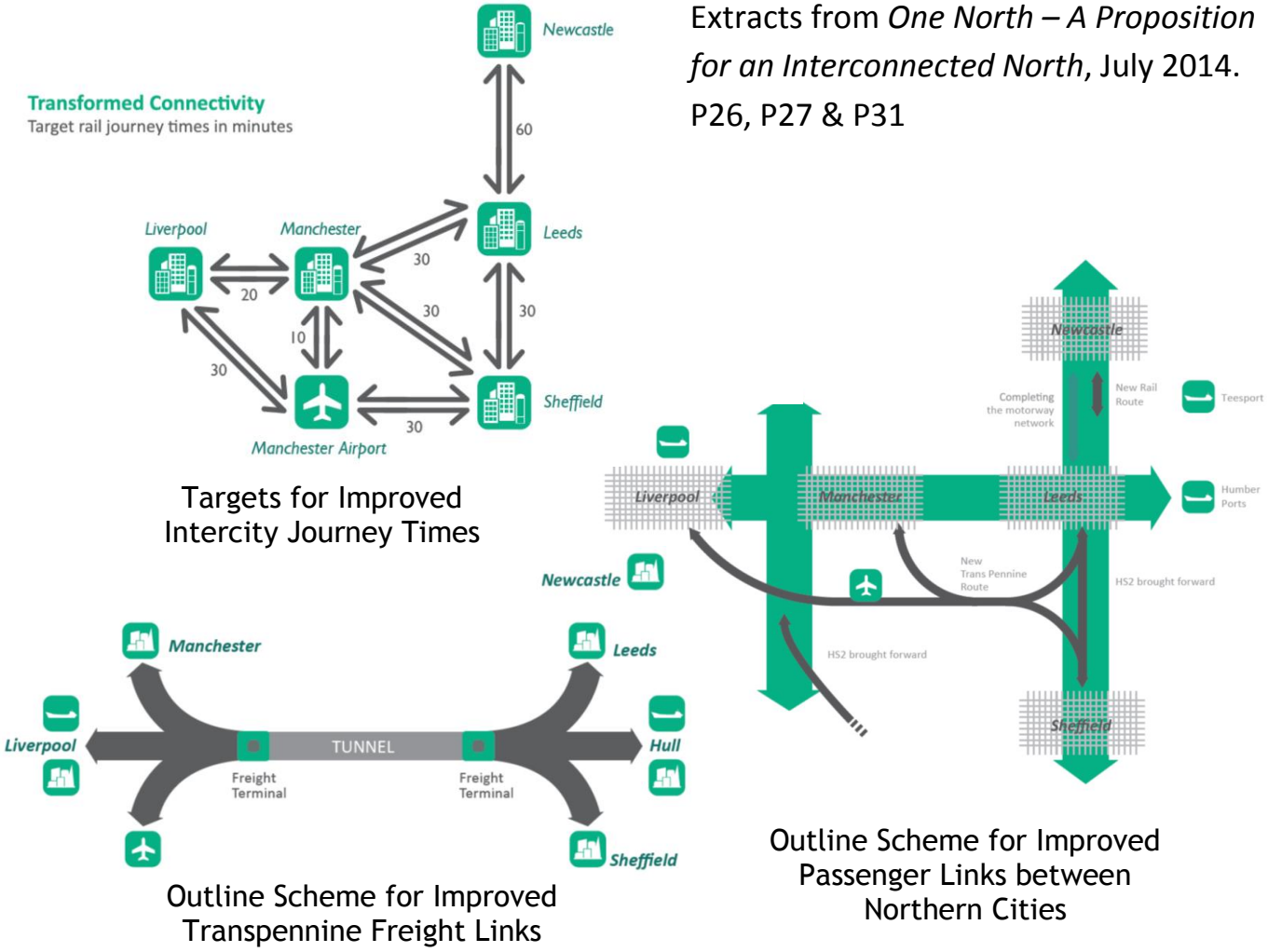


Figure 1 : Key Elements of the 'One North' Initiative (2014)

The 'One North' *Proposition for an Interconnected North* report established[5] an unambiguous requirement for a mixed-use passenger and freight 'transpennine corridor' that would transform rail connectivity across the North. This 'transpennine corridor' would comprise the following key features:

- A new east-west express passenger route crossing the Pennines, with the primary aim of linking Manchester to Sheffield and Leeds.
- Westward extension of the new transpennine line to Manchester Airport, Liverpool and Chester.
- Connection to (and integration with) the north-south HS2 line to enable services using the new transpennine line to access east-sided cities such as Newcastle, York, Hull and Nottingham.
- Parallel use of the new 'transpennine corridor' by long distance railfreight, presumably on separate tracks from the express passenger services.
- A potential Channel Tunnel-style 'lorry shuttle' operation between terminals either side of the Pennines.

It is appropriate to reproduce the text from Page 31 of the 'One North' *Proposition for an Interconnected North*. This sets out in full the 'One North' vision for how a railway network might develop in the North of England, to meet the core objectives of radically reduced intercity journey times and transformed freight connectivity, as set out in Figure 1.

[5] P31, *One North : A Proposition for an Interconnected North,* 'One North', July 2014

(The new transpennine corridor)… might be developed in phases, but will require tunnelling and take time to build. It should allow for speeds of 125MPH and our target of a 30 minute journey time between Manchester, Leeds and Sheffield city centres. The key to success is to ensure that the route is well connected to both the east and west and designed to dovetail with HS2, enhancing its benefits. On the eastern side it should link into the north-south HS2 line with a delta junction arrangement to allow fast services from northern centres such as Newcastle, York and Hull as well as centres in the Midlands and the south, such as Nottingham, to access the route. To the west, the line should serve Manchester Airport directly, and Liverpool/Chester as well as Manchester city centre. But we also need to see connections with the existing rail network for long distance railfreight. We will need to examine the case for purpose-designed terminals so that the corridor can offer a drive-on facility for road freight too, in the style of Eurotunnel. This could offer an all-weather transpennine freight capability, and in the longer term help transform the freight functionality of the North.

This text describes the key features of the 'One North' scheme and sets out its 'geographic logic' as discussed in Section 3.3.

3.2.1. 'One North' Rationale for Intercity Journey Time Targets

The targeted reductions in journey times, generally to 30 minutes or less between the close-spaced cities of Liverpool, Manchester, Sheffield and Leeds, would represent a step-change improvement in intercity connectivity. The greater ease of communication between the North's principal cities is anticipated to deliver major economic benefit, and it is broadly proportionate (see Table 2) to what HS2 will achieve on its primary routes to London.

	Intercity Journey	Existing Journey Time (mins)	Proposed Journey Time (mins)	Percentage Improvement	Straight Line Distance (km)	Average Speed (km/h)
Northern Powerhouse	Leeds-Manchester	49	30	39%	57	115
	Leeds-Sheffield	40	30	25%	47	94
	Sheffield-Manchester	48	30	37%	52	104
	Liverpool-Manchester	32	20	37%	50	151
	Leeds-Newcastle	82	60	27%	131	131
HS2	Leeds-London	131	81	38%	270	200
	Manchester-London	127	67	47%	260	232
	Birmingham-London	84	49	42%	161	197

Table 2 : Existing and Proposed Journey Times for Northern Powerhouse Rail and HS2

However, when the 'One North' journey time targets are examined in the context of the average speeds that they will offer between the principal cities of the North, it is immediately apparent that they are an order of magnitude below what HS2 will offer on its longer distance routes. These speeds – ranging from 94km/h (58MPH) to 151km/h (94MPH) – are well within the capability of even conventional rolling stock used for express passenger services operating at 201km/h (125MPH) maximum speed.

So, given the 'One North' ambition for new lines to link the major cities of the Northern Powerhouse, their targets for reduced intercity journey times appear to be eminently reasonable and achievable. Rather than view these simply as targets to be reached, they should be viewed as the minimum requirements, as targets to be exceeded by the greatest possible margin.

The value of reduced intercity journey times is encapsulated in Transport for the North's '60-minute Criterion', described in Section 6.2 and tested in Section 7.2.

3.2.2. 'One North' Rationale for City Centre Stations

Whilst the journey time targets put forward by the 'One North' group concern only intercity links between the principal cities of the North, it is commonly acknowledged that there is a parallel demand for a similar scale of improvement in the suburban and interurban rail networks focussed upon each principal city. It has so far been assumed that the intervention of new high speed rail lines will release the capacity on the existing network to allow increased suburban and interurban services to operate.

There is a clear need for these improved local networks around the North's principal cities to be fully integrated with 'HS3' links between these principal cities. This dictates that high speed and local services should operate from a single central hub in each city; where possible, the existing city centre station should be developed for this purpose.

Without this integrated operation, it will not be possible to extend the benefits of the reduced journey times between the North's principal cities to more than a very small proportion of the North's 10 million or more citizens.

3.2.3. 'One North' Rationale for Transformed Railfreight Links

The economic performance of the North is greatly hampered by the poor freight links that exist between its industry, its ports and its major population centres. With only limited prospect of major gains in the capacity of the currently dominant road transport sector, the 'One North' *Proposition for an Interconnected North* identifies rail as the primary mode by which freight transport can be improved, and in so doing facilitate major developments such as Liverpool Superport (also widely known as either 'Liverpool2' or 'Atlantic Gateway').

It is important to appreciate the potential scale, in railway terms, of the Liverpool Superport development. Liverpool Superport is designed to handle container ships of up to 20,000 TEU (twenty-foot equivalent unit) capacity. To avoid unacceptable congestion in suburban Liverpool and on arterial motorway routes, most containers will have to be taken from the port by rail; this would require of the order of 200 trains 775m long. Assuming a broadly 50:50 split of the Northern Powerhouse's population to either side of the Pennines, this would indicate around 100 container trains crossing the Pennines for each ship that is unloaded. This is clearly far beyond the capacity of the existing rail network.

The 'One North' *Proposition for an Interconnected North* also identifies[6] the opportunity for a Channel Tunnel-style shuttle operation to transport lorries across the Pennines, and thus avoid the congestion on transpennine routes, in particular the M62 and the A628(T) Woodhead Road. Again, with aggregate daily flows of around 10,000 HGVs in each direction (and over 1,000 HGVs running via Woodhead, causing crippling congestion), this creates another imperative for new railway construction or restoration.

[6] P31, *One North : A Proposition for an Interconnected North,* 'One North', July 2014

However, any development of the railfreight network must first address its many existing deficiencies, in particular the lack of any viable cross-Manchester and transpennine freight route.

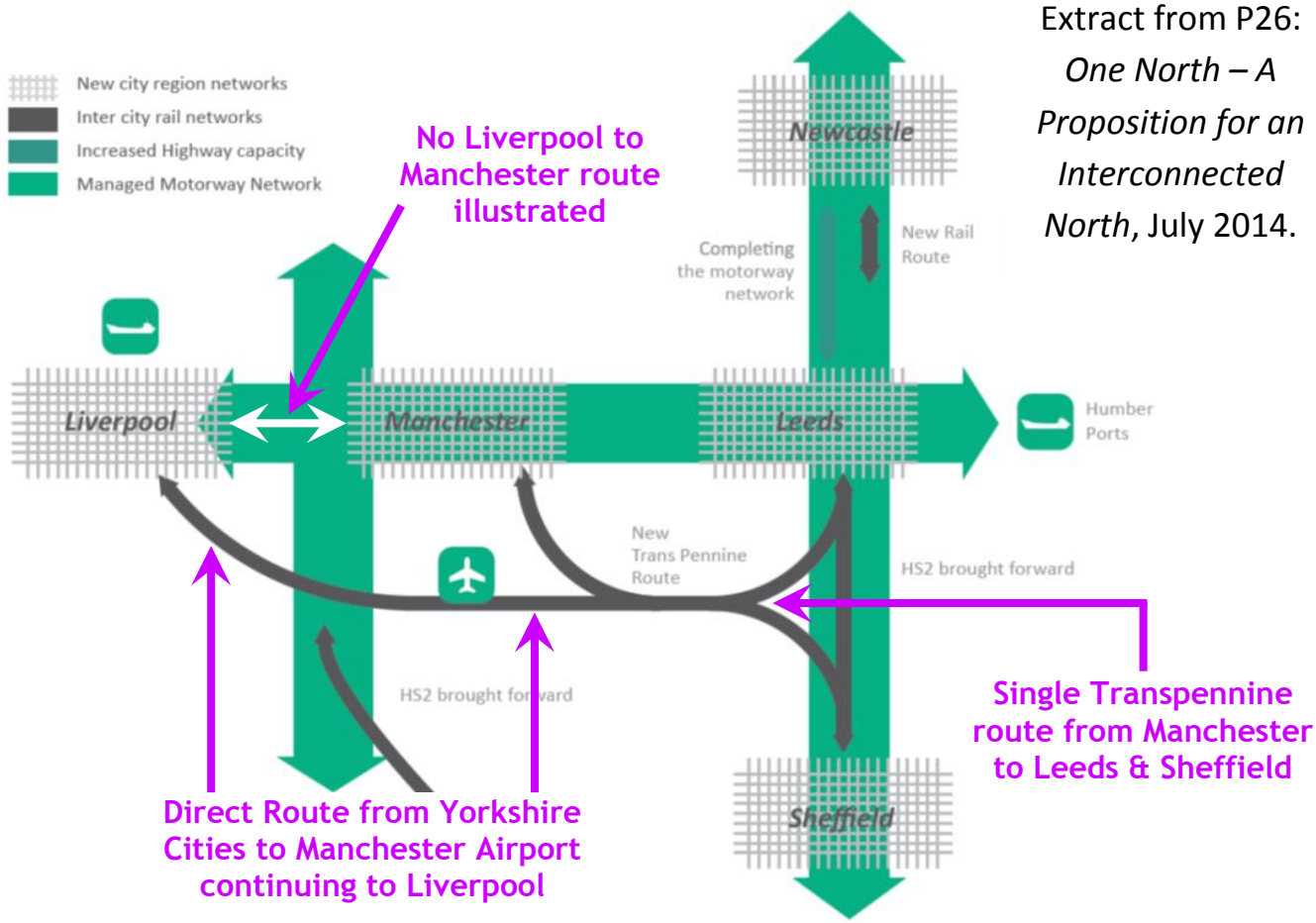
3.2.4. 'One North' Rationale for New Transpennine Rail Route

Whilst it would not seem practicable to build new infrastructure between all of the North's principal cities, it would equally not appear possible to achieve the required improvements, in intercity passenger links, in local passenger links and in railfreight links, without the intervention of new railways at the core of an enhanced regional (and national) network.

It should not be forgotten that exactly the same logic has applied in the development of HS2. To achieve its aim[7] of ***'hugely enhanced capacity and connectivity'*** between the UK's major conurbations, HS2 Ltd has correctly dismissed the concept of further upgrading the nation's existing principal routes such as the West and the East Coast main lines; instead, it has opted for new-build railways to form all of its primary routes, and achieve the radically reduced journey times noted in Table 2.

3.3. Geographic Logic of 'One North' Initiative

The 'One North' *Proposition for an Interconnected North* not only set out journey time targets for enhanced links between the North's primary cities, it also provided a geographic vision for a new network linking these cities.



Extract from P26: *One North – A Proposition for an Interconnected North*, July 2014.

Figure 3 : 'One North' Requirements for New 'HS3' Routes

[7] On 30th November 2015, HS2 Ltd Technical Director Andrew McNaughton informed the HS2 Select Committee that: "The aim of the HS2 project is to deliver hugely enhanced capacity and connectivity between our major conurbations."

Whilst the 'One North' vision reproduced in Figure 3 is highly diagrammatic, with little apparent relationship to geographic reality, it is still possible to infer 3 clear requirements for new 'HS3' routes:

- ***A new northward route from Yorkshire to the North-East.*** Such a route, broadly aligned with the existing East Coast Main Line, implicitly acknowledges the capacity pressures that exist along this congested corridor, and the impracticality of achieving major journey time savings given the fact that most if not all upgrade opportunities have already been exploited.
- ***A single new transpennine route capable of providing direct links from Manchester and Manchester Airport to Leeds and Sheffield, and integrated with the north-south HS2 route in Yorkshire.*** Such a route must logically be located south of Leeds and north of Sheffield, in an intermediate position between the existing Manchester-Leeds 'Diggle' route and the Manchester-Sheffield 'Hope Valley' route. This effectively specifies the former Manchester-Sheffield 'Woodhead' route (closed to passengers in 1970 and closed to freight in 1981). There is no other corridor that aligns with the aspiration[8] for a single new transpennine route, meeting HS2 at a 'delta junction', from which trains would continue either north to Leeds or south to Sheffield.
- ***A new westward route running via Manchester Airport to Liverpool.*** Such a route should radically transform rail access to Manchester Airport from all the principal cities of the Northern Powerhouse region. However, it is less certain whether this route is intended also to be the primary transpennine route to Liverpool. The journey time targets shown in Figure 4 clearly indicate a faster Sheffield-Liverpool route via Manchester than via Manchester Airport, and this would seem to require a transpennine trunk route running through central Manchester, possibly with tunnelled platforms below Manchester Piccadilly.

Sheffield-Liverpool: Route via Manchester	Target Journey Time (mins)	**Sheffield-Liverpool: Route via Manchester Airport**	Target Journey Time (mins)
Sheffield-Manchester	30	Sheffield-Manchester Airport	30
Manchester-Liverpool	20	Manchester Airport-Liverpool	30
Total	**50**	**Total**	**60**

Table 4 : Sheffield-Liverpool Journey Times via either Manchester or Manchester Airport

With no specific routeing requirements given for a Manchester-Liverpool high speed line, there is certainly no remitted requirement that a high speed line running from Manchester to Liverpool (located 50km to the west of Manchester) should be routed via Manchester Airport (located 12km to the south of Manchester).

[8] P31, *One North : A Proposition for an Interconnected North,* 'One North', July 2014

3.4. Rationale for a Comprehensive Requirements Statement for NPR

The journey time targets and the aspirations for improved freight routes and a new transpennine main line are essentially political requirements. Much further work is needed to form these requirements into a comprehensive specification (or Requirements Statement) to guide the development of the railway network of the North in such a way that will deliver maximum benefit.

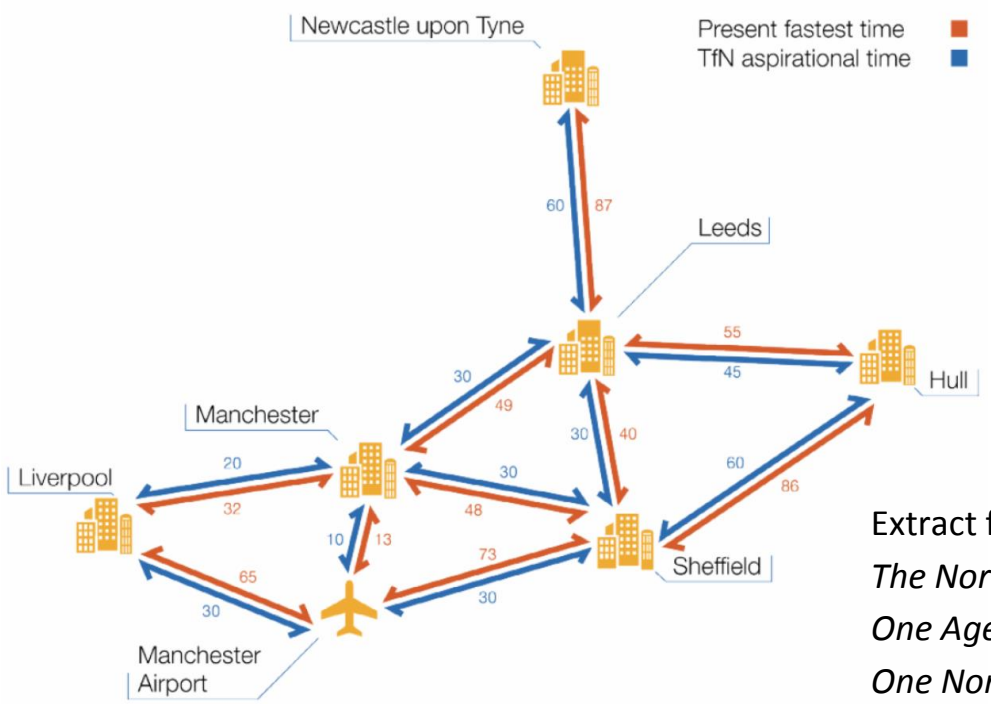
An outline Requirements Statement is set out in Section 6.1 and Appendix D of this report. This establishes the key criteria determining how Northern Powerhouse Rail should perform as a network. It addresses the key requirements of connectivity, capacity, journey time reduction, and accessibility/ inclusivity – in other words, gaining the greatest benefits for the greatest number of beneficiaries. None of the requirements should be in any way controversial – they simply state, in a structured fashion, how a railway network should perform to deliver the required capacity, connectivity etc.

3.5. Further Development of HS3/Northern Powerhouse Rail

Since July 2014, Transport for the North (TfN) has been responsible for developing proposals for improved 'HS3' rail links in the Northern Powerhouse region.

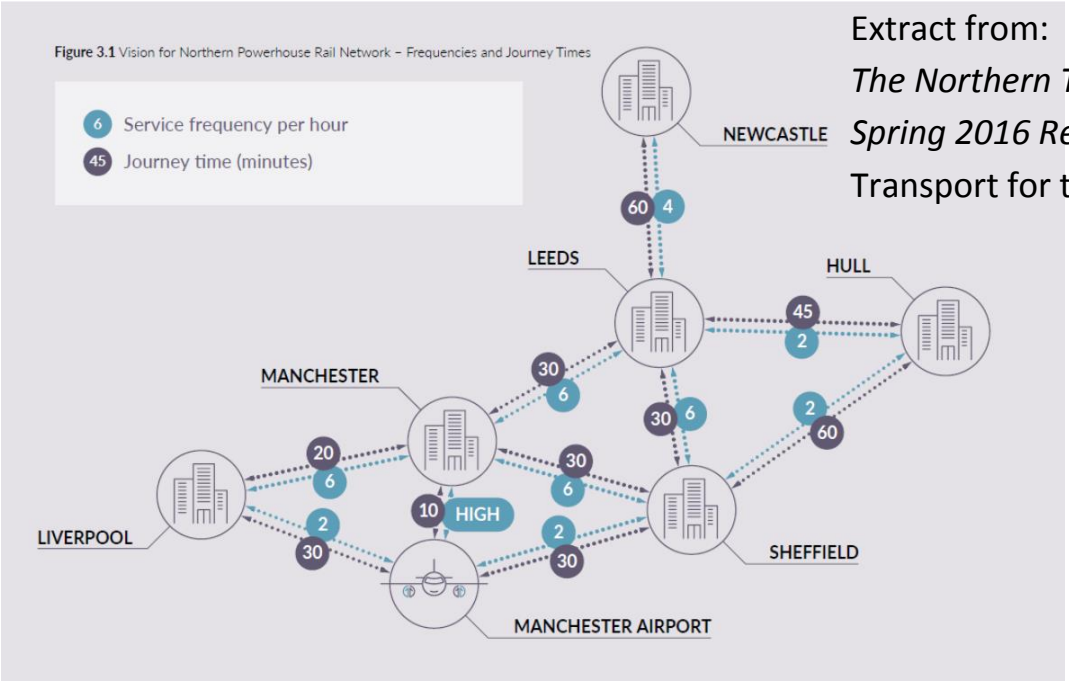
In March 2015, TfN published *The Northern Powerhouse : One Agenda, One Economy, One North*, and in March 2016 a further study *The Northern Transport Strategy : Spring 2016 Report* was released. In both reports, the 'One North' journey time specification was endorsed and amplified with the inclusion of Hull (2015) and the addition of targets for train frequency (2016). See Figures 5 and 6.

The 'One North' journey time and train frequency targets were also included in a further TfN report *Initial Integrated Rail Report Strategic Transport Plan Evidence Base*, published in June 2017.



Extract from:
The Northern Powerhouse : One Agenda, One Economy, One North March 2015 (P19)

Figure 5 : Northern Powerhouse Rail Journey Time Targets (2015)



Extract from:
The Northern Transport Strategy : Spring 2016 Report
Transport for the North, 2016

Figure 6 : Northern Powerhouse Rail Journey Time and Train Frequency Targets (2016/17)

The reduced intercity journey times and enhanced train frequencies noted in Figure 6 are hereafter in this report referred to as the 'HS3 Specification'.

3.6. Conflicts between Development of HS2 and Northern Powerhouse Rail

3.6.1. Revised Station Locations in Leeds and Sheffield

During the development of proposals for Northern Powerhouse Rail, considerable pressure was exerted upon HS2 Ltd to revise their station proposals for both Leeds and Sheffield. Under the HS2 Phase 2 proposals (originally released in 2012) Leeds was to be served by the isolated 'New Lane' terminus station, 400m walking distance from the existing Leeds station, and Sheffield was to be served by a new station at Meadowhall, 6km from the city centre. Both proposals were clearly unfit for purpose for a new railway whose primary function was to ***'hugely enhance capacity and connectivity'*** between the UK's major conurbations. In 2016, revised proposals were released for:

- **Leeds** to be served at its existing 'Leeds City' station, with the HS2 tracks at 'New Lane' extended 400m to the north to form a single station with a common concourse. Due to the north-south alignment of HS2 and the east-west alignment of the existing station, the HS2 element of Leeds station would still comprise a terminus, with no possibility for trains to continue to destinations such as Bradford, Skipton and Harrogate to match current service patterns.
- **Sheffield** to be served at its existing 'Sheffield Midland' station, with HS2 services branching off the trunk route near Alfreton (40km to the south) to join the Midland Main Line south of Chesterfield, and rejoining near Thurnscoe (25km to the north). With the Meadowhall station proposal abandoned, there was now no need for the heavily engineered HS2 new-build line to be routed via Meadowhall, and the HS2 route was revised to run further east, via Mexborough. It is valid to note that while the move to the east might have reduced HS2's engineering difficulties, the number of residential demolitions has hugely increased, with the 'Shimmers' housing estate in Mexborough standing in the path of HS2.

3.6.2. No Fundamental Change to North-South HS2 Route

Whilst local interests successfully lobbied HS2 Ltd to revise their inadequate station proposals for Leeds and Sheffield, there appears to have been no similar questioning of the HS2 route in Yorkshire linking the two cities. This route had been selected by HS2 Ltd with no consideration of transpennine connectivity; its primary aims were to minimise north-south journey times, and to minimise cost, and this led naturally to a route in the less undulating Yorkshire terrain to the east of Barnsley and Wakefield.

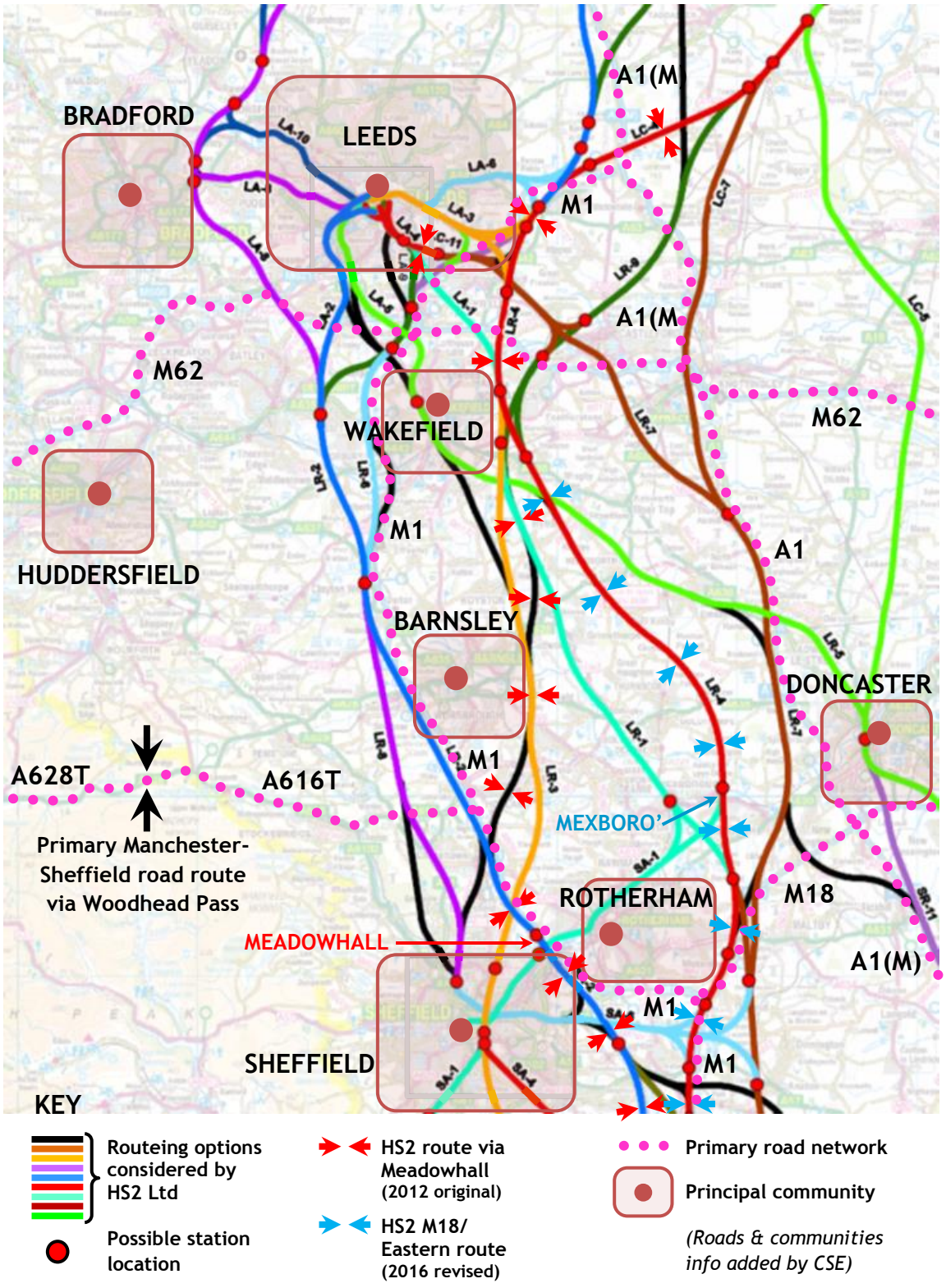


Figure 7 : HS2 Route Options in South and West Yorkshire considered by HS2 Ltd

(Extract from FOI18-1944 response by HS2 Ltd, dated 21 February 2018)

Figure 7 illustrates the full range of route options within Yorkshire that were considered by HS2 Ltd in their development of proposals for Phase 2b of HS2. This proves beyond doubt that HS2's routes within Yorkshire were developed only to deliver north-south connectivity, with no thought whatsoever for future east-west transpennine links. Even routes passing to the west of Barnsley and Wakefield (shown lilac, blue and turquoise), which could make a useful connection to a transpennine route via the Woodhead corridor, appear to have been designed to exclusively north-south priorities. These routes were of course rejected in favour of the selected HS2 alignments – either the original 2012 'Meadowhall' route or the 2016 'M18/Eastern' route – located further east in more favourable terrain.

There is no indication that senior figures at Transport for the North – in their role as transport professionals representing the interests of Northern communities – ever raised with HS2 Ltd the question of whether this HS2 route, running to the east of Barnsley and Wakefield[9] (see Figure 7), was located too far to the east to be compatible with the 'One North' vision[10] of a single transpennine route, connected to and integrated with HS2 (see Figure 3), and capable of delivering the target journey times of 30 minutes between Manchester, Sheffield and Leeds.

Instead, Transport for the North appears to have accepted the HS2 route without question.

The process by which TfN's Northern Powerhouse Rail proposals have developed from the established HS2 scheme is confirmed in Figure 8. This shows slides from a presentation given by Transport for the North to an Institution of Civil Engineers meeting in Leeds on 21 February 2017. These slides confirm a) that TfN was still working to the HS3 Specification in 2017 and b) that the fundamental design philosophy of Northern Powerhouse Rail is founded upon the established HS2 proposals.

The catastrophic consequences of basing the design of Northern Powerhouse Rail upon the deeply flawed HS2 scheme can only be truly appreciated by comparing the combined performance of HS2 and NPR against an alternative scheme that does not embody this dependency. This is the fundamental purpose of this report.

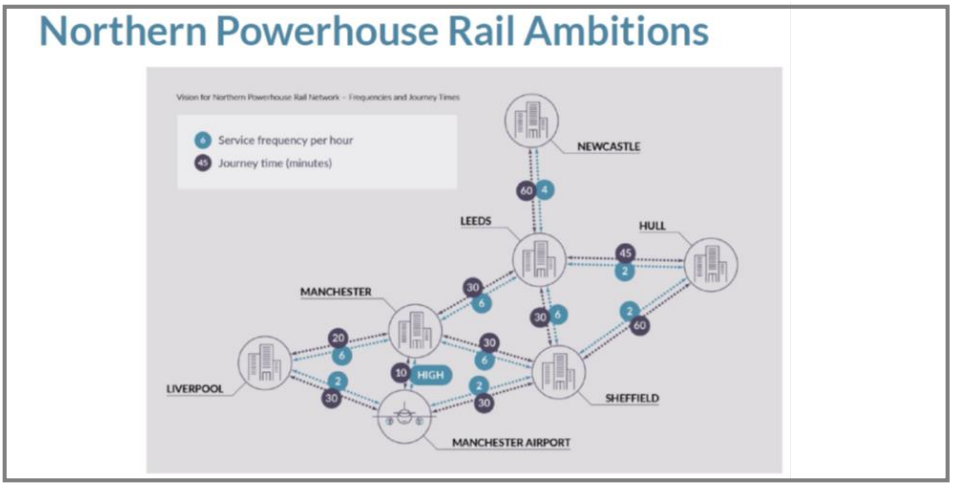
3.6.3. No Commitment to New Transpennine Rail Route

Both of the key TfN reports (*The Northern Powerhouse : One Agenda, One Economy, One North* (2015) and *The Northern Transport Strategy : Spring 2016 Report* (2016) adopted the 'One North' targets for reduced journey times. However it is significant to note that neither report gave any commitment to the 'One North' stipulation for a single new transpennine rail route. Instead, informed sources consistently indicated that Transport for the North's primary focus was directed towards the upgrading of existing routes (in particular, the 'North Transpennine' Manchester-Huddersfield-Leeds route) as the principal strategy for achieving its journey time targets.

During this period of project development, there was also little indication of an emerging strategy for a new transpennine route that might deliver the transformational improvements required for railfreight links within the North.

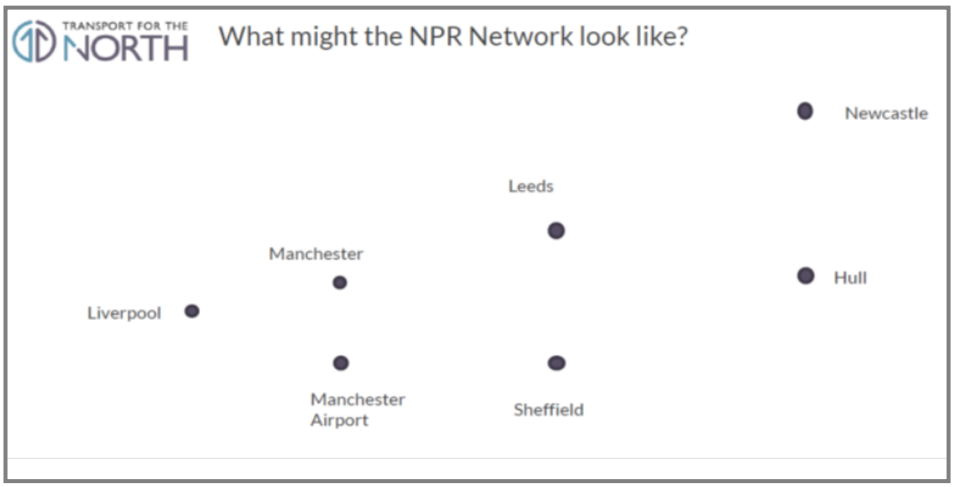
[9] The issue of compatibility between east-west 'HS3' routes and north-south HS2 routes is discussed also in Section 7.1.8 and Appendix E8 of this report.

[10] P31, *One North : A Proposition for an Interconnected North,* 'One North', July 2014



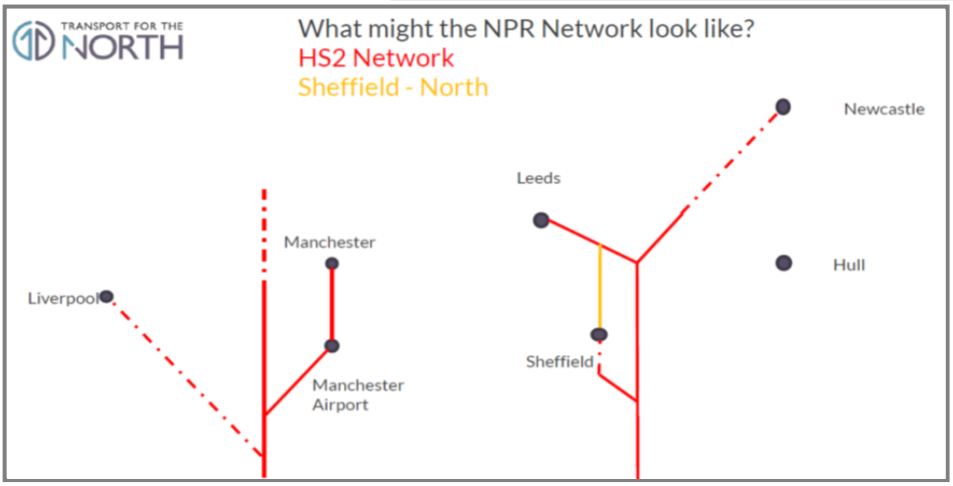
Slide 10/19

'HS3 Specification' for intercity journey times and service frequency – as per Figure 6 of this report



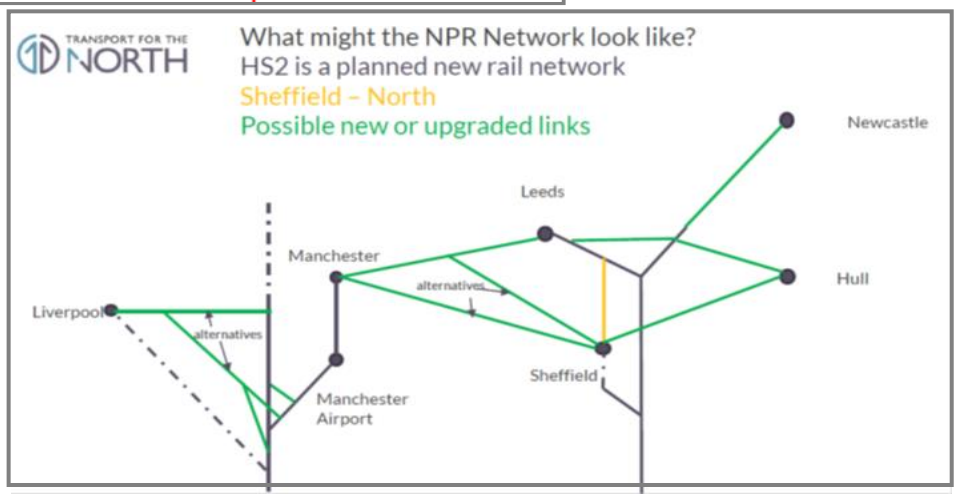
Slide 11/19

'Clean Sheet of Paper' showing cities and airport to be linked by the 'NPR Network'



Slide 13/19

Proposals for HS2 'Y', with routes to North-West and to Yorkshire, taken as the basis of the 'NPR Network'



Slide 14/19

Northern Powerhouse Rail routes then retrofitted onto HS2 to form the 'NPR Network'

Figure 8 : Slides from Transport for the North Presentation, 21 February 2017

4. January 2018 Release of TfN *Strategic Transport Plan*

On 16 January 2018, Transport for the North (TfN) released its long-awaited *Strategic Transport Plan*. The key railway elements of the TfN strategy are summarised in Figure 9.

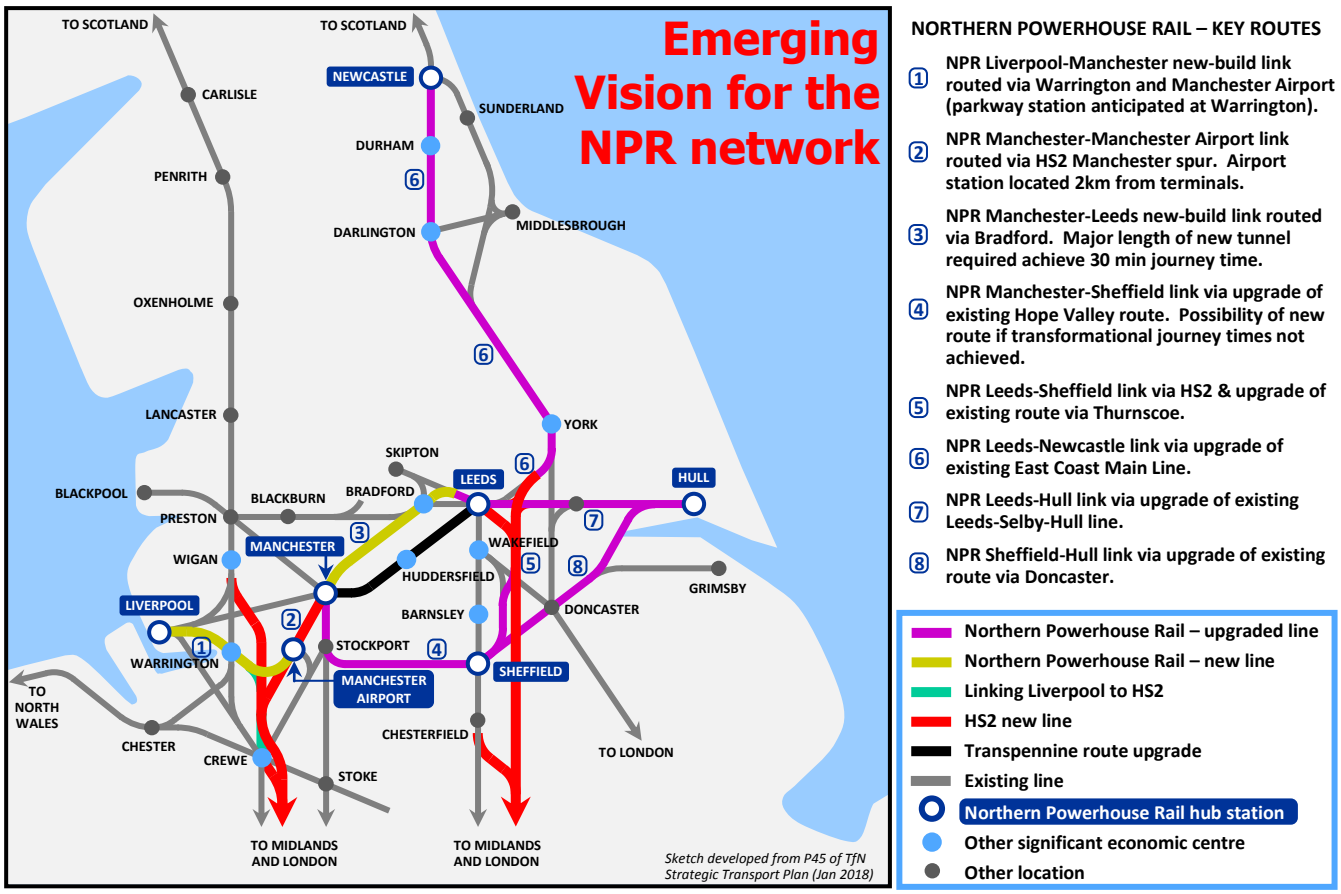


Figure 9 : 'Emerging Vision' for TfN Northern Powerhouse Rail Proposals

4.1. Initial Review of TfN *Strategic Transport Plan*

The 'Emerging Vision' for the Northern Powerhouse Rail network indicated in Figure 9 cannot be regarded as a complete scheme, but sufficient detail is provided[11] in the TfN documentation to allow the proposed routes to be modelled. From this modelling, several definitive conclusions can be drawn:

- The stated 28 minute journey time along the proposed new line between Liverpool and Manchester is greatly in excess of the specified journey time of 20 minutes, and scarcely superior to the existing direct journey time of 32 minutes. This deficiency can be attributed to circuitous routeing along the proposed HS2 Manchester Spur via Manchester Airport.
- Although the Liverpool-Manchester route is shown as passing through Warrington, this appears only to be possible with a parkway station located either north or south of the town. Such a station would contravene the fundamental 'One North' requirement for city centre stations.
- Any Sheffield to Liverpool or Manchester Airport service will need to reverse at the HS2 Manchester terminus, significantly adding to through journey times. The journey time from Sheffield to the Manchester Airport HS2 station, and by some as-yet-unspecified shuttle connection to the airport terminals, is likely to be of the order of 60 minutes – hugely in excess of the specified 30 minutes.

[11] P44, *Strategic Transport Plan*, Transport for the North, January 2018

- Contrary to earlier reported initiatives for an upgrade of the Transpennine Main Line, the TfN *Strategic Transport Plan* has instead proposed a new transpennine rail line, connecting Manchester and Leeds via Bradford. HSUK modelling – see Appendix E1 – indicates that this will require a new tunnel over 30km long – far longer than any existing tunnel on the UK rail network – to meet the 30 minute journey time target.
- There is no new-build option so far proposed for the Sheffield-Manchester route to match what is proposed for the Manchester-Leeds route. Instead, the aspiration remains to upgrade ***'the corridor of the existing Hope Valley line'***, but no information is given as to how ***'transformational journey times'*** will be realised. Reduction of journey times from the existing 48 minutes to the 30 minute target set by 'One North' seems improbable for a route on which most upgrade opportunities have already been exploited; the only option by which the target might be achieved would be another transpennine tunnel over 30km long (see Appendix E1).
- Despite the original 'One North' report effectively specifying[12] the Woodhead corridor as the route for a new transpennine railway, there is no reference whatsoever to Woodhead in the TfN *Strategic Transport Plan*.
- The proposed strategy for improvements between Leeds and Newcastle – again an already highly engineered route, with few if any remaining opportunities for significant upgrades – appears unable to achieve the specified 60 minute journey time.

There is therefore considerable prima-facie evidence that the 'emerging vision' for Northern Powerhouse Rail will fail to meet many aspects of the HS3 journey time specification originally established by 'One North'. Any success that might be achieved (for instance on transpennine routes between Manchester and Leeds, or Manchester and Sheffield) will only be at the expense of unprecedented lengths of tunnel. These lengths of tunnel will of course carry associated implications not only for excessive project cost but also for excessive time to completion.

4.2. Omission of HS3 Specification for Improved Journey Times

With regard to the HS3 journey time specification – which has been included in all previous iterations of TfN documentation, as late as June 2017 – this specification is conspicuous by its absence in the current TfN *Strategic Transport Plan*. The TfN *Strategic Transport Plan* offers no explanation; but given the broad failure of the TfN proposals to meet this crucial specification, the onus must be upon Transport for the North to provide a credible narrative to account for its omission.

However, the TfN *Strategic Transport Plan* does offer two alternative criteria[13] by which success in reducing journey times might be determined.

The following primary aim is stated: ***'Increase the population within one hour of four of the largest cities from less than 10,000 today to 1.3 million, helping support a modal shift from road to rail'***.

A secondary aim is also stated: ***'Change the way labour markets work… (so that) …40% of businesses identified in the Northern Powerhouse Independent Economic Review as prime capabilities would be within 90 minutes rail travel of four or more of the North's largest cities'.***

[12] P31, *One North : A Proposition for an Interconnected North,* 'One North', July 2014
[13] P44, *Strategic Transport Plan*, Transport for the North, January 2018

4.3. Speed Ambitions of TfN *Strategic Transport Plan*

The TfN *Strategic Transport Plan* sets out an ambition[14] to achieve average journey speeds as follows:

- 40MPH (64km/h) for local services;
- 60MPH (96km/h) for inter-urban services;
- 80MPH (128km/h) for long distance services.

It must be emphasised that speed is not an end in itself, but rather the means of achieving a desired journey time. Noting the average speeds implied by the 'One North' journey time targets (ranging from 94km/h to 151km/h, see Table 10), it is clear that these targets can only be met if TfN's ambitions for average speed are considerably increased.

	Intercity Journey	Existing Journey Time (mins)	Proposed Journey Time (mins)	Percentage Improvement	Straight Line Distance (km)	Average Speed (km/h)
Northern Powerhouse	Leeds-Manchester	49	30	39%	57	115
	Leeds-Sheffield	40	30	25%	47	94
	Sheffield-Manchester	48	30	37%	52	104
	Liverpool-Manchester	32	20	37%	50	151
	Leeds-Newcastle	82	60	27%	131	131
HS2	Leeds-London	131	81	38%	270	200
	Manchester-London	127	67	47%	260	232
	Birmingham-London	84	49	42%	161	197

Table 10 : Existing and Proposed Journey Times for NPR and HS2 ***(Repeat of Table 2)***

The TfN *Strategic Transport Plan* also notes[15] that new trains employed on Northern Powerhouse Rail services are likely to have a maximum speed capability of 125MPH (201km/h).

This is clearly at odds with the Government's ambition to operate HS2 at 360km/h, and to design its infrastructure for future 400km/h operation. The huge speed differentials between NPR trains running at 201km/h and HS2 trains running at 400km/h are certain to cause major operational conflicts, and therefore capacity problems, on routes where both NPR and HS2 services are planned to operate.

Such routes include Leeds to Sheffield and Liverpool to Manchester, but the greatest problems are anticipated on any new high speed line from Yorkshire to the North-East, with a route length of 118km from York to Newcastle. It would thus seem prudent for the trains employed on Northern Powerhouse Rail services to be designed to a common technical platform with those intended for HS2.

For the purposes of assessing the journey time potential of TfN's proposed new-build routes, it has been assumed that where curvature permits, new-build routes will operate at 230km/h, and rolling stock will be procured accordingly.

[14] P51, *Strategic Transport Plan*, Transport for the North, January 2018
[15] P51, *Strategic Transport Plan*, Transport for the North, January 2018

4.4. Dependency of NPR upon established HS2 proposals

There is also plentiful evidence in the TfN *Strategic Transport Plan* of the excessive dependency of Northern Powerhouse Rail upon the established HS2 proposals[16]. Whilst it is desirable that one project is integrated with another, the TfN report fails to recognise any possible danger in basing Northern Powerhouse Rail – whose core rationale is the transformation of transpennine connectivity – upon the northern sections of HS2, both in Yorkshire and Greater Manchester.

As noted in Item 3.6.2, these routes were designed with the primary aim of minimising north-south journey times, and with no thought for enhanced transpennine connectivity[17]. It would therefore seem highly unlikely that TfN's predication of its transpennine routes upon HS2 could deliver optimum outcomes for transpennine connectivity.

4.5. TfN Claim for 'maximised economic outcomes for the UK'

Overall, there is little evidence that the TfN *Strategic Transport Plan* has been developed with any holistic consideration of the many factors that must come together to deliver an optimised railway network. However, it must be emphasised that this is largely a qualitative judgment. It is only possible to make a more rational and more quantitative judgment through:

- Assessing Northern Powerhouse Rail against a fully structured Requirements Statement which embodies the ideal of an efficiently functioning regional (and national) rail network.
- Comparing its performance with an alternative proposal such as High Speed UK, in order to test the degree to which NPR has been optimised as a regional (and national) rail network.

It should particularly be noted that the TfN *Strategic Transport Plan* has made a clear claim[18] for the overall optimisation of the Northern Powerhouse Rail proposals: ***'Together with the existing mainline route network, HS2 and Northern Powerhouse Rail can create a flexible set of services to maximise the economic outcomes for the UK'***.

These ***'maximised economic outcomes'*** can of course only come about if two preconditions are met. Firstly, HS2 and Northern Powerhouse Rail must be fully integrated to form an efficient network capable of transforming the connectivity of the North, and indeed the wider UK. Secondly, HS2 and Northern Powerhouse Rail must together form a railway system that outperforms any rival option.

However, the TfN *Strategic Transport Plan* offers no evidence to justify either:

- the claim of ***'maximised economic outcomes'***; or
- the improved network performance and the ***'flexible set of services'*** necessary to bring about these claimed gains.

[16] P35, P44-P46, *Strategic Transport Plan*, Transport for the North, January 2018. For further details of the Government's HS2 proposals, see Appendix A.
[17] The design of HS2's routes to exclusively north-south priorities is demonstrated unambiguously in the Freedom of Information response ref FOI18-1944 by HS2 Ltd, dated 21 February 2018. See Section 3.6 and Figure 7.
[18] P46, *Strategic Transport Plan*, Transport for the North, January 2018

5. High Speed UK 'Exemplar Alternative'

To verify that the TfN proposals are properly optimised to deliver the greatest benefit either for the Northern Powerhouse region or for the UK, this report will where appropriate make structured comparisons with the 'exemplar alternative' of the High Speed UK (HSUK) scheme.

High Speed UK is planned and designed as a national intercity network that directly addresses the core HS2 remit for ***'hugely enhanced capacity and connectivity'***[19] between the UK's major conurbations. Central to the HSUK scheme is a new transpennine high speed line routed via the Woodhead corridor, which will provide direct high speed links from Manchester to Sheffield ***and*** Leeds. This appears to align very closely with the 'One North' aspiration for a new 'transpennine corridor', as set out in Sections 3.2 and 3.3 of this report.

Although HSUK's greatest advantage lies in its optimised performance as a national network, it can also be considered as a set of 'modular' intercity links which can be assembled in many different sequences. Unlike HS2 (and therefore also Northern Powerhouse Rail), which can only logically be built in a northward progression from London, it would be eminently feasible to commence construction of HSUK in the North, in advance of its southern sections.

The HSUK core network in the Northern Powerhouse region is shown in Figure 11 below, and further details are provided in Appendix B.

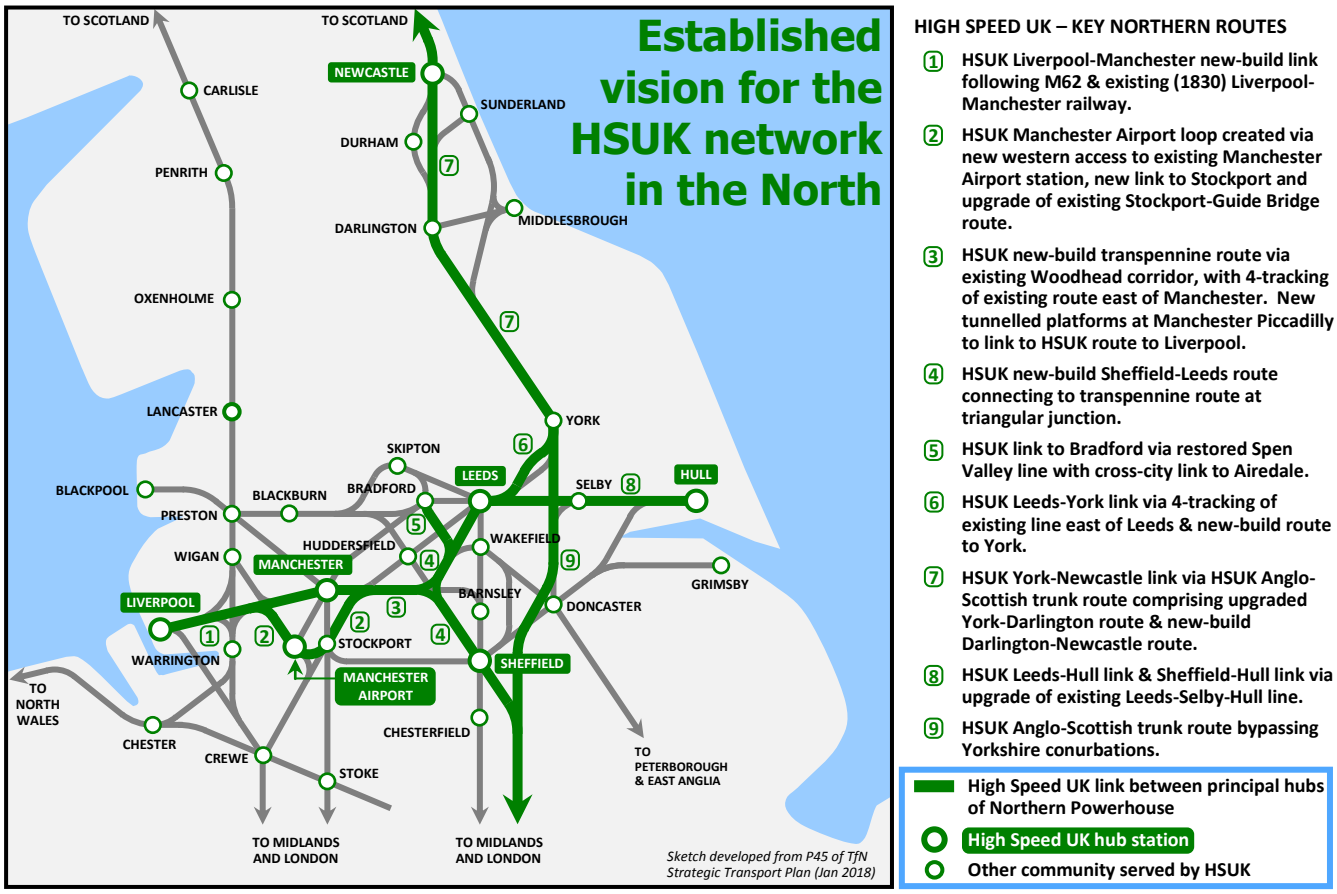


Figure 11 : 'Established Vision' for HSUK links between principal Northern Powerhouse cities

[19] On 30th November 2015, HS2 Ltd Technical Director Andrew McNaughton informed the HS2 Select Committee that: "The aim of the HS2 project is to deliver hugely enhanced capacity and connectivity between our major conurbations."

6. Assessment Criteria for Northern Powerhouse Rail

Whilst the primary aim of this report is to develop a Requirements Statement, or specification, by which the performance of the TfN *Strategic Transport Plan* for Northern Powerhouse Rail can be judged, it must be acknowledged that there are competing considerations of project cost and timescale. In making a structured judgment between rival projects, all aspects of specification, cost and timescale must be considered.

The assessment criteria set out in the following sections 6.1 – 6.4 will be applied both to the Northern Powerhouse Rail scheme (as set out in the TfN *Strategic Transport Plan*) and to the High Speed UK 'exemplar alternative'.

6.1. Development of Requirements Statement for Northern Powerhouse Rail

A Requirements Statement is essential to define the criteria to which the railway network of the Northern Powerhouse should be developed. None of these requirements should be viewed as 'absolutes'; but success in meeting as many as possible of these requirements would indicate the scheme best able to satisfy the political and public need for a well-connected and prosperous Northern Powerhouse.

This Requirements Statement is summarised below, and is set out in full in Appendix D.

6.1.1. Adherence to HS3 Journey Time Specification

The Northern Powerhouse Rail scheme should achieve the reduced journey times detailed in the HS3 Specification.

6.1.2. Increased Capacity for Enhanced Services

The Northern Powerhouse Rail scheme should provide the increased network capacity to accommodate not only Northern Powerhouse Rail intercity (and city to airport) services operating at the specified frequency, but also step-change increases in local passenger services and freight services.

6.1.3. NPR Station Location and Configuration

Northern Powerhouse Rail stations should generally be located in city centres, fully integrated with local transport networks and with HS2. They should provide the extra capacity to accommodate both the increased intercity frequencies stipulated by the HS3 Specification and the required step-change increase in local services. As a broad guideline, there should be an aspiration for local services to be doubled in frequency.

6.1.4. Longer Distance NPR Services

The Northern Powerhouse Rail scheme should enable longer-distance intercity links (e.g. Liverpool to Hull or Newcastle) that are not covered explicitly in the HS3 Specification.

6.1.5. Northern Powerhouse Network Connectivity

The enhanced network created by the Northern Powerhouse Rail scheme should extend to cover all second-tier centres (e.g. Bradford, York, Warrington, Preston, all in the 100,000 – 500,000 population range), and also to less populous / more peripheral communities, that are not addressed explicitly in the HS3 Specification.

6.1.6. Integration of NPR with HS2

Northern Powerhouse Rail and HS2 services should be integrated to ensure seamless links to neighbouring cities outside the Northern Powerhouse region e.g. Nottingham, Derby, Leicester, Stoke, Edinburgh and Glasgow.

6.1.7. NPR Vision for Railfreight

The Northern Powerhouse Rail scheme must offer a holistic vision for transformed railfreight links across the North. This should address all the deficiencies of the present network which prevent efficient railfreight services.

6.1.8. Minimised Dependency on HS2

The Northern Powerhouse Rail scheme and local elements of HS2 should be fully integrated to optimise their overall performance in connecting Northern communities. The NPR scheme should be capable of implementation in advance of HS2 works in other parts of the country.

6.1.9. A Complete Vision for Northern Powerhouse Rail

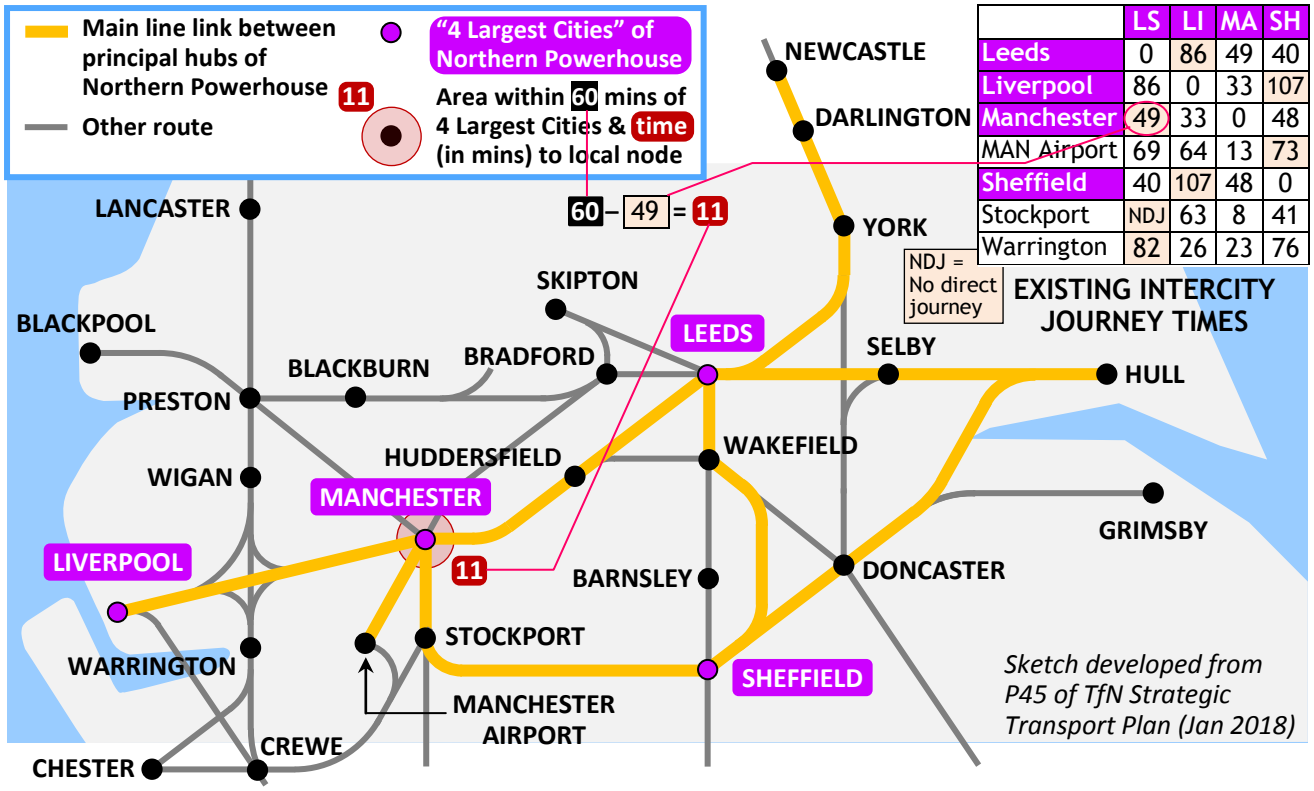
The Northern Powerhouse Rail scheme must offer a complete vision for achieving all the railway requirements of the Northern Powerhouse, as detailed in this Requirements Statement.

6.1.10. Technical Excellence for the Northern Powerhouse

It is naturally assumed that the Northern Powerhouse Rail scheme that is finally adopted will be the option best able to deliver the optimised regional (and national) railway network as defined in this Requirements Statement, and thus maximise the opportunities for sustainable economic growth in the Northern Powerhouse Region.

6.2. TfN '60-minute Criterion'

Whilst Transport for the North's *Strategic Transport Plan* appears to have abandoned the HS3 Specification for reduced intercity (and city to airport) journey times, it has introduced[20] a new criterion, to maximise the population within 60 minutes' travel time of the '4 largest cities' of the Northern Powerhouse. These 4 cities are presumed to be Liverpool, Manchester, Leeds and Sheffield, respectively at the hearts of the Merseyside, Greater Manchester, West and South Yorkshire conurbations which together comprise over 7 million population.



	LS	LI	MA	SH
Leeds	0	86	49	40
Liverpool	86	0	33	107
Manchester	49	33	0	48
MAN Airport	69	64	13	73
Sheffield	40	107	48	0
Stockport	NDJ	63	8	41
Warrington	82	26	23	76

Figure 12 : Areas currently within 60 minutes of 4 largest Northern Powerhouse cities

The TfN *Strategic Transport Plan* notes that only 10,000 people currently live within 60 minutes of all 4 cities. Given the central position of Manchester relative to the other 3 cities, and given the existing intercity journey times, all over 30 minutes, it is clear that these 10,000 people meeting the '60-minute Criterion' must reside within a relatively small area in central Manchester. As shown in Figure 12, the longest journey time of 49 minutes (to Leeds) determines that only the population located within 11 minutes of Manchester Piccadilly can be within 60 minutes (=49+11) of the 4 largest cities.

Noting the secondary TfN ambition for 40% of 'prime capability' businesses to be located within 90 minutes of the 4 largest cities, insufficient information currently exists as to what constitutes a 'prime capability' business to allow a precise assessment in this regard. However, it seems highly likely that the scheme that succeeds best in the '60-minute Criterion' discussed above will also succeed best in linking the greatest proportion of 'prime capability' businesses to the principal cities of the Northern Powerhouse.

[20] P44, *Strategic Transport Plan*, Transport for the North, January 2018

6.3. Assessment of Cost of Northern Powerhouse Rail Links

With the broad routeing strategy of Northern Powerhouse Rail defined in the TfN *Strategic Transport Plan*, it is possible to make projections of the works required to meet the journey time targets of the HS3 Specification. The costings for these works can then be extrapolated from the 'baseline' costing of £55.6 billion for the defined elements of the HS2 'Y-network', as shown in Figure A1.

The costings developed in this report for Northern Powerhouse Rail will include both the elements defined in the TfN *Strategic Transport Plan*, and the elements of HS2's northern routes on which the TfN proposals are based i.e routes accessing Liverpool, Manchester Airport, Manchester, Bradford, Leeds and Sheffield. Costs are then developed for the residual elements of HS2 in the Midlands and the South, and for projected elements of HS2 extending north to Newcastle, Edinburgh and Glasgow to provide a total cost for the Government's UK high speed rail project i.e. both HS2 and Northern Powerhouse Rail.

The detailed route design undertaken for High Speed UK – which has included the preparation of horizontal and vertical railway alignments – has allowed a parallel costing exercise to be undertaken for:

- All HSUK elements necessary to interlink the principal centres of the Northern Powerhouse within Lancashire and Yorkshire i.e. Liverpool, Manchester, Manchester Airport, Sheffield and Leeds, plus Bradford.
- All HSUK elements necessary for southward connections to the same primary cities served by HS2 i.e. Nottingham, Birmingham and London.
- All HSUK elements necessary for northward connections to Newcastle, Edinburgh and Glasgow.

6.4. Assessment of Timescale

At this stage, it is not possible to make a detailed assessment of the timescale necessary to complete the works necessary for any NPR scheme for improved rail links in the Northern Powerhouse. Notwithstanding this uncertainty, it can still be definitively stated that a self-standing project requiring shorter lengths of new route and tunnel will take less time to complete than a project which is dependent upon another, and which requires greater length of new route and tunnel.

6.5. The 'Project Manager's Triangle'

The need to complete a project to a restricted budget and timescale may prevent the achievement of all aspects of the specification, and political and financial judgments may dictate a reduced specification to enable the project to be completed as soon as possible, to the budget that is currently available. This is represented as Option A in the 'Project Manager's Triangle' set out in Figure 13.

Alternatively, a project may carry such prestige that completion to the highest specification is paramount, and timescale and budget overruns can be tolerated. This is represented as Option B.

In the example set out in Figure 13, neither triangle representing either Option A or Option B fully overlaps the other, and hence it is not possible to make a simple engineering determination of which option is superior. Instead, it is probable that financial and political externalities, rather than the quality of the engineering design, have determined the different performances.

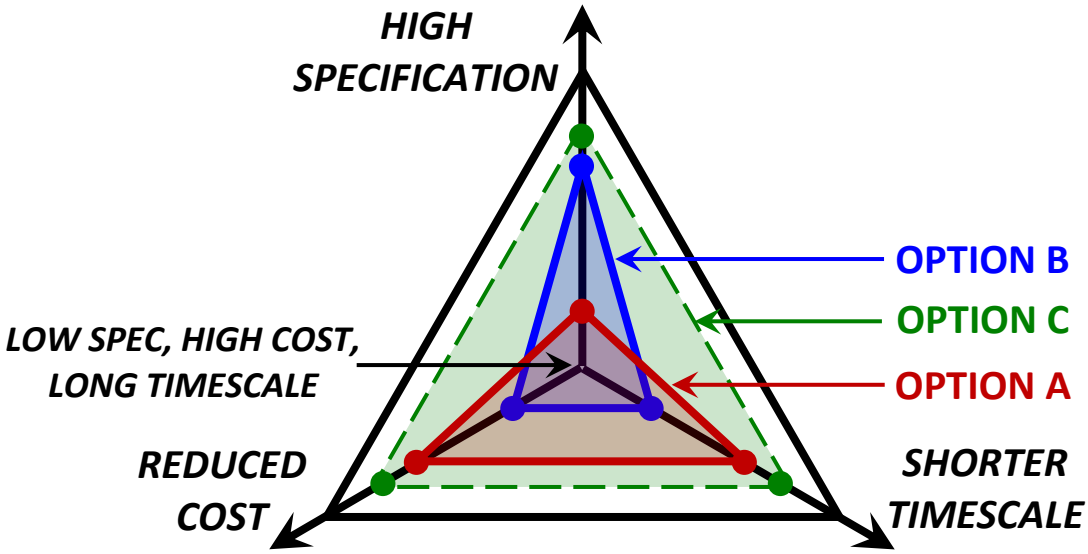


Figure 13 : The 'Project Manager's Triangle'

However, if a third Option C were to emerge, that offered higher specification, shorter timescale and lower cost than either Option A or B (and thus its triangle would fully overlap the others, as shown), the difference in performance could reasonably be ascribed to simpler questions of superior design and more appropriate specification.

7. Assessment of TfN *Strategic Transport Plan*

The TfN *Strategic Transport Plan* for Northern Powerhouse Rail has been assessed against the High Speed UK 'exemplar alternative' on 4 key aspects of project performance:

- Performance against the Requirements Statement developed by HSUK (see Section 7.1).
- Performance against TfN's own '60-minute Criterion' (see Section 7.2).
- Project cost, both for Northern Powerhouse links and nationally (see Section 7.3).
- Project timescale (see Section 7.4).

As noted previously, these comparisons are informed by:

- Detailed route design undertaken by HSUK in the development of the HSUK scheme.
- Publicly available information on HS2 Ltd's proposals for the HS2 'Y-network'.
- TfN's own proposals as published in the January 2018 *Strategic Transport Plan*.
- Calculation of journey times for HSUK routes, validated against published timings for HS2.
- Estimation of construction costs for HSUK, validated against published costings for HS2.

The information listed above has allowed the formulation of putative routes for TfN's proposed Northern Powerhouse links, the calculation of journey times and the estimation of construction costs.

Further information on the methodologies adopted by HSUK is given in *HS2 – High Speed to Nowhere*, available on www.highspeeduk.co.uk .

7.1. Northern Powerhouse Rail : Performance against Requirements Statement

The performance of TfN's Northern Powerhouse Rail proposals against the Requirements Statement set out in Section 6 is described in the following items:

- Adherence to 'One North' Journey Time Targets (7.1.1)
- Increased Capacity for Enhanced Northern Powerhouse Rail Services (7.1.2)
- Northern Powerhouse Rail Station Location and Configuration (7.1.3)
- Longer Distance Northern Powerhouse Rail Services (7.1.4)
- Northern Powerhouse Network Connectivity (7.1.5)
- Integration of Northern Powerhouse Rail with HS2 (7.1.6)
- A Vision for Northern Powerhouse Railfreight (7.1.7)
- Minimised Dependency upon HS2 (7.1.8)
- A Complete Vision for Northern Powerhouse Rail (7.1.9)

This Requirements Statement is set out in full in Appendix D.

7.1.1. Adherence to 'One North' Journey Time Targets

The performance of TfN's Northern Powerhouse Rail proposals and the HSUK scheme in meeting the journey time targets of the 'HS3 Specification', originally established by 'One North' in 2014, is set out in Table 14 below. This demonstrates the near-complete failure of TfN's proposals to meet these journey time targets, and also the comprehensive superiority of the HSUK scheme.

Journey between Northern Powerhouse cities	**Existing journey time** (mins)	**Specified journey time** (mins)	**NPR journey time** (mins)	**HSUK journey time** (mins)	**Winner?? NPR or HSUK??**
Liverpool - Manchester	**32**	**20**	**28**	**19#**	**HSUK**
Manchester - Sheffield	**48**	**30**	**40**	**23**	**HSUK**
Manchester - Leeds	**49**	**30**	**30**	**26**	**HSUK**
Sheffield - Leeds	**40**	**30**	**28**	**19**	**HSUK**
Manchester - MAN	**13**	**10**	**13**	**13**	**–**
Leeds - MAN	**62**	**40**	**47**	**37**	**HSUK**
Sheffield - MAN	**73**	**30**	**60**	**34**	**HSUK**
Liverpool - MAN	**65**	**30**	**28**	**26**	**HSUK**
Leeds - Newcastle	**87**	**60**	**70**	**51#**	**HSUK**
Leeds - Hull	**55**	**45**	**??**	**??**	**??**
Sheffield - Hull	**86**	**60**	**??**	**??**	**??**

Journey time meeting HS3 Specification

Journey time failing to meet HS3 Specification

MAN = Manchester Airport

\# Timings increase to 21 min (LI-MA) & 60min (LS-NE) at 230km/h maximum speed

Table 14 : NPR & HSUK Performance in meeting 'One North' Journey Time targets

General notes:

- All journey times include a standard 'dwell time' allowance of 2 minutes at through stations.
- NPR journey times via Manchester Piccadilly (i.e. Sheffield to Manchester Airport and to Liverpool) are enhanced by 3 minutes for longer standing time in terminus platforms.
- NPR Journey times to Manchester Airport include 8 minute allowance for transfer from proposed 'Manchester Airport' station on the HS2 Manchester spur to the existing Manchester Airport station, located in a centroidal position between all 3 airport terminals.
- Neither NPR nor HSUK are capable of reducing existing journey times from Manchester to Manchester Airport, therefore the existing journey time is quoted.
- Neither TfN nor HSUK have advanced detailed proposals for routes to Hull.

NPR and HSUK routes are shown in Figures 15 and 16. For further information, refer to Appendix E1.

The following summarised commentary is based upon detailed analysis of TfN's proposed routes, to determine whether they are capable of meeting the HS3 Specification for reduced intercity journey times. In the assessment of on-line upgrades, it has been assumed that line speeds can be increased to the maximum permitted by the track geometry. It is likely however that many of the routes have already been upgraded, but to a lesser speed dictated by considerations of shared use by freight and other traffic, and few if any further gains are achievable.

Liverpool – Manchester : **20** minute journey time required by HS3 Specification

NPR	**28**	HSUK analysis confirms the 28 minute Liverpool-Manchester journey time claimed by TfN. This journey time includes a stop at Manchester Airport but does not include any Warrington stop, presumed to be at a parkway station located either north or south of the town. TfN's failure to meet the specified 20 minute journey time is directly attributable to the proposed circuitous routeing via Manchester Airport.
HSUK	**19**	HSUK only beats the HS3 specification by adopting a direct route, following the M62 and the existing Liverpool-Manchester 'Chat Moss' line, with no intermediate stops. Manchester Airport and Warrington (Bank Quay) are served by other routes.

Manchester – Sheffield : **30** minute journey time required by HS3 Specification

NPR	**40**	HSUK analysis shows that a 40 minute journey time is the fastest possible with an on-line upgrade of the existing Hope Valley route via Stockport – but probably not achievable given the needs of freight traffic. To achieve the specified 30 minute timing will require a new tunnel approximately 33km long between New Mills and Dore.
HSUK	**23**	HSUK's new transpennine high speed line via Woodhead (with 4-tracking of existing route from central Manchester to Hattersley), connecting to a Leeds-Sheffield (Victoria) route near Penistone, easily beats the HS3 Specification.

Manchester – Leeds : **30** minute journey time required by HS3 Specification

NPR	**30**	HSUK analysis indicates that a Manchester-Leeds route via Bradford will require a new tunnel approximately 33km long from Littleborough to Calverley in the Aire Valley, plus 4-tracking of existing routes from Manchester to Littleborough and from Calverley to Leeds, to achieve the specified 30 minute journey time. It is believed that this route was only selected after the works required for a 30 minute journey time via the existing 'Diggle' route – an 'upgrade' comprising around 25km of new tunnel plus 4-tracking of remaining route sections via Huddersfield – were deemed impracticable.
HSUK	**26**	HSUK's new transpennine high speed line via Woodhead (with 4-tracking of existing route from central Manchester to Hattersley), connecting to a Sheffield (Victoria)-Leeds route near Penistone, easily beats the HS3 Specification.

Sheffield – Leeds : **30** minute journey time required by HS3 Specification

NPR	**28**	HSUK analysis confirms that with the existing route from Sheffield to Thurnscoe upgraded to 4 tracks, and with a connection to HS2 at Clayton, the specified 30 minute journey time can be achieved. 4-tracking is necessary to separate high speed services from local services, and thus maintain service levels to intermediate stations.
HSUK	**19**	HSUK's new Sheffield-Leeds high speed line, running to the west of Barnsley and Wakefield to connect to the HSUK transpennine route near Penistone, easily beats the HS3 Specification.

Leeds – Newcastle : **60** minute journey time required by HS3 Specification

NPR	**70**	HSUK analysis demonstrates that a 70 minute journey time is the best achievable with an upgraded/new route from Leeds to York, and an on-line upgrade of the existing York-Newcastle East Coast Main Line. To achieve the specified 60 minute journey time will require a new high speed route from Darlington to Newcastle to bypass the existing highly-curved route via Durham (where no upgrades are deemed practicable).
HSUK	**51**	HSUK's upgraded/new route from Leeds to York, connecting to HSUK Anglo-Scottish spine route north of York, easily beats the HS3 Specification even with intermediate stops at York and Darlington. Timing increases to 60 minutes at 230km/h max speed.

The journey times set out in Table 14 are based upon the routes depicted in Figures 15 and 16.

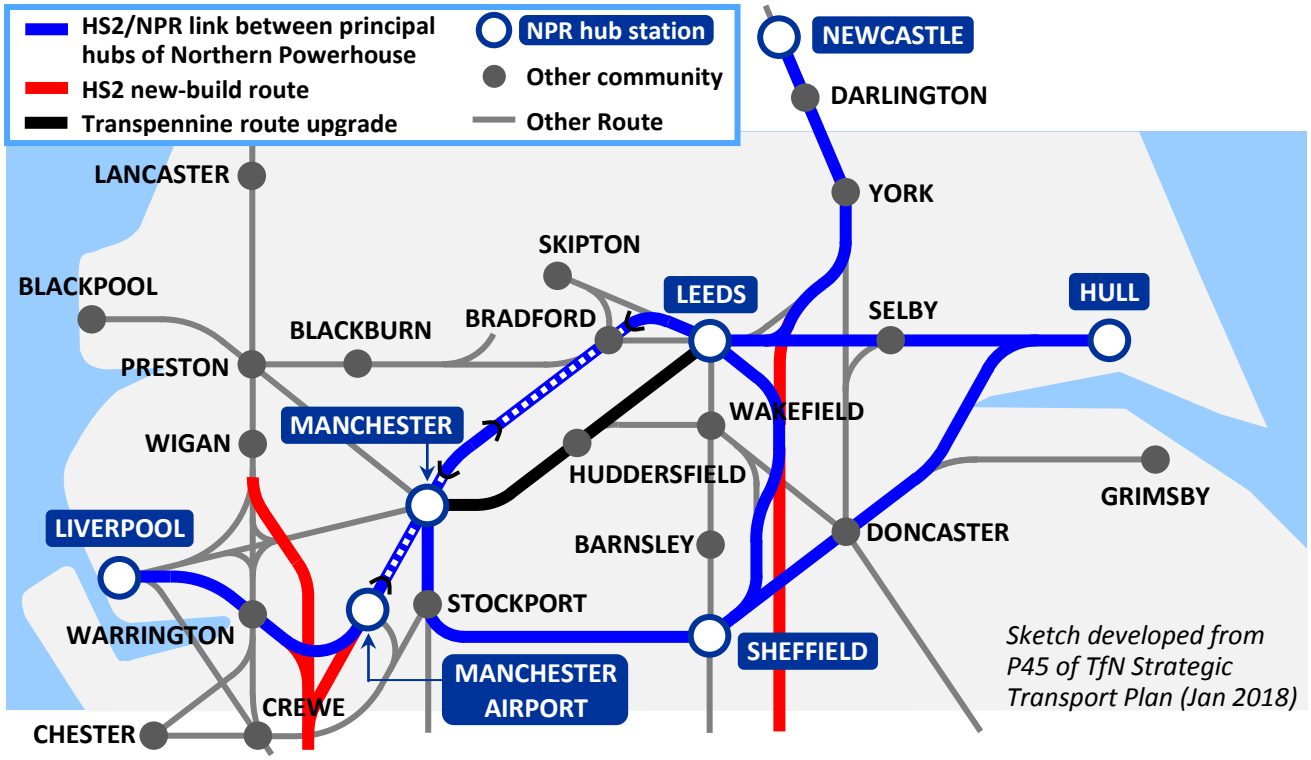


Figure 15 : NPR Routes Analysed to Determine Intercity Journey Times

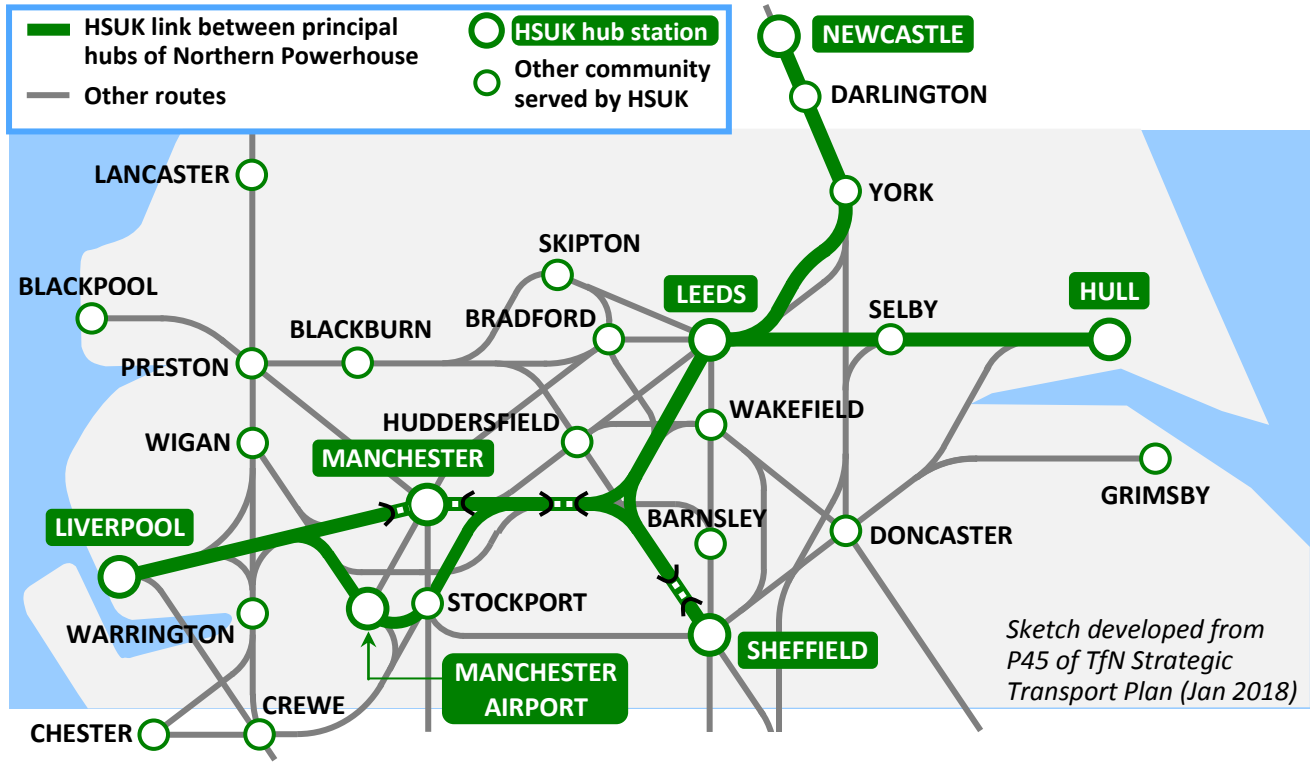


Figure 16 : HSUK Routes Analysed to Determine Intercity Journey Times

7.1.2. Increased Capacity for Enhanced Northern Powerhouse Rail Services

The 'One North' targets for radically reduced intercity journey times and the requirement for transformed freight services cannot be met through the TfN strategy, which is mostly focussed upon upgrading of existing routes. Such a strategy will not provide the new tracks that are necessary to segregate high speed intercity traffic from local passenger traffic and from freight traffic, and thereby achieve the required step-change increase in capacity on all primary routes.

Only High Speed UK has the integrated strategy for complementary development of:

- new-build routes;
- upgrading of existing 2-track routes to 4 tracks; and
- restoration of abandoned routes.

These 3 strands of network development will together provide 2 new tracks along all the congested primary routes between the principal centres of the Northern Powerhouse (note that for routes to Hull, HSUK and TfN are still developing definitive proposals).

Primary Route between Northern Powerhouse cities	**Northern Powerhouse Rail**		**High Speed UK**	
	2 New Tracks provided?		2 New Tracks provided?	
Liverpool - Manchester	Yes	Except for approaches to Liverpool Lime Street	Yes	Except for approaches to Liverpool Lime Street
Manchester - Sheffield	No	Under current upgrade plans, most of route will remain a 2-track railway	Yes	HSUK route from Leeds to Sheffield meets transpennine route via Woodhead to Manchester to form '3-pointed star' of high speed lines, with 2 new tracks for full length. (Existing Woodhead route also restored to provide 2 new tracks for freight.)
Manchester - Leeds	Yes	4-tracking assumed along existing Aire Valley and Manchester-Rochdale routes	Yes	
Sheffield - Leeds	??	Not certain whether upgrade plans north of Sheffield include full-length 4-tracking	Yes	
Leeds - Newcastle	No	Upgrade plans assumed not to include extra tracks/new routes from York to Newcastle	Yes	2 new tracks planned for full length between Leeds and Newcastle

Table 17 : NPR & HSUK Provision of New Tracks on Principal Intercity Routes

Table 17 charts the performance of Northern Powerhouse Rail and HSUK in meeting the 'One North' aspiration for new routes, or new tracks, to be provided on all principal intercity corridors. Without these new tracks, it would appear impossible to provide the extra capacity necessary for enhanced intercity and local rail services in the Northern Powerhouse region.

It must of course be emphasised that route capacity is only one aspect of the wider requirement for increased network capacity. It is equally important to increase capacity at the key network hubs, in particular Manchester, Sheffield and Leeds.

For further information refer to Appendix E2, and to the route diagrams (Figures A – E and W – X) and associated tables in Appendix E1.

7.1.3. Northern Powerhouse Rail Station Location and Configuration

The TfN Strategic Transport Plan offers no insight as to how the main line stations in the principal cities of the Northern Powerhouse can be developed to:

a) address existing congestion problems; and
b) provide the new capacity necessary to accommodate both the increased intercity frequencies stipulated by the HS3 Specification, and a similar step-change increase in local services.

This demands efficient 'through' stations – but instead, the TfN strategy endorses the misguided HS2 proposals for new terminus stations in both Leeds and Manchester. With TfN strategy based upon these inadequate proposals, it appears impossible to achieve the broad aspiration for a doubling of capacity to achieve a doubling in local service frequency and thus meet wider aspirations for improved connectivity.

Current TfN plans for principal stations are as follows:

- **Manchester Piccadilly** – new underground platforms on north-south tunnel linking NPR Liverpool-Manchester high speed line to NPR transpennine high speed line via Bradford. Sheffield-Liverpool flows routed via proposed HS2 terminus at Piccadilly. (Option for new surface terminus handling all NPR flows discounted due to high frequency train movements causing conflicts and congestion, and the certainty of increased journey times).
- **Manchester Airport** – proposed station on HS2 Manchester spur linked to airport terminals via new dedicated shuttle (presumed necessary, but not yet specified by TfN).
- **Sheffield Midland** – existing Sheffield Midland station developed as terminal for both HS2 and Northern Powerhouse Rail services. The major physical expansion required to accommodate the planned extra services appears unachievable without huge disruption.
- **Leeds** – major expansion seems essential to accommodate planned increase in NPR services, yet no space appears to exist, and no expansion is allowed for in the Leeds Station Masterplan.

HSUK's proposals for the development of Manchester Piccadilly, Manchester Airport, Sheffield Victoria and Leeds stations will transform capacity and connectivity across the North.

- **Manchester Piccadilly** – new underground platforms on east-west tunnel linking HSUK Liverpool-Manchester high speed line to HSUK transpennine high speed line via Woodhead. Connections to Stockport and Bolton lines offer major benefits for local services.
- **Manchester Airport** – existing terminus station transformed into through station with new tunnel to the west to create full 'South Manchester Loop' via Stockport and Altrincham. Capacity will be massively increased, allowing direct services to all major Northern communities.
- **Sheffield Victoria** – new station built on site of former Sheffield Victoria, to cater primarily for intercity traffic. New station will include interchange platforms on approaches to Sheffield Midland and new tram services to maximise integration with local rail and other public transport.
- **Leeds** – capacity of approach routes doubled by restoration of Farnley Viaduct to south-west, and 4-tracking to east. New Stourton-Neville Hill link proposed to enable through running (rather than termination) of many local services, part of a wider plan to double frequency of local services without any requirement for major expansion of the station.

Further details of proposed HSUK and HS2/NPR station developments are given in Appendix E3.

7.1.4. Longer Distance Northern Powerhouse Rail Services

Under TfN's proposals set out in the January 2018 *Strategic Transport Plan*, it appears possible and viable to operate direct services between all the principal centres of the Northern Powerhouse Rail, with the single exception of Hull to Newcastle. However, the performance of these links will be compromised by:

- The long transfer from the HS2 Manchester Airport station to the airport terminals.
- Sheffield-Liverpool services needing to reverse at Manchester Piccadilly terminus station.

It is presumed that TfN would favour the scheme for a north-south tunnel with underground platforms at Manchester Piccadilly, rather than the suggested alternative of a surface terminus station catering for all Northern Powerhouse Rail services to Manchester. If this latter option were to be chosen, then all trans-pennine services to Manchester Airport and Liverpool would be compelled to turn back at this terminus. As noted previously, this terminus option has been discounted due to its simple impracticality.

					Shuttle Link at MAN Airport		
				MP	Via Manchester Picc terminus		
Hull	**HU**				NPR Direct Intercity Link		
Leeds		**LS**			o	No NPR Direct Link	
Liverpool			**LI**				
Manchester				**MA**			
MAN Airport				o	**MAN**		
Newcastle	o					**NE**	
Sheffield			***MP***		***MP***		**SH**
	HU	**LS**	**LI**	**MA**	**MAN**	**NE**	**SH**

Figure 18 : NPR Direct Intercity Connectivity between Northern Powerhouse Cities

With both Manchester Piccadilly and Manchester Airport stations developed to accommodate through services, connecting Northern Powerhouse communities to the east and west, HSUK is capable of offering far superior (and significantly faster) long distance services across the entire Northern Powerhouse region. All the connections noted in Figure 19 are high speed services that are detailed in the HSUK timetable, and supported by the comprehensive route design undertaken for the HSUK project. (As with NPR, HSUK will not offer a direct Hull-Newcastle service, and there is no proposed HSUK service between Manchester and Manchester Airport faster than the current service).

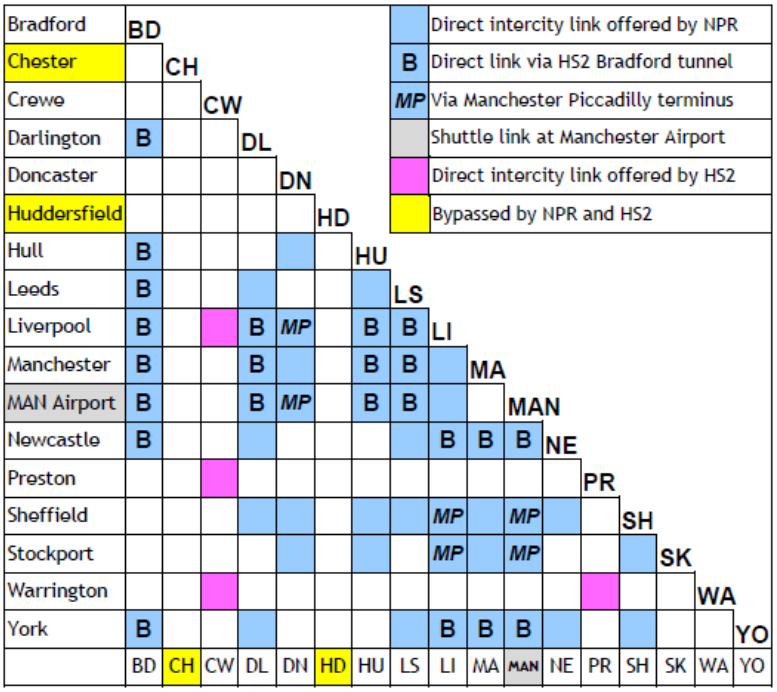
Hull	**HU**				HSUK Direct Intercity Link		
Leeds		**LS**			o	No HSUK Direct Link	
Liverpool			**LI**				
Manchester				**MA**			
MAN Airport				o	**MAN**		
Newcastle	o					**NE**	
Sheffield							**SH**
	HU	**LS**	**LI**	**MA**	**MAN**	**NE**	**SH**

Figure 19 : HSUK Direct Intercity Connectivity between Northern Powerhouse Cities

For further information, including a comprehensive comparison of journey times, see Appendix E4.

7.1.5. Northern Powerhouse Network Connectivity

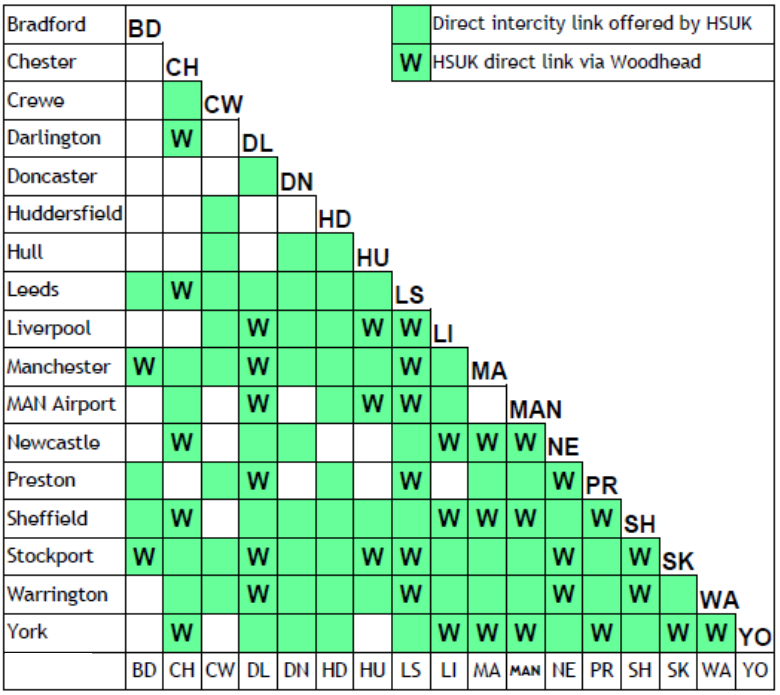
The connectivity of TfN's proposed Northern Powerhouse Rail network has been assessed by considering 17 key centres, and charting the number of possible direct (i.e. no change of trains) journeys between these 17 centres. Even with a journey to the remote HS2 Manchester Airport station accepted as a direct link to the airport, NPR and HS2 succeed in providing only 53 direct links out of a possible 136.



Note: *With no credible proposals for a central Warrington station on the proposed Liverpool-Manchester line (instead, a peripheral parkway has been assumed), Warrington has been deemed* ***'not served by Northern Powerhouse Rail'****.*

Figure 20 : Direct Intercity Connectivity between principal centres of Northern Powerhouse, with NPR and HS2 in place.

By contrast, HSUK will provide 103 direct links out of a possible 136. This superior performance is directly attributable to HSUK's design as a fully integrated intercity network, designed to serve all centres served by the present intercity network and also to achieve optimal interregional connectivity.



For further information re proposed HSUK services, see Appendix E5

Figure 21 : Direct Intercity Connectivity between principal centres of Northern Powerhouse, with HSUK in place.

Figures 20 and 21 also chart the connections that are made possible by the proposed NPR transpennine tunnel via Bradford, and by the proposed HSUK transpennine crossing via Woodhead. Whereas HSUK's Woodhead route offers 39 transpennine connections, the NPR Bradford route offers only 23.

7.1.6. Integration of NPR with HS2

Whilst NPR will connect to HS2 services at all major cities, HS2's critical failings as a national intercity network mean that it cannot offer effective links from Northern Powerhouse cities to its closest neighbours ie Glasgow, Edinburgh, Derby, Leicester, Nottingham and Stoke. Rather than offer improved intercity services to these neighbouring communities, the intervention of HS2 will instead result in services generally being made worse – either through reduced frequency, increased journey time or the introduction of new changes of trains. Out of 102 possible links, HS2 is predicted to make 46 worse.

These service reductions – all documented in HS2 Ltd's own reports – are directly attributable to HS2 Ltd's irresponsible policy of developing services aimed at 'creaming off' lucrative flows between primary cities (e.g. Manchester or Sheffield to London) whilst failing to serve intermediate cities such as Stoke, Derby and Leicester. In a similar fashion, HS2 Ltd's proposed diversion of Edinburgh-London services from East Coast to West Coast corridors, and truncation of CrossCountry services, mean that services from Yorkshire and North-Eastern cities to Edinburgh and Glasgow will also be greatly degraded.

	Interregional Links Provided by											
	High Speed 2						High Speed UK					
	HS2 direct intercity link						HSUK direct intercity link					
	Journey made worse by HS2						W	HSUK direct link via Woodhead				
Bradford												W
Chester											W	
Crewe												
Darlington												W
Doncaster												
Huddersfield												
Hull												
Leeds												W
Liverpool							W	W		W	W	
Manchester							W	W	W	W	W	
MAN Airport											W	
Newcastle												W
Preston									W	W		
Sheffield												W
Stockport							W	W		W	W	
Warrington											W	
York												W
	Edinburgh	Glasgow	Derby	Leicester	Nottingham	Stoke	Edinburgh	Glasgow	Derby	Leicester	Nottingham	Stoke
	High Speed 2						High Speed UK					

Information on reduced main line intercity services resulting from the intervention of HS2 is given in HS2 Regional Economic Impacts, HS2 Ltd, September 2013. For further details see Appendix E6.

Information on proposed HSUK high speed intercity services is given in HS2 – High Speed to Nowhere, Colin Elliff, 2017, available on www.highspeeduk.co.uk

See also Appendix E6.

Figure 22 : Direct Intercity Connectivity between principal centres of Northern Powerhouse and neighbouring major cities

All these problems are avoided by HSUK's design as an integrated national network. High speed services will interlink most principal cities, irrespective of whether they are located inside or outside the Northern Powerhouse region. HSUK will achieve 77 direct city-to-city connections out of a possible 102, while HS2 achieves a derisory score of 2 out of 102.

It is significant also to note how valuable HSUK's Woodhead transpennine crossing will be in improving wider interregional connectivity. Figure 22 shows 24 links out of 102 routed via Woodhead.

7.1.7. A Vision for Northern Powerhouse Railfreight

The TfN *Strategic Transport Plan* declares a laudable ambition for a ***'Freight Superhighway connecting Liverpool and the Humber'***[21]. However, it fails to demonstrate any substantive strategy to develop the dedicated transpennine freight route necessary to link the region's industry, ports and population centres without congestion.

Current initiatives, supported by both Government and Transport for the North, to reopen the Skipton-Colne line (noted **(7)** below) offer only limited capacity for transpennine flows. Problems are particularly severe at Leeds West Junction **(8)**, but more generally conflicts at many locations with existing (and increasing) passenger traffic will limit this route's potential to accommodate new freight traffic.

Moreover, Skipton-Colne reopening will not address either:

- the more central Liverpool-Manchester-Sheffield axis, where road congestion on M62, M60 and A628T Woodhead Road (linking Manchester-Sheffield) is critical.
- Any requirement for increase in loading gauge beyond 'W12' container gauge.

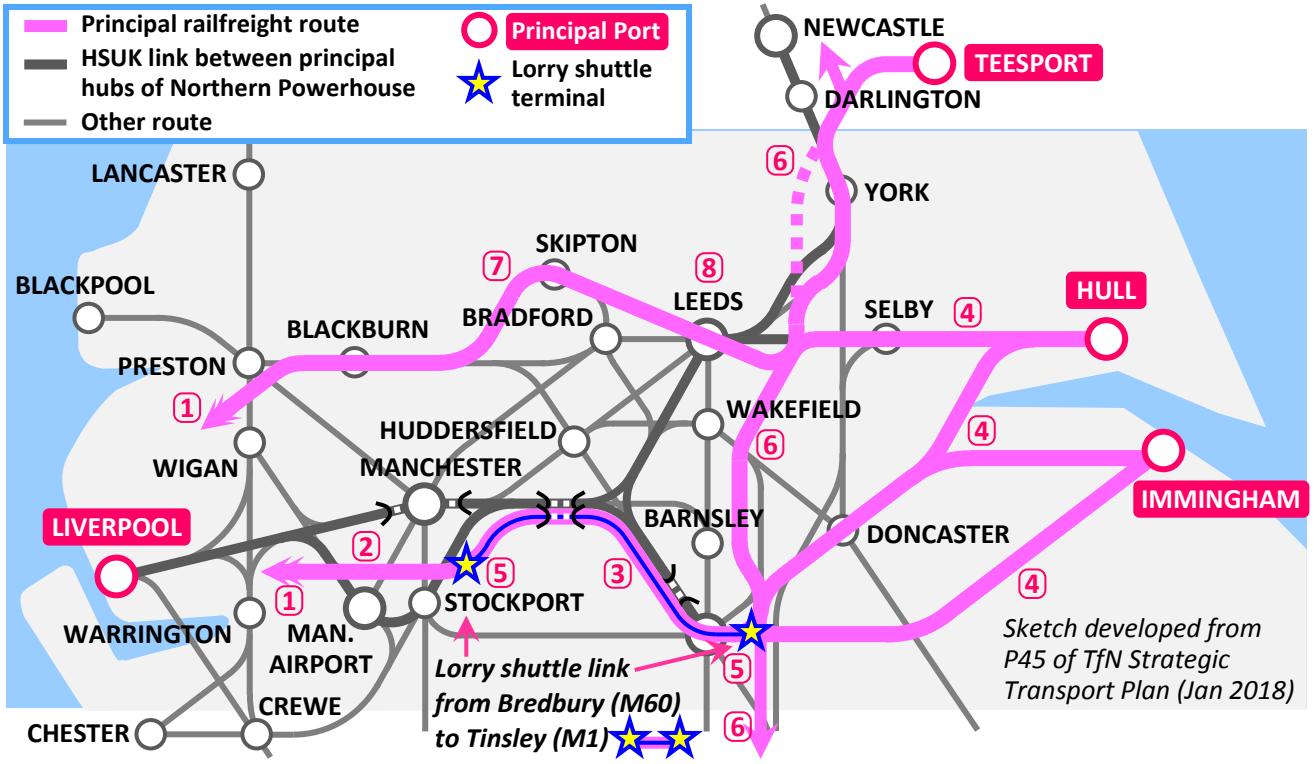


Figure 23 : High Speed UK Transpennine Freight Strategy

The HSUK railfreight strategy indicated in Figure 23 includes Skipton-Colne reopening **(7)**, but more importantly it proposes restoration of the abandoned Sheffield-Manchester Woodhead route **(3)** and the combination of other restored routes into a South Manchester bypass for freight **(2)**, to create:

- a coast-to-coast freight route **(1)**,**(2)**,**(3)**,**(4)** along which freight services will be 'prime user' on critical sections.
- a regional and national freight network **(1)**,**(2)**,**(3)**,**(4)**,**(6)** with enhanced loading gauge capable of accommodating long-distance 'piggyback' services (i.e. articulated HGV trailers on rail wagons).
- a Channel Tunnel-style lorry shuttle link between Sheffield and Manchester **(5)**.

[21] P34, *Strategic Transport Plan*, Transport for the North, January 2018.

The Requirements Statement set out in Appendix D identifies 6 key issues for freight transport in the Northern Powerhouse region:

a) the congestion on existing transpennine road routes, in particular the A628T 'Woodhead' road between Manchester and Sheffield;
b) the lack of capacity for freight traffic on existing transpennine rail routes;
c) the lack of any east-west cross-Manchester routes avoiding Piccadilly and Victoria stations;
d) the restricted structure gauge existing on all transpennnine routes, that prevents the operation of 'W12' container traffic and other larger 'Continental gauge' wagon formats;
e) the poor connectivity of the region's ports (in particular Liverpool, Immingham, Hull and Teesport) to their hinterlands;
f) the limited extent of these hinterlands, generally restricted by the lack of capacity on transpennine rail routes.

Table 24 below evaluates the performance of TfN and HSUK railfreight strategies in addressing these 6 critical issues (bracketed numbers refer to Figure 23):

Issue	**NPR** Freight Strategy: **Skipton-Colne** (S-C) reopening	**HSUK** Freight Strategy: **Woodhead** reopening	**Winner**
a) Congestion on transpennine roads	S-C reopening **(7)** will do little to relieve M62 congestion, and nothing to relieve the critical A628T Woodhead corridor **(3)**.	HSUK strategy for Woodhead reopening **(3)** & cross-Manchester freight route **(2)** achieves high capacity 'prime user' freight route from the North-West to Yorkshire. HGV congestion on both M62 and A628T Woodhead Road hugely reduced. HSUK strategy includes Skipton-Colne reopening **(7)**.	**HSUK**
b) Lack of transpennine capacity	Capacity of reopened S-C route **(7)** limited by congestion at Leeds West Junction **(8)** and elsewhere.		**HSUK**
c) No cross-Manchester freight route	S-C reopening does not address this issue – too far north **(7)**.		**HSUK**
d) Restricted structure gauge	S-C reopening **(7)** will achieve at best a transpennine freight route with W12 capability ie 2.5m containers on standard flat wagons.	Woodhead reopening **(3)** part of HSUK strategy for larger 'Continental gauge' (UIC-C) freight network **(6)** interlinking all principal UK conurbations. Enhanced structure gauge for lorry shuttles **(5)** on Woodhead route.	**HSUK**
e) Poor connectivity to ports	Still to be resolved **(4)**; greatest problems with enhanced rail access to Liverpool Superport **(1)**.	Still to be resolved **(4)**; greatest problems with enhanced rail access to Liverpool Superport **(1)**.	**-------**
f) Limited extent of port hinterlands	S-C reopening **(7)** has restricted capacity and is located too far to north to resolve this issue.	Woodhead reopening offers far greater capacity and has superior, more central location.	**HSUK**

Table 24 : Comparison of NPR and HSUK Transpennine Freight Strategies

The HSUK railfreight strategy will not create a fully dedicated transpennine route for the exclusive use of freight trains. However, it will create a network of gauge-enhanced routes on which freight traffic will be the 'prime user', with express passenger traffic diverted to other routes. As such, the HSUK railfreight strategy appears to align closely with TfN ambitions for a ***'Freight Superhighway connecting Liverpool and the Humber'***, and it is documented further in Appendix E7. Work is currently in progress to better define options for improving rail access to the proposed 'Liverpool Superport'.

7.1.8. Minimised Dependency on HS2

The TfN *Strategic Transport Plan* makes it abundantly clear that its proposals – ***which are intended to transform transpennine connectivity*** – are based upon HS2 – ***which was designed with no thought for transpennine connectivity***. Section 3.6 presents detailed evidence to support these assertions.

With HS2's routes in Yorkshire required only to offer north-south links, there was a natural tendency to locate the trunk route in the flatter and more favourable terrain to the east of Barnsley and Wakefield. This made HS2 relatively cheap to construct as a north-south route; however, this route was completely incompatible with the single east-west transpennine high speed line, as stipulated by 'One North' – see Sections 3.2 and 3.3 – that might connect Manchester and Liverpool to Leeds *and* Sheffield.

Instead – as is confirmed in the TfN *Strategic Transport Plan* – attention has focussed upon developing 2 separate routes, from Leeds to Manchester and from Leeds to Sheffield. Analysis by HSUK indicates that both routes will require tunnels around 33km long to achieve the specified 30 minute journey times.

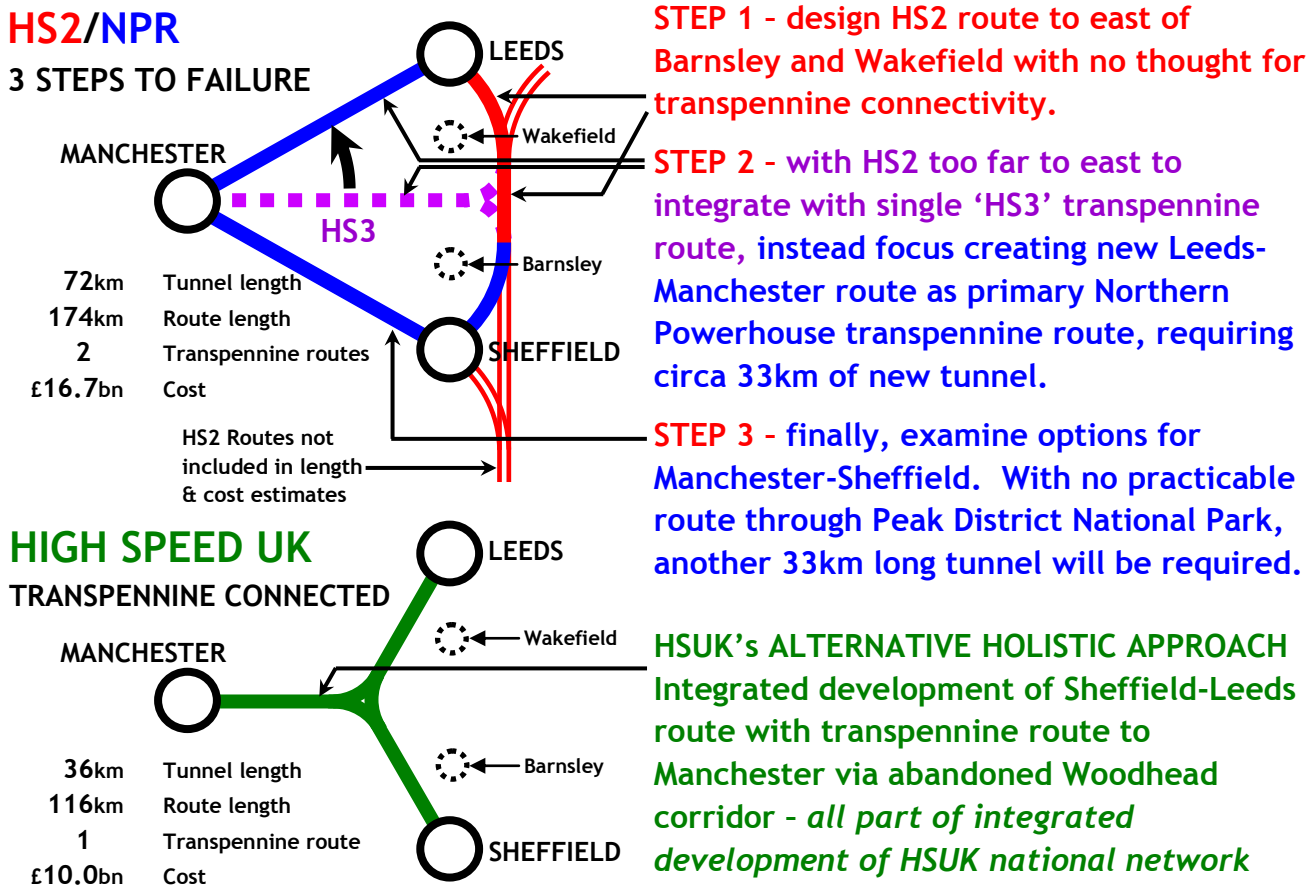


Figure 25 : HS2 and NPR – Epic Fail in the Transpennine Triangle

These problems appear to be directly attributable to HS2's design with no remit to improve transpennine connectivity. This is effectively proven by the 'exemplar alternative' of High Speed UK, which was designed with the single priority of forming an efficient national intercity network, interlinking all major cities. HSUK's response to the challenge of the 'Transpennine Triangle' was to locate its Leeds-Sheffield route in the hillier (and more expensive) terrain to the west of Barnsley and Wakefield, allowing a 'delta junction' connection to a single east-west route to Manchester via the abandoned Woodhead corridor, in full accordance with the original 'One North' scheme (see Figure 3).

For further information, including details of the £7bn cost savings achieved by HSUK, see Appendix E8.

7.1.9. A Complete Vision for Northern Powerhouse Rail

Overall, the TfN *Strategic Transport Plan* fails to offer the holistic vision to demonstrate how passenger and freight links between the principal centres of the Northern Powerhouse can be transformed to create an optimised network connecting both the region and the wider nation.

At best, the TfN *Strategic Transport Plan* offers a highly incomplete vision. Whilst certain routes – in particular Leeds to Manchester – appear to have been prioritised to comply with the specification for a 30 minute journey time, most other routes fail either to achieve the specified journey times, or to provide the necessary increased capacity. These are the aims that were at the core of the original 'One North' vision for a better-connected and more prosperous North, as set out in Section 3.2.

The greatest failing of the TfN *Strategic Transport Plan* lies with its unquestioning acceptance of the established HS2 proposals. This leads not only to wholly inadequate links to neighbouring Midlands and Scottish cities, but also to a hugely inefficient configuration of rail routes within the Northern Powerhouse region in which two separate transpennine routes, each with extreme (>30km) lengths of tunnel, are required. This adoption of an inefficient and suboptimal network configuration then leads to all the other failings of Transport for the North's proposals, whether in achieving the specified journey time reductions, or in achieving the higher-capacity and better-connected rail network that the North so clearly needs.

Without this transformed network, rail connectivity within the North will remain poor, and the North-South Divide will remain to blight the economy of the entire nation.

7.1.10. Technical Excellence for the Northern Powerhouse

All the assessments presented in the foregoing sections demonstrate conclusively that HSUK comprehensively outperforms Northern Powerhouse Rail (and HS2) as the option best able to deliver the optimised regional (and national) railway network as defined in this Requirements Statement. It can thus be reasonably concluded that HSUK is also the option best able to maximise the opportunities for sustainable economic growth in the Northern Powerhouse Region.

The Project Scorecard below documents a 'Nine-Nil' victory for HSUK in its performance against the Requirements Statement set out in Section 6.

Test		Ref	Winner
1	HS3 Journey Time Specification	7.1.1	HSUK
2	Increased Capacity for Enhanced NPR Services	7.1.2	HSUK
3	NPR Station Location and Configuration	7.1.3	HSUK
4	Longer Distance NPR Services	7.1.4	HSUK
5	Northern Powerhouse Network Connectivity	7.1.5	HSUK
6	Integration of NPR with HS2	7.1.6	HSUK
7	Vision for Northern Powerhouse Railfreight	7.1.7	HSUK
8	Dependency upon HS2/other proposal?	7.1.8	HSUK
9	Complete Vision for Northern Powerhouse Rail	7.1.9	HSUK

Table 26 : Interim Project Scorecard : HSUK 9, Northern Powerhouse Rail 0

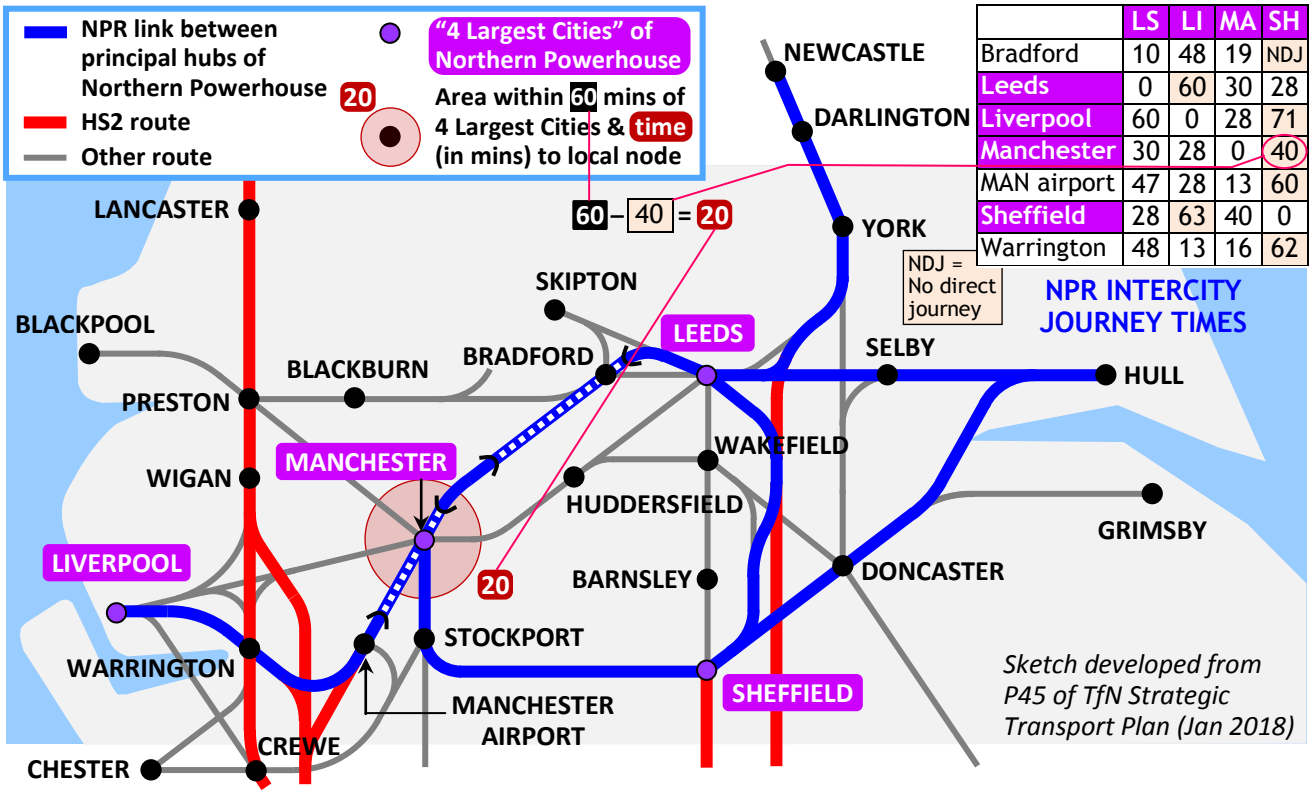
7.2. Northern Powerhouse Rail : Performance against TfN '60-minute Criterion'

Possibly in lieu of the HS3 journey time specification established by 'One North', TfN's *Strategic Transport Plan* has introduced a new requirement, to maximise the number of people living within 60 minutes of the 4 principal cities of the Northern Powerhouse i.e. Liverpool, Manchester, Sheffield and Leeds. Transport for the North states that currently, only 10,000 people – all presumed to live in central Manchester – are located sufficiently close to Manchester Piccadilly and/or Victoria to be less than 60 minutes' total journey (i.e. journey to local station, transfer to platform, board train and travel to other city) from the centres of the 3 other cities (and of course Manchester itself).

TfN's ambition is to develop accelerated Northern Powerhouse Rail services so that 1.3 million people would then benefit from being within the '60-minute Criterion'. Under current TfN proposals, it seems highly unlikely that any of the immediate intercity journeys – either to Liverpool, Leeds or Sheffield – can be reduced significantly below 30 minutes, and thus the only locations satisfying the '60-minute Criterion' will be Manchester, and possibly Manchester Airport.

If the Manchester-Sheffield route could be upgraded to offer a 30 minute journey time, then people living up to a radius 30 minutes from central Manchester (and a smaller radius around Manchester Airport) would fall within the '60-minute Criterion'. This would seem to correspond to the 1.3 million potential beneficiaries claimed by Transport for the North.

However, HSUK's analysis demonstrates that no upgrade option (short of a new tunnel 33km long) can practicably deliver Manchester-Sheffield journey times less than 40 minutes. In the continuing absence of credible proposals for a 30-minute Manchester-Sheffield journey, the radius would shrink from 30 minutes to 20 minutes, and the number of beneficiaries would reduce to perhaps 600,000. All of these beneficiaries would be located in Greater Manchester.



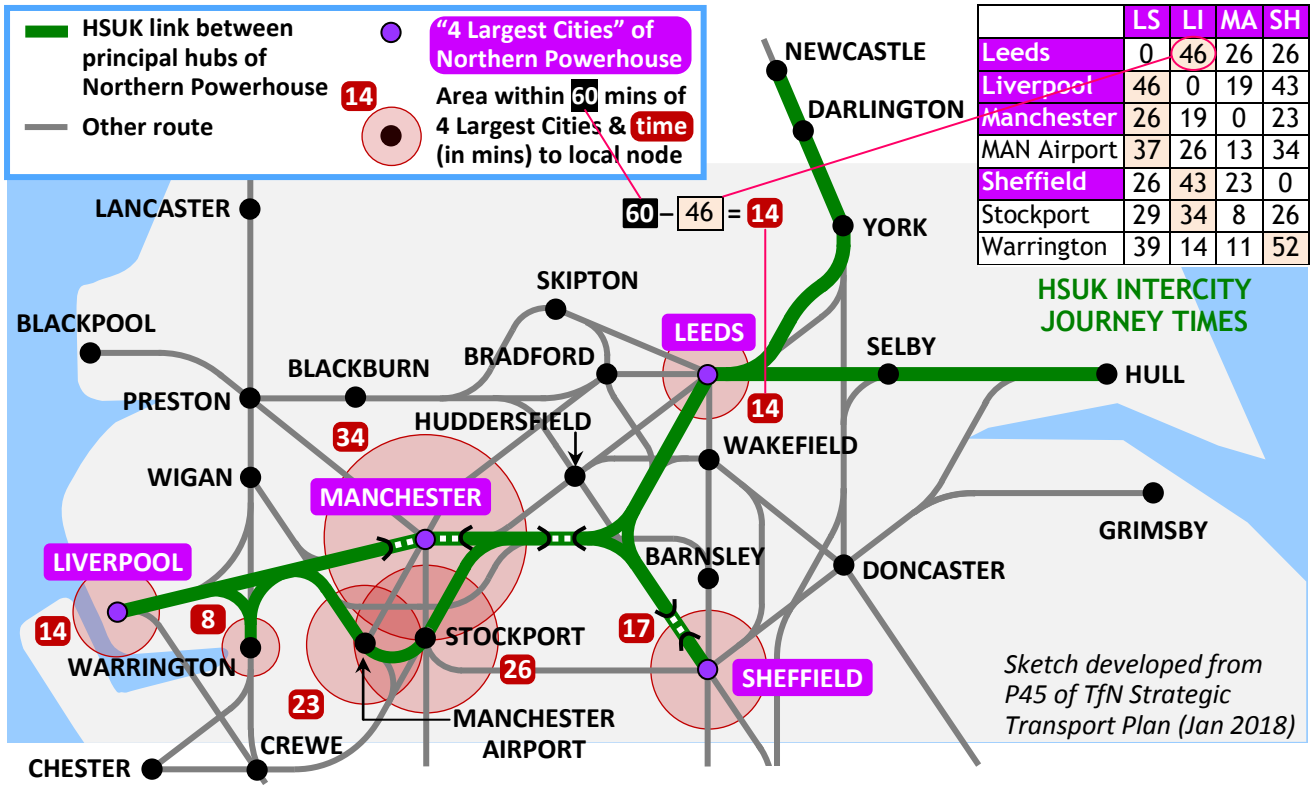
	LS	LI	MA	SH
Bradford	10	48	19	NDJ
Leeds	0	60	30	28
Liverpool	60	0	28	71
Manchester	30	28	0	40
MAN airport	47	28	13	60
Sheffield	28	63	40	0
Warrington	48	13	16	62

NDJ = No direct journey

NPR INTERCITY JOURNEY TIMES

Figure 27 : Areas within 60 minutes of 4 largest Northern Powerhouse cities under TfN proposals

By contrast, HSUK's achievement of significantly greater reductions in intercity journey times will bring Leeds and Sheffield respectively within 46 and 43 minutes of Liverpool. This will then bring residents of Liverpool, Warrington, Stockport, Leeds and Sheffield within the '60-minute Criterion', and it will have the effect of greatly increasing the population benefiting from the improved connectivity, and also of extending these benefits beyond the confines of Greater Manchester. By a simple scaling exercise, around 3.5 million people will fall within the '60-minute Criterion' with the HSUK scheme in place.



	LS	LI	MA	SH
Leeds	0	46	26	26
Liverpool	46	0	19	43
Manchester	26	19	0	23
MAN Airport	37	26	13	34
Sheffield	26	43	23	0
Stockport	29	34	8	26
Warrington	39	14	11	52

Figure 28 : Areas within 60 minutes of 4 largest Northern Powerhouse cities under HSUK scheme

7.2.1. Performance against '90-minute Criterion'

Currently, there is insufficient information to make any definitive judgement on how many 'prime capability' businesses might be located within 90 minutes of the 4 largest cities (i.e. Liverpool, Manchester, Sheffield and Leeds), either for TfN's Northern Powerhouse Rail proposals or for the High Speed UK scheme.

However, given HSUK's 'order of magnitude' superiority in bringing the people of the North within 60 minutes of the 4 largest cities of the Northern Powerhouse, it seems inconceivable that HSUK would not show a similar superiority improving the connectivity of the region's businesses to the same '4 largest cities'.

7.3. Northern Powerhouse Rail : Assessment of Cost of Proposed Links

Figure 29 below sets out estimated costs and key route data (i.e. length of new-build route and length of new tunnel) for:

- the Northern Powerhouse Rail links defined in the TfN *Strategic Transport Plan* within the Lancashire/ Yorkshire area. Projected NPR routes to Hull are excluded, on account of the current lack of any technical definition. A 33km long tunnel on the Manchester-Sheffield route is included, in order to meet the HS3 Specification for a 30 minute journey time, as originally established by 'One North'.
- Elements of HS2 running to the north and the south.

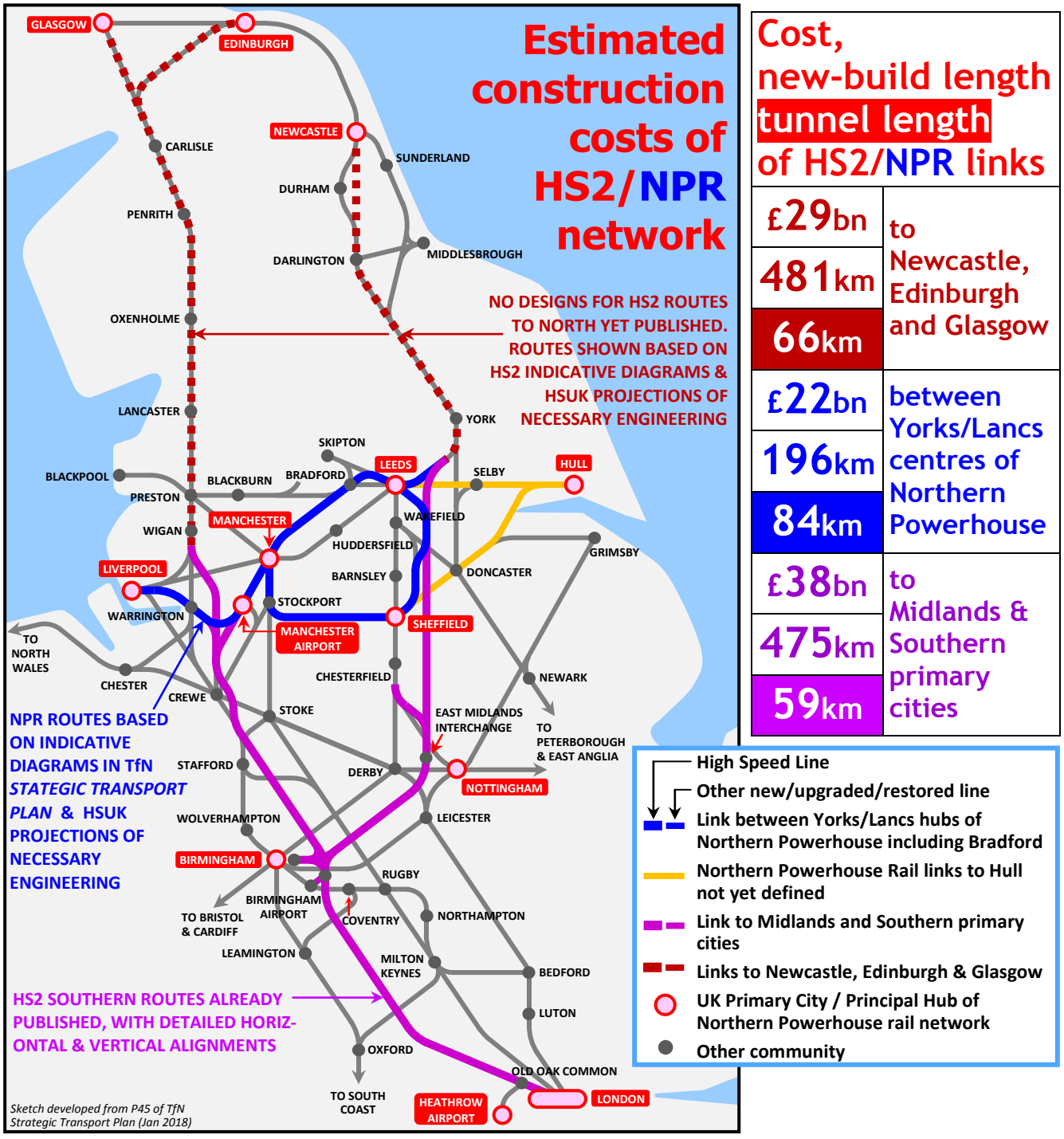


Figure 29 : Cost Estimates for Northern Powerhouse Rail and HS2, by region

Figure 30 below sets out estimated costs and key route data (i.e. length of new-build route and length of new tunnel) for:

- the HSUK elements necessary to provide the specified Northern Powerhouse links within the Lancashire/Yorkshire area, and achieve the journey times defined in the 'One North' *Proposition for an Interconnected North*. Projected HSUK routes to Hull are excluded, on account of the current lack of any technical definition.
- Elements of HSUK running to the north and the south.

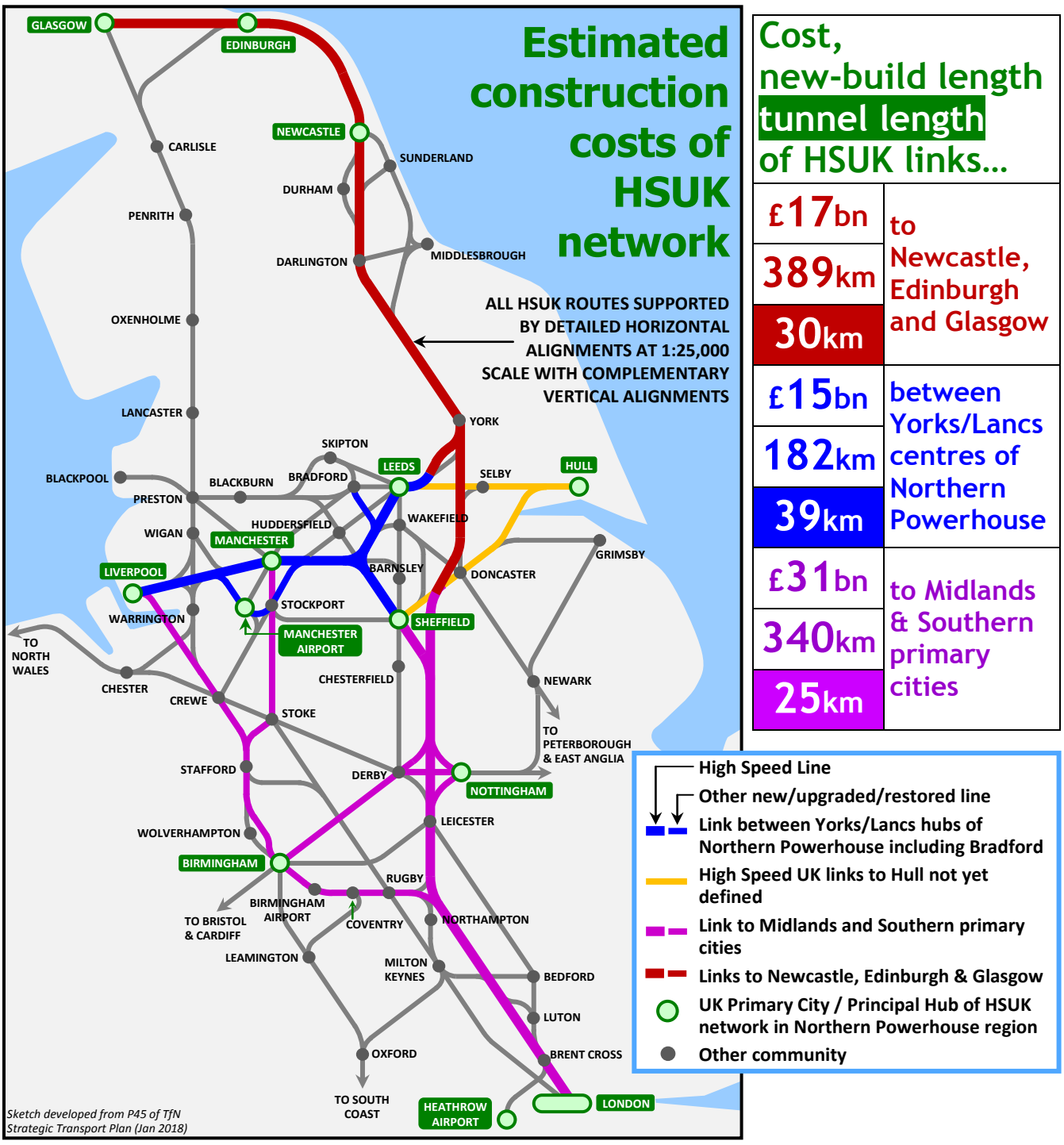


Figure 30 : Cost Estimates for High Speed UK, by region

Zone	Category	HS2/NPR	HSUK	Difference
High speed links to Newcastle, Edinburgh and Glasgow	Estimated Cost	£29bn	£17bn	£12bn
	New-build length	481km	389km	92km
	Upgraded** length	27km	31km	-4km
	Tunnelled length	66km	30km	36km
High speed links between Yorks/Lancs centres of Northern Powerhouse	Estimated Cost	£22bn	£15bn	£7bn
	New-build length	196km	182km	14km
	Upgraded** length	66km	67km	-1km
	Tunnelled length	84km	39km	45km
High speed links to Midlands & Southern primary cities	Estimated Cost	£38bn	£31bn	£7bn
	New-build length	475km	340km	135km
	Upgraded** length	5km	209km	-204km
	Tunnelled length	59km	25km	34km

** 'Upgraded length' includes:

a) lengths of existing railway to be upgraded, and:

b) lengths of abandoned railway to be restored

Table 31 : Relative Cost and Route Length Parameters for HS2/NPR and HSUK

The costs and route length parameters for Northern Powerhouse Rail, and for southern and northern sections of HS2, are summarised in Table 31, and contrasted with High Speed UK. The comparisons show a consistent picture; the HSUK works required to connect the Northern Powerhouse, and to achieve north-south links equivalent to those of HS2, will cost of the order of 20-30% less than official proposals, yet will – as is demonstrated throughout this report – achieve far superior connectivity.

HSUK's lower costs can broadly be attributed to the shorter length of new-build route and the far shorter length of tunnel that the scheme requires, when compared with relevant sections of Northern Powerhouse Rail and HS2. Only on the criterion of upgraded/restored route does HSUK require greater lengths than those of either Northern Powerhouse Rail or HS2.

Within the Northern Powerhouse region, the cost differences between HSUK and the TfN proposals can be ascribed to one primary factor – TfN's design of a Northern Powerhouse Rail network requiring two new transpennine rail routes, both incorporating extreme (>30km) lengths of tunnel, to enable the journey time targets of the HS3 Specification to be met. The HSUK 'exemplar alternative' demonstrates clearly that the journey time targets can be easily met, and beaten, with a single transpennine route via Woodhead, and much shorter lengths of tunnel, and a scheme cost lower by £7 billion.

7.4. Northern Powerhouse Rail : Assessment of Timescale

No detailed assessment has yet been made of the timescales necessary to construct either TfN's proposals for Northern Powerhouse Rail, or the High Speed UK 'exemplar alternative'. However, given the simple fact that HSUK only requires one short new transpennine tunnel rather than two much longer tunnels required by Northern Powerhouse Rail scheme, it seems certain that HSUK will have a far shorter timescale to completion.

7.5. Overall Review of NPR and HSUK Performance

As has been demonstrated in all the previous pages of this report, HSUK enjoys comprehensive technical superiority over Northern Powerhouse Rail (and HS2) on almost any conceivable comparator. It will also be cheaper to construct, by several billions of pounds, and it will require a far shorter timescale to implement.

HSUK's massive superiority also definitively discredits Transport for the North's claim[22]: ***'Together with the existing mainline route network, HS2 and Northern Powerhouse Rail can create a flexible set of services to maximise the economic outcomes for the UK'***. This can only happen with an optimised and fully integrated network, as has been developed for the HSUK scheme. There is no indication that the same level of integration and efficiency can possibly be achieved for TfN's proposals, given their predication upon the established (and fundamentally segregated rather than integrated) HS2 scheme.

It is now possible to finalise the Project Scorecard:

Test		Ref	Winner
1	HS3 Journey Time Specification	7.1.1	HSUK
2	Increased Capacity for Enhanced NPR Services	7.1.2	HSUK
3	NPR Station Location and Configuration	7.1.3	HSUK
4	Longer Distance NPR Services	7.1.4	HSUK
5	Northern Powerhouse Network Connectivity	7.1.5	HSUK
6	Integration of NPR with HS2	7.1.6	HSUK
7	Vision for Northern Powerhouse Railfreight	7.1.7	HSUK
8	Dependency upon HS2/other proposal?	7.1.8	HSUK
9	Complete Vision for Northern Powerhouse Rail	7.1.9	HSUK
10	Transport for the North '60-minute Criterion'	7.2	HSUK
11	Project Cost	7.3	HSUK
12	Project Timescale	7.4	HSUK

Table 32 : Finalised Project Scorecard : HSUK 12, Northern Powerhouse Rail 0

[22] P46, *Strategic Transport Plan*, Transport for the North, January 2018

Figure 33 below shows the performance of both Transport for the North's proposals for Northern Powerhouse Rail and the High Speed UK 'exemplar alternative' plotted onto the 'Project Manager's Triangle'. Given HSUK's superior performance in every aspect of specification, cost and timescale, its plotted triangle completely encompasses that of TfN's proposal.

As noted previously, the primary single reason for Northern Powerhouse Rail's poor performance as a network connecting Northern communities is its undue and unnecessary dependency upon HS2. This might be deemed a political externality, but in reality it is an engineering issue revolving around the efficient and optimal functioning of the national rail network, with HS2's new high speed lines in place.

As demonstrated in Section 7.1.6 and Figure 22, HS2 represents a gargantuan multi-billion pound failure of engineering design in its inability to interconnect the UK's major cities. HS2's core dysfunction lies in the total mismatch between its ambition for ***'hugely enhanced capacity and connectivity'*** between the UK's major conurbations and its actuality, a London-centric funnel that will concentrate national rail connectivity (and therefore prosperity) upon London. This then rebounds upon any scheme such as Northern Powerhouse Rail that is based upon HS2.

This is a technical issue of railway network design, that those guiding the development of Northern Powerhouse Rail should have recognised[23] and addressed, in order to remain true to their political objective of enhancing the rail connectivity, and thereby enhancing the economy, of the North of England.

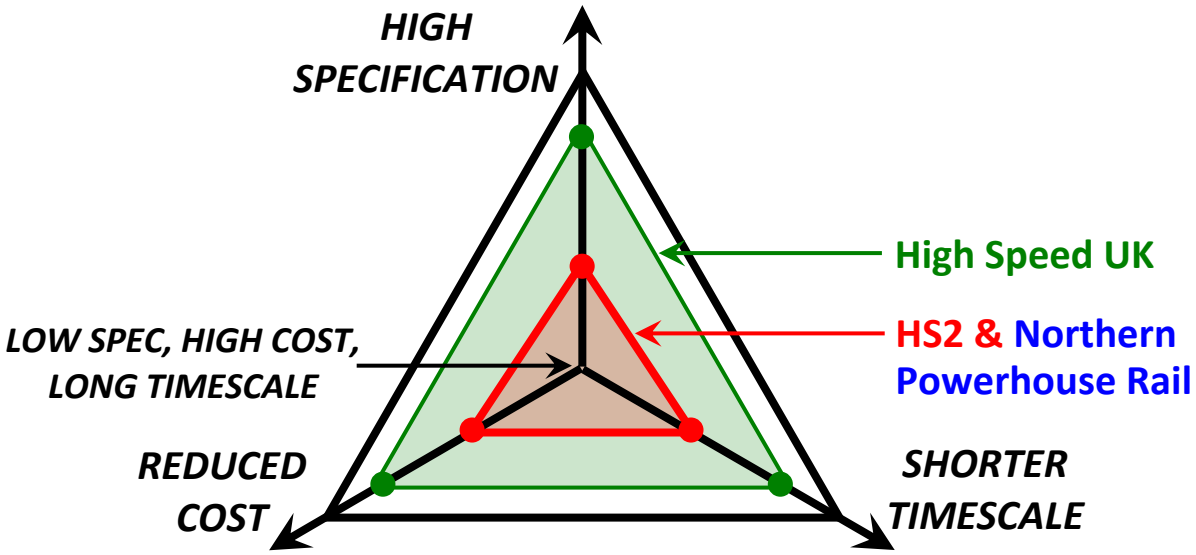


Figure 33 : HSUK comprehensively outperforming HS2 & Northern Powerhouse Rail

[23] It should be noted that HS2's inability to interconnect UK regional cities, or to maintain the integrity of the national intercity network, is well documented in HS2 Ltd's own reports. Table 23 on pages 91-92 of *HS2 Regional Economic Impacts*, HS2 Ltd, September 2013, lists both proposed HS2 services (principally linking larger UK 'primary' cities), and reductions in service levels on existing intercity routes serving smaller 'second-tier' cities. These reductions are caused primarily by the transfer of intercity flows between primary cities to HS2 resulting in fewer passengers to support intercity services on the residual intercity routes on the existing network.

8. Local Implications of Transpennine Route Selection

The fundamental aim of this report has been to assess the fitness of Transport for the North's *Strategic Transport Plan* for its purpose of delivering a rail transport system that will offer maximum economic benefit for the 10 million or more UK citizens in the Northern Powerhouse region. On all grounds of connectivity, capacity, cost, timescale to completion and compliance with the original requirements of the 'One North' initiative, this report has demonstrated the multiple inadequacies of the TfN proposals, and the comprehensive superiority of the High Speed UK 'Exemplar Alternative'.

However, it must be emphasised that the determination of HSUK's superior performance compared with TfN's Northern Powerhouse Rail is generally predicated upon two fundamental tenets:

- The TfN proposals will, in addition to its proposed new transpennine route linking Leeds and Manchester via Bradford, require a further new transpennine route linking Sheffield and Manchester, in order to meet the journey time targets originally set by 'One North'.
- The comparisons made in this report essentially define the 'greater good', with no reference to specific communities that might be advantaged or disadvantaged by either HSUK or NPR.

It is necessary also to consider the implications of:

- Northern Powerhouse Rail delivered with just one single new transpennine route (via Bradford).
- The headline 'winners and losers' arising from implementation of either HSUK or NPR. This issue can be resolved by considering the connectivity implications of the HSUK and NPR schemes for the cities of Bradford and Sheffield.

8.1. Northern Powerhouse Rail with Single Transpennine Route

With no new transpennine route between Manchester and Sheffield, and the existing Hope Valley route upgraded instead, the following implications can be anticipated for the performance of a Northern Powerhouse Rail network:

- Detailed analysis of the Hope Valley route (see Appendix E1.2) indicates that the existing route cannot practicably be upgraded to achieve the 30 minutes Manchester-Sheffield journey time specified by 'One North'. The track alignment is dictated by the mountainous landscape, and it is not feasible to ease the curves to allow faster speeds. If speed limits are set to the maximum speeds permitted for each curve, a 40 minute journey time is the best that can be achieved. However, given the competing use of the line by freight and slower passenger traffic, journey time savings will be smaller than the calculation indicates. Analysis also indicates that use of tilting rolling stock would deliver only small additional gains. (Refer 7.1.1 and Appendix E1).
- With the route remaining largely a 2-track route, there will be insufficient capacity to accommodate either the projected 6 train per hour service frequency, or any increase in freight or local services. (Refer 7.1.2).
- All the connectivity deficiencies arising from routeing Sheffield-Manchester-Liverpool services via a central Manchester terminus will still apply. (Refer 7.1.3 and 7.1.4).
- Even a fully upgraded Hope Valley route cannot practicably satisfy the 'One North' requirement for a transformational capacity increase in transpennine freight services. (Refer 7.1.7).
- With the cost of a second transpennine tunnel eliminated, HSUK's cost advantage over the TfN Northern Powerhouse Rail proposals will reduce from £6.7 billion to £2.3 billion. (Refer 7.3).

8.2. Connectivity Implications for Sheffield and Bradford

It is clear that Sheffield is the greatest single 'loser' from TfN's decision to develop a new transpennine route along its chosen 'North Transpennine' corridor. This route will link Liverpool, Manchester Airport and Manchester via Bradford to Leeds, Hull and Newcastle; yet in the absence of any equivalent new 'South Transpennine' route, Sheffield will be excluded. This will only compound the connectivity problems of a city which is already poorly served by the HS2 scheme.

The routeing of TfN's proposed new line via Bradford would seem to bring about an unprecedented gain in connectivity for a city that currently has very poor rail links. However, there must be major concerns over a situation whereby Bradford's gain appears to be Sheffield's loss. The ideal proposition would be one that delivers significant connectivity gains for both cities, provides dynamic city centre stations facilitating local regeneration, and at the same time eliminates any deficiencies that exist in the local networks serving each city.

On such considerations, HSUK's proposals for both Sheffield and Bradford would appear to significantly outperform those of TfN and HS2 Ltd.

Under Transport for the North's and HS2 Ltd's proposals:

- **Bradford** will be well connected only along the axis of the new transpennine route; it will still lack direct links on key routes to London, Birmingham and Sheffield.
- There is presently no certainty either that the new transpennine route will serve **Bradford** at a city centre station, or that the required 33km long tunnel will be technically and operationally feasible.
- The proposals will do nothing to improve **Bradford**'s present dysfunctional rail network, whereby its two terminus stations serve separate networks to north and south, and lack any cross-city link. There is no comparable inland English city with similar disconnection between two opposed terminus stations, and this must in part account for Bradford's depressed economy relative to its neighbours.
- **Sheffield** will enjoy only limited connectivity gains, effectively 'parked on a siding' by both Transport for the North's and HS2 Ltd's proposals.

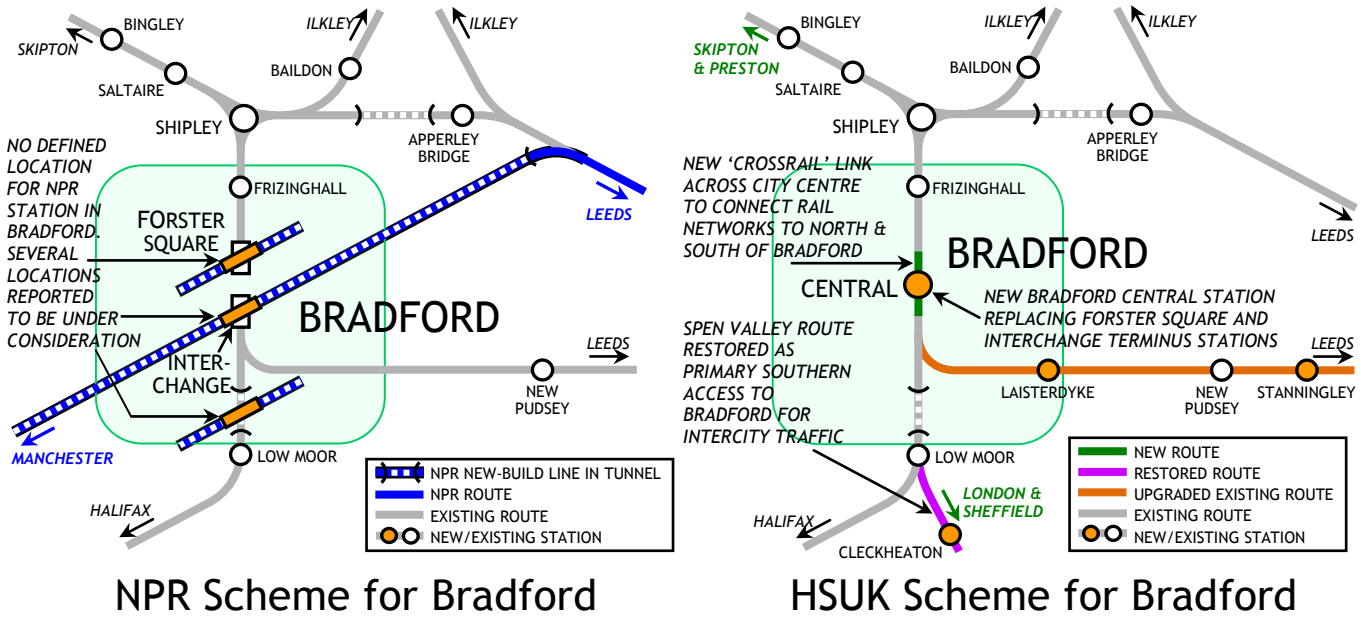


Figure 34 : Northern Powerhouse Rail and High Speed UK Schemes for Bradford

Under the High Speed UK proposals:

- Restoration of the abandoned Spen Valley route and creation of a new **Bradford** cross-city link will establish a new north-south rail corridor to complement the east-west Calder Valley route. This will provide a direct connection to HSUK's north-south and transpennine routes and achieve unprecedented intercity connectivity for **Bradford**, including fast trains to London and Sheffield.
- HSUK's new cross-city route will cross the Westfield development at second-floor level and will include a new **Bradford Central** station, located on the site of the former Bradford Exchange.
- A new **Bradford** cross-city route will greatly enhance links between communities in the Kirklees, Calderdale and Bradford boroughs of West Yorkshire, and will reduce congestion at Leeds.
- **Sheffield** will be located on a fast through route from London and the Midlands to the North-West, West Yorkshire, and Scotland, which will hugely enhance the city's intercity connectivity. Sheffield Victoria will be restored as the primary intercity hub, with new interchange platforms constructed on the approaches to Sheffield Midland to ensure integration with local services.

From all of the comparisons presented in this report it is clear that HSUK's proposed Woodhead transpennine route will deliver far greater connectivity gains for the entire Northern Powerhouse region (see Appendix E6.1), and for Sheffield (see Appendix E3.2). It also offers far superior performance for Bradford (see Appendix E3.3), when more local issues of cross-city connectivity and balanced performance of the West Yorkshire rail network are taken into account.

It must however be stressed that this is fundamentally an argument revolving around the question of prioritisation. Given the vast cost differential, estimated at around £7 billion (see Section 7.3), between HSUK and TfN's Northern Powerhouse Rail routes linking Manchester, Sheffield and Leeds, there is no reason why a second transpennine route via Bradford should not be built at some time in the future, and still show a significant overall cost saving.

There is of course no question that a second transpennine route via Bradford would not deliver significant connectivity gains, and also provide much-needed extra capacity. The comparisons presented in this report merely indicate that of all potential transpennine crossings, a Woodhead route would offer the greatest gains to the greatest number of stakeholders, and as such it must be constructed first.

	HS2 and NPR Intercity links to		High Speed UK Intercity links to	
	Bradford	Sheffield	Bradford	Sheffield
Birmingham				
Bradford				
Chester				W
Crewe				
Darlington	B			
Derby				
Doncaster				
Edinburgh				
Glasgow				
Huddersfield				
Hull	B			
Leeds	B			
Leicester				
Liverpool	B			W
London				
Manchester	B		W	W
MAN Airport	B			W
Newcastle	B			
Nottingham				
Preston				W
Sheffield				
Stockport			W	W
Stoke			W	W
Warrington				W
York	B			
Total journeys improved	8	10	10	26
Direct Journeys made worse	0	4	0	0

	Direct intercity link provided by NPR
	Direct intercity link provided by HS2
X	Direct journey made worse by HS2
	Direct intercity link provided by HSUK
B	NPR link via Bradford tunnel
W	HSUK link via Woodhead

Table 35 : Sheffield & Bradford Links

9. Conclusions

With over 3 years having passed since Transport for the North (TfN) was first charged with developing plans for Northern Powerhouse Rail, it would be reasonable to expect the launch (on 16 January 2018) of TfN's *Strategic Transport Plan* to reveal a dynamic and optimised vision for a transformed rail network for the Northern Powerhouse region.

This is certainly what TfN has claimed; however, all the comparisons presented in this report demonstrate a starkly different reality. Not only do the TfN proposals fail to meet the original journey time specification established in the 'One North' *Proposition for an Interconnected North*, they are also comprehensively outperformed by the 'Exemplar Alternative' of the High Speed UK scheme, on every single technical comparison. HSUK's superior performance exists not just in its superior connectivity, capacity and faster journey times; it will also cost less to build, and it will be much quicker to implement.

The evidence indicates clearly that under the oversight of Transport for the North, the Northern Powerhouse project has regressed, rather than progressed. The detailed design effort underpinning the HSUK scheme proves beyond doubt that the 'One North' vision for a single new transpennine route, aimed at interlinking all of the North's principal centres and offering radically reduced journey times, was eminently feasible; yet the Northern Powerhouse Rail scheme outlined in the TfN *Strategic Transport Plan* falls far short of the 'One North' journey time targets and wider network vision.

This raises the very obvious question of how an official and well-resourced body such as Transport for the North could have failed so disastrously in their development of a scheme intended to serve the public interest, and to represent 'best value'.

There is also the question of how such inadequate and suboptimal proposals could be put forward for public consultation without meaningful peer review, that would have revealed their deficiencies. The current consultation exercise might constitute some form of peer review, but the track record of public bodies such as Transport for the North in taking note of critical responses is poor. TfN's stated intention is to use the public's responses to the consultation to guide the work of consultants who will shortly be remitted to take the Northern Powerhouse Rail proposals to the next stage of development. However, no amount of consultants' input can remedy the fundamental flaws revealed in this report; it will simply have the effect of squandering still more public money.

There are possibly many factors to account for TfN's failure to develop a fit-for-purpose and optimised suite of railway initiatives to deliver step-change connectivity improvements, and thus stimulate the economic development of the Northern Powerhouse. However, the simplest explanation appears to lie with the unhealthy and pervading dependency of TfN's proposals upon the established HS2 scheme. The primary purpose of Northern Powerhouse Rail (and indeed the original 'HS3' concept put forward by 'One North') was to transform transpennine connectivity – so to shape Northern Powerhouse Rail around the HS2 routes which were not designed with any consideration of transpennine connectivity, would seem to be at the very least illogical, and extremely unwise.

Yet TfN failed to recognise this danger, and failed to question HS2's inappropriate routes, either in Yorkshire or in Greater Manchester. In Yorkshire, this failure has led to an HS2 route incapable of integration with any single transpennine 'HS3' route, and as a consequence it has led to the necessity for two separate transpennine routes, each requiring long and highly expensive tunnels. In Greater

Manchester, the same failure to question has led to a circuitous (and expensively tunnelled) Manchester-Liverpool route incapable of meeting its 20 minute journey time target.

Comparisons with HSUK show that the undue and unnecessary dependency of Northern Powerhouse Rail upon the established HS2 scheme will result in additional costs of at least £7 billion.

The failure of TfN's *Strategic Transport Plan* is underlined by HSUK's massively superior performance on any conceivable criterion, be it cost, connectivity, capacity or compliance with the original HS3 Specification established by 'One North'. HSUK's success in effectively meeting all 'One North' aspirations can be attributed to two simple facts – its design to robust principles of railway engineering and network performance, and its independent development, free of any undue influence from HS2 or other established scheme.

All this indicates a crucial failure on the part of Transport for the North. The requirements of the 'One North' initiative, both for reduced journey times and for wider connectivity improvements, were clear; but TfN has developed proposals for Northern Powerhouse Rail that effectively ignore most of what 'One North' originally called for. The 'One North' requirements were also fully achievable, as is demonstrated by every aspect of HSUK's performance as an efficient and well-connected rail network; but TfN has instead put forward a hugely modified scheme which is inferior in all respects, and which cannot deliver the comprehensive connectivity improvements that the North requires.

As noted previously, the primary cause of Northern Powerhouse Rail's suboptimal performance is its predication upon the established HS2 proposals. If HS2 were the well-engineered and world-leading scheme that its promoters claim it to be, then this might not matter greatly. But when HS2 fails every test[24] as an optimised national network, then these failures will inevitably spread into any scheme such as Northern Powerhouse Rail, that is based upon HS2.

These are admittedly problems outside the direct control of Transport for the North; however they are still problems that its leadership should have identified and dealt with in an appropriate manner. The appropriate and proper course of action would have been to:

a) engage with HS2 Ltd to make the necessary changes to ensure efficient integration between HS2 and Northern Powerhouse Rail; and
b) inform their political leaders and the wider public of the problem.

However, there is no indication that any of this has happened. Indeed, with senior HS2 Ltd figures on the board of Transport for the North (see Appendix C), there is a clear conflict of interest that will have made truly independent and critical questioning of the HS2 scheme extremely difficult. Instead, TfN has largely accepted HS2 as a given, and has shaped its own proposals around HS2's unmodified routes.

It is difficult to avoid the conclusion that Transport for the North's greatest priority throughout the development of Northern Powerhouse Rail has been to conform with HS2, rather than to develop and deliver the optimised scheme that will best serve the people of the North. This is what the available evidence clearly shows; the challenge is on Transport for the North (and HS2 Ltd) either to present an alternative narrative, or to withdraw their current inadequate proposals in favour of a superior scheme.

[24] HS2's inadequate performance as a national network is fully documented in *HS2 – High Speed to Failure* and *HS2 – High Speed to Nowhere*, both available on www.highspeeduk.co.uk

APPENDIX A

The Government's Scheme for the HS2 'Y-network'

HS2 is the Government's scheme for a system of new high speed lines extending northwards from:

- London to the West Midlands (Phase 1);
- The West Midlands to Manchester and the North-West (Phases 2a and 2b);
- The West Midlands to the East Midlands and Yorkshire (Phase 2b).

Together these new lines comprise the HS2 'Y-network', as depicted on Figure A1. The HS2 'Y-network' is planned ultimately to extend northwards along the axis of the West Coast Main Line to Glasgow and Edinburgh, and along the axis of the East Coast Main Line to Newcastle.

Within South and West Yorkshire, it is proposed that HS2 will serve:

- central Sheffield at the existing 'Sheffield Midland' station.
- central Leeds at a new terminus adjacent to the existing 'Leeds City' station.
- a possible parkway station located on the 'M18/Eastern' route bypassing Sheffield.

The M18/Eastern route was adopted in 2017, when earlier proposals for HS2 to serve a station at Meadowhall near Sheffield were abandoned and Sheffield Midland was instead adopted as the sole HS2 station in South Yorkshire. HS2 will connect to the East Coast Main Line near Church Fenton, to allow HS2 services to continue to York and the North-East.

Within the North-West, it is proposed that HS2 will serve:

- Crewe at the new 'Crewe Hub' station.
- Manchester Airport at a new station located 2km from the airport terminals.
- central Manchester at a new terminus station located adjacent to Manchester Piccadilly.

As yet, there are no proposals for a direct HS2 route to Liverpool. Instead, HS2 trains will transfer to the existing network at Crewe, and continue along existing tracks via Runcorn to Liverpool. HS2 will also connect to the West Coast Main Line at Bamfurlong near Wigan, to allow HS2 services to continue to Preston and Scotland.

The HS2 proposals embody two fundamental deficiencies:

- An almost complete lack of integration between HS2's new-build high speed lines and the existing 'classic' network. This leaves most second-tier cities (e.g. Milton Keynes, Coventry, Stoke, Leicester, Derby) bypassed and it prevents HS2 and the classic network from working together to form the enhanced network necessary to meet the HS2 project's fundamental objective of ***'hugely enhanced capacity and connectivity'*** between the UK's major conurbations.
- No improvement whatsoever to transpennine connections between the principal cities of the North (i.e. Liverpool, Manchester, Sheffield and Leeds). Instead, contrary to its intended effect of stimulating regional economies, HS2 as planned would have the opposite effect of concentrating connectivity and therefore economic activity upon London.

Political pressure from Northern business interests forced the Government to recognise the latter deficiency, leading to the launch of HS3 and the Northern Powerhouse in 2014.

However, the failure to integrate HS2 with other routes has gone largely unrecognised and – as noted in Section 3.6 – there has been no meaningful attempt to integrate the routes offered by HS2 and NPR to create an optimised network interconnecting the principal communities of the Northern Powerhouse.

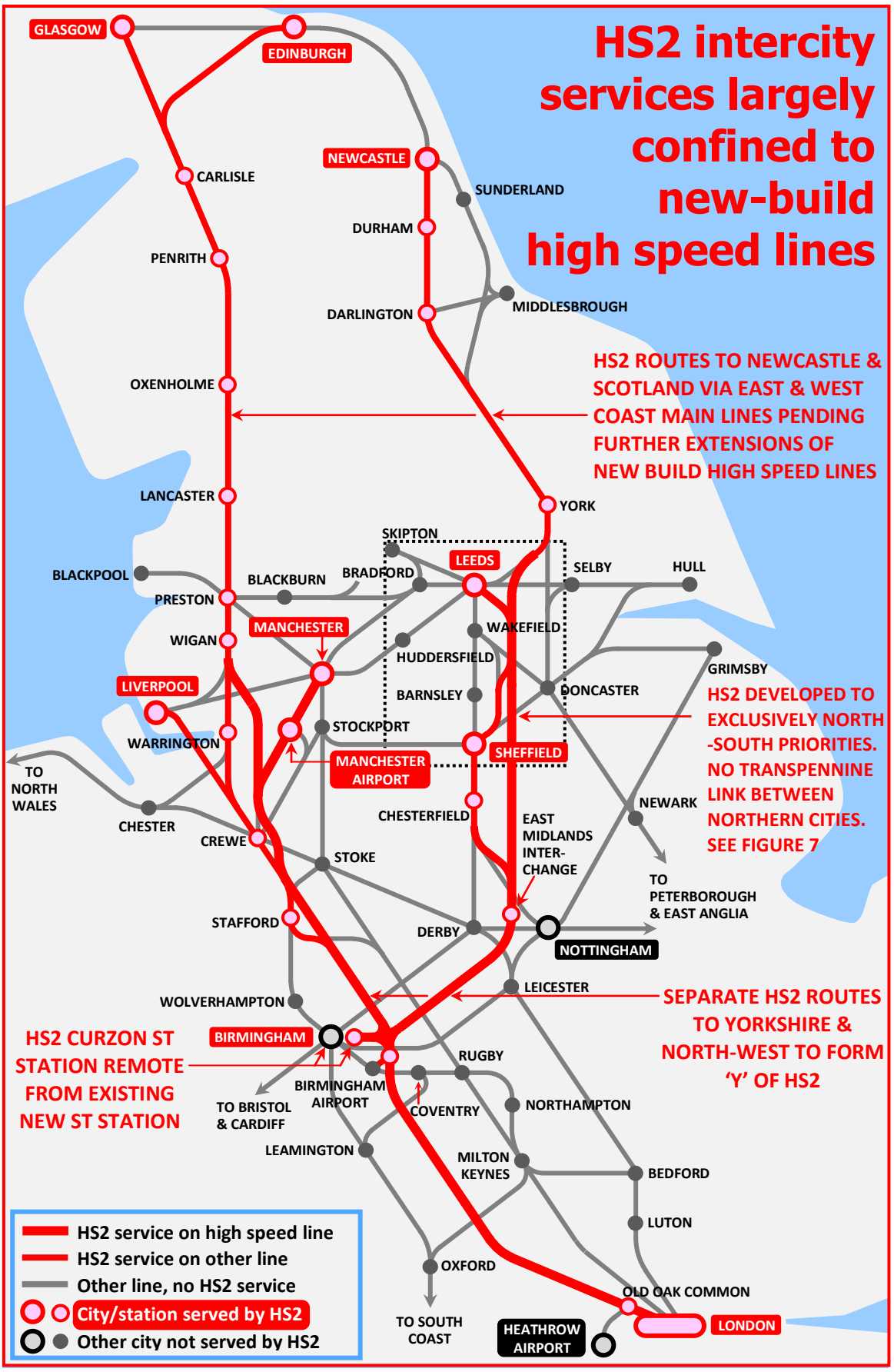


Figure A1 : HS2 'Y-network' extending from London to all major UK conurbations

APPENDIX B

The High Speed UK 'Exemplar Alternative'

Figure B1 : HSUK 'Spine & Spur' network extending to all major UK conurbations

High Speed UK has been designed as an alternative to HS2, to address its fundamental weaknesses of poor network performance/lack of integration, and its lack of connectivity between the UK regions, most particularly across the Pennines between the major cities of the North. Rather than adhere to HS2's misplaced priorities of excessive speed and exclusivity, HSUK has been developed to diametrically opposite principles of a lower design speed consistent with following existing transport corridors (in particular the M1) and of full integration with the existing network.

HSUK has been designed from the outset to complement and enhance the existing national intercity network, with a blend of:

- new-build high speed lines, including a north-south spine extending from London to Glasgow and a new transpennine route following the abandoned Woodhead corridor to Manchester and Liverpool;
- upgrading of existing routes, with close-spaced connections to the new high speed lines.
- restoration of abandoned routes.

The principal HSUK elements in the Northern Powerhouse region are shown in Figure B2 and Table B3.

HSUK's design – see Figures B1-B4 – is based upon a radically different configuration to the HS2 'Y'. HSUK's 'spine and spur' configuration includes an integral transpennine link via Woodhead that will enable efficient links between all Northern cities. With complementary direct links to Manchester Airport (again achieved through a combination of new, upgraded and restored routes), HSUK can meet all the key requirements of the HS3 journey time specification.

HSUK will serve all principal cities at their existing city centre stations, with the single exception of Sheffield where the former Sheffield Victoria station will be redeveloped as the city's primary intercity hub. In accordance with HSUK's philosophy of full integration, interchange platforms will be provided on the approaches to the existing Sheffield Midland. HSUK's achievement of comprehensive city centre access for high speed services is only possible with radical bespoke interventions in all principal cities; proposed HSUK interventions in Leeds, Bradford, Sheffield, Manchester and Manchester Airport are illustrated in Appendix E3.

HSUK's development is underpinned by comprehensive route design of over 1,000km of new railway. This has enabled development of both rigorous comparative cost estimates between HSUK and HS2, and also a 'demonstrator timetable' to show how HSUK will perform as an optimised national network.

The comparative cost estimates show HS2 and Northern Powerhouse Rail to cost around £26 billion more to build than equivalent sections of HSUK.

On all comparisons of improved connectivity and reduced journey time, HSUK vastly outperforms both HS2 and any transpennine Northern Powerhouse Rail proposals that might develop. It should particularly be noted that despite its design for a lower maximum speed (of 360km/h, as opposed to the 400km/h maximum adopted in the design of HS2's routes) HSUK can offer far greater network-wide journey time reductions. HSUK's design and proposed high speed intercity services are documented on www.highspeeduk.co.uk and in the following principal reports which are also referenced in this study:

- HSUK report *HS2 – High Speed to Failure* (2017).
- HSUK report *HS2 – High Speed to Nowhere* (2017).

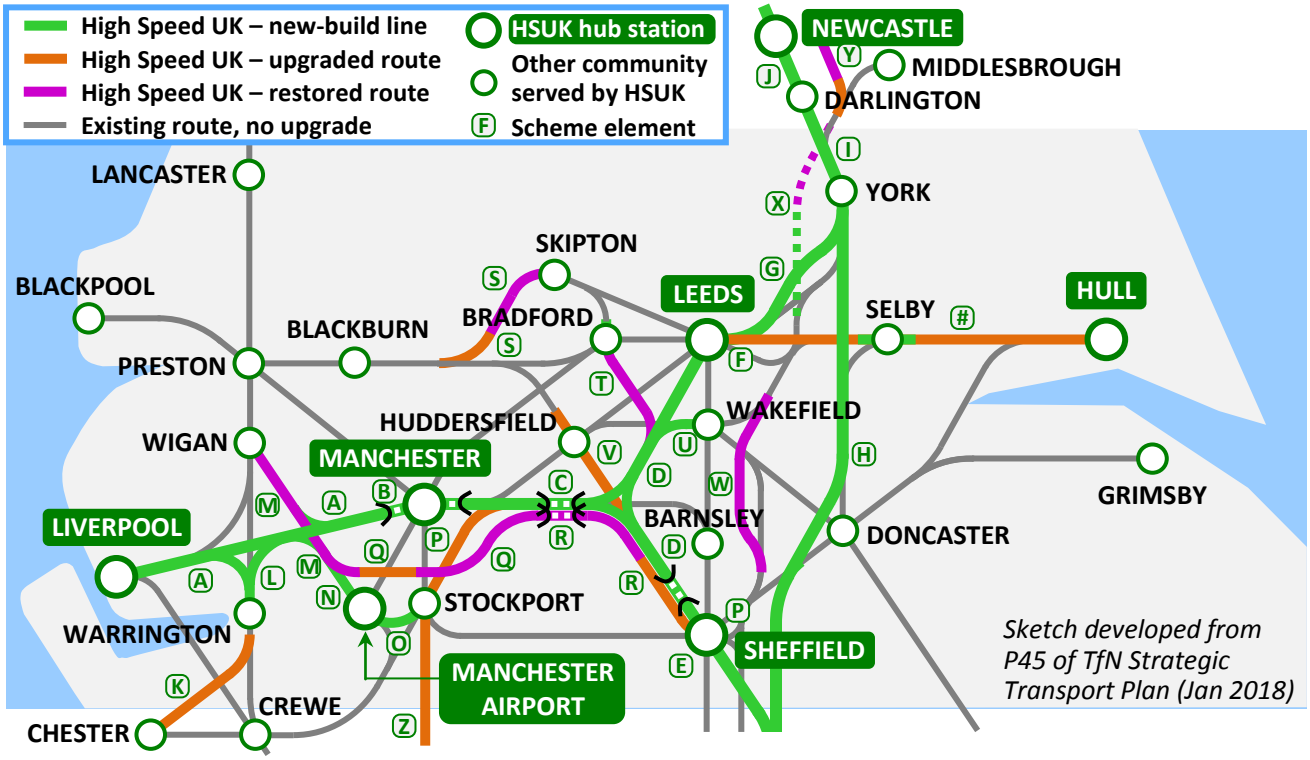


Figure B2 : HSUK Scheme Elements in Northern Powerhouse Region

A	New high speed line following route of M62 and original Liverpool–Manchester Railway	
B	East-West cross-Manchester tunnel with new underground platforms at Manchester Piccadilly. See Appendix E3.	
C	New high speed line along abandoned Woodhead corridor, with 4-tracking of existing line into Manchester	
D	New Sheffield-Leeds high speed line, running to west of Barnsley and Wakefield	
E	New Sheffield HSUK station on former Victoria site, with interchange platforms on approaches to existing Sheffield Midland station. See Appendix E3.	
F	New Stourton-Neville Hill link to increase through working at Leeds station. Farnley Viaduct to south-west restored, route to east 4-tracked. See Appendix E3.	
G	New Leeds-York high speed line, following corridor of A1(M) and A64	
H	'Yorkshire Bypass' high speed line following corridor of East Coast Main Line and serving Doncaster and York	
I	Existing York-Darlington line upgraded as 360km/h-capable high speed line	
J	New Darlington-Newcastle high speed line following corridor of A1(M) and bypassing Durham	
K	Chester-Warrington line upgraded to 200km/h standard	
L	New spurs to HSUK north of Warrington, focussing HSUK intercity services on Warrington Bank Quay	
M	CLC routes restored as western access to Manchester Airport and South Manchester freight bypass	See Appendix E3 & E7
N	New western access to Manchester Airport, transforming existing terminus into through station	
O	New eastern access to Manchester Airport from existing Stockport-Crewe line	
P	Guide Bridge-Stockport line upgraded enabling direct access to Manchester Airport from Yorkshire	
Q	Former Tiviotdale route restored as South Manchester freight bypass	
R	Former Woodhead route restored as primary transpennine freight route, part of gauge-enhanced UK 'freight spine'. Note also lorry shuttle operation from M60 at Bredbury to M1 at Tinsley, and local passenger services	
S	Skipton-Colne route restored as secondary transpennine freight route, with local passenger services also	
T	Spen Valley route restored as southern access route to Bradford, with new Bradford Central station and new cross-city route allowing services to continue to Aire Valley. See Appendix E3.	
U	Spur to Wakefield and new west-to-north chord allowing high speed services to access Wakefield Westgate	
V	Penistone-Huddersfield route and Bradley Wood chord restored to 2 tracks	
W	Midland Main Line in Yorkshire restored as part of national north-south 'freight spine'	See Appendix E7
X	New 'freight spine' following A1(M) and former 'Leeds Northern' route to Northallerton	
Y	Stillington Branch upgraded and former Leamside Line restored as continuation of 'freight spine'	
Z	Stockport-Stoke line upgraded as element of HSUK Birmingham-Manchester route for sub-60 min. journey time	
#	Proposals for upgrade of Leeds-Selby-Hull route still under development	

Table B3 : HSUK Scheme Elements in Northern Powerhouse Region

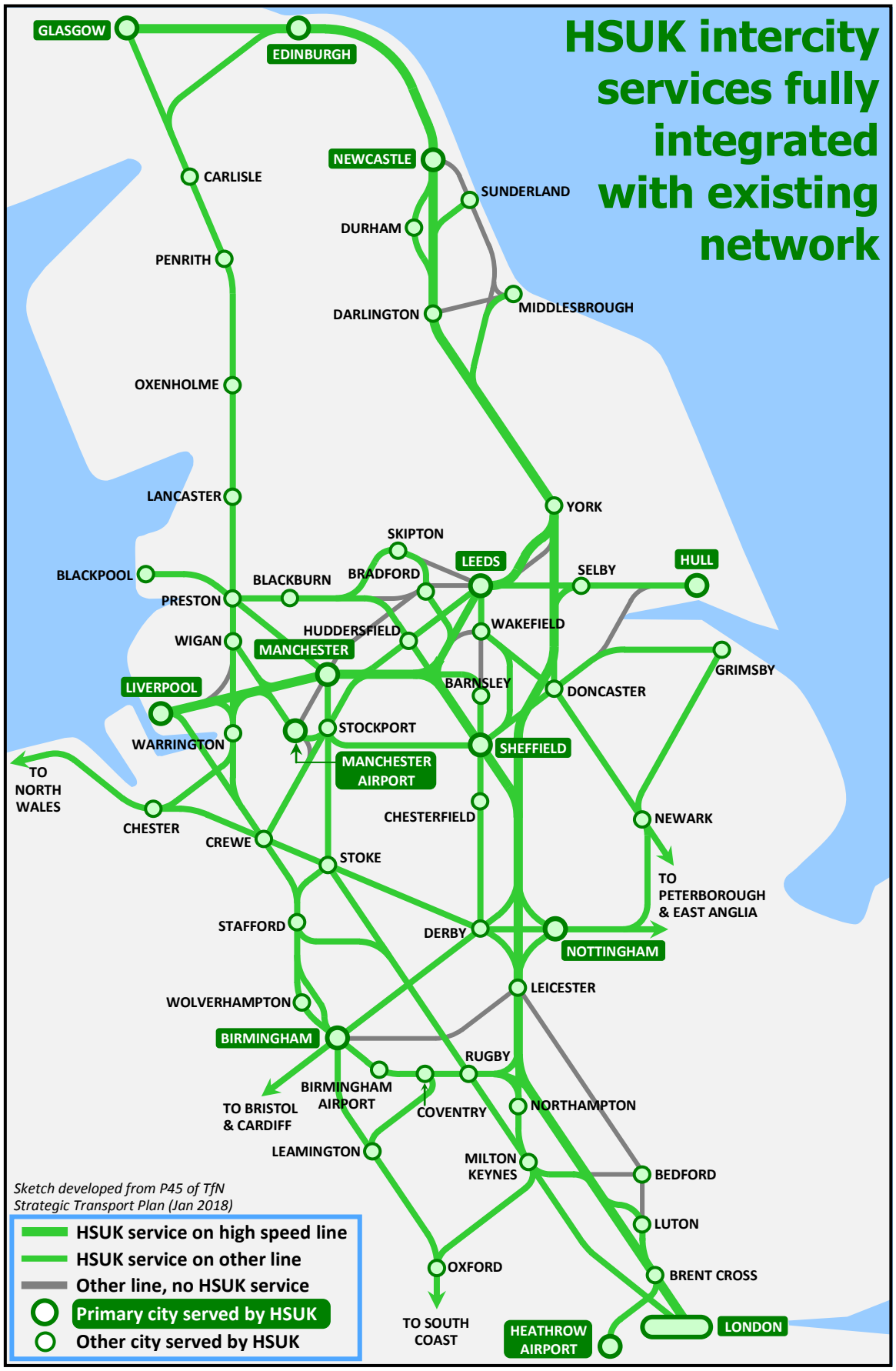


Figure B4 : HSUK Services extending to all principal UK cities

Proposed HSUK intercity services are documented in Appendix A1 of *HS2 – High Speed to Nowhere*, available on www.highspeeduk.co.uk.

APPENDIX C

Transport for the North Corporate Governance

Transport for the North (TfN) is a partnership[25] of public and private sector representatives working with central government and national transport bodies to develop and deliver strategic transport infrastructure across the North of England. TfN is governed by a Partnership Board comprising:

- Representatives of principal public transport bodies;
- Representatives of local government;
- Representatives of Local Enterprise Partnerships (LEPs).

Organisation/Region	Representative	LEP representative
Highways England	Jim O'Sullivan	
HS2 Ltd	Paul Griffiths	
Network Rail	Peter Hendy	
Cumbria & Lancashire	Cllr Keith Little (Cumbria) Cllr Phil Riley (Blackburn with Darwen) Cllr Simon Blackburn (Blackpool) Cllr Geoff Driver (Lancashire)	Jim Jackson
North-East	Cllr Nick Forbes (Newcastle)	David Land
Tees Valley	Mayor Ben Houchen (Tees Valley)	Paul Booth
York, North Yorkshire & East Riding	Cllr Carl Les (North Yorkshire) Cllr Ian Gillies (City of York) Cllr Stephen Parnaby (East Riding)	Matthew Lamb
Leeds	Cllr Judith Blake (Leeds)	Roger Marsh
Manchester	Mayor Andy Burnham (Greater Manchester)	Mike Blackburn
Sheffield	Mayor Dan Jarvis (Sheffield CR)	Martin McKervey
Hull and the Humber	Cllr Darren Hale (Hull) Cllr Matthew Patrick (North East Lincolnshire) Cllr Rob Waltham (North Lincolnshire)	Lord Haskins
Cheshire & Warrington	Cllr Rachel Bailey (Cheshire East) Cllr Samantha Dixon (Cheshire West & Chester) Cllr Terry O'Neill (Warrington)	Christine Gaskell
Liverpool	Mayor Steve Rotheram (Liverpool CR)	Robert Hough

Table C1 : Members of Partnership Board of Transport for the North

[25] https://en.wikipedia.org/wiki/Transport_for_the_North

APPENDIX D

Requirements Statement for the Northern Powerhouse Rail (HS3) scheme

BACKGROUND

The Northern Powerhouse Rail (HS3) concept was first put forward in the 'One North' initiative[26], launched in 2014 by the city councils of the principal cities of the North i.e. Liverpool, Manchester, Sheffield, Leeds and Newcastle. The essential purpose of the 'One North' initiative was to:

- Remedy the severe congestion and lack of rail connectivity that currently exist both around and between these principal Northern cities.
- Achieve a quality of connectivity on east-west transpennine rail routes equivalent to what HS2 is intended to deliver[27] on north-south routes.
- Enable necessary enhancements of the Northern economy through increasing the capacity and connectivity of the regional rail network, and in so doing achieve a wider rebalancing of the UK economy.
- Enable environmental improvements through the transfer of high-emitting road transport flows to lower-emitting rail.

To achieve these goals, the 'One North' initiative set out the following key targets to be achieved by any proposals for HS3/Northern Powerhouse Rail:

- A comprehensive specification (hereafter referred to as the 'HS3 Specification'[28]) for reduced intercity journey times between the principal cities of the North, and from these cities to Manchester Airport.
- A transformation of east-west transpennine freight routes to enable efficient connection between the region's ports and its industry.
- Establishment of a new transpennine rail route, necessary to accommodate the anticipated step-change increases in both passenger and freight flows.

Proposals for Northern Powerhouse Rail have been developed by Transport for the North (TfN) and were published for public comment and consultation on 16 January 2018.

[26] *One North: A Proposition for an Interconnected North*, 'One North', July 2014

[27] On 30th November 2015, HS2 Technical Director Andrew McNaughton informed the HS2 Select Committee that the aim of HS2 was "to deliver hugely enhanced capacity and connectivity between our major conurbations."

[28] A specification for reduced journey times between the principal cities of the North was set out in *One North: A Proposition for an Interconnected North*, 'One North', July 2014 (P27).
This specification was endorsed and amplified with a requirement for train frequencies in *The Northern Transport Strategy: Spring 2016 Report,* Transport for the North, March 2016 (P25).

A 'REQUIREMENTS STATEMENT' FOR IMPROVED TRANSPENNINE LINKS

To guide the development of efficient and optimised HS3/Northern Powerhouse Rail links, the following 'Requirements Statement' has been formulated. This comprises a set of balanced performance requirements intended to ensure that the physical intervention of new or upgraded railway lines will form the integrated network necessary to deliver maximised economic and environmental benefits to the widest spread of population.

1. NORTHERN POWERHOUSE RAIL (NPR) JOURNEY TIMES

The new or upgraded routes proposed for the HS3/Northern Powerhouse Rail scheme must be capable of offering the reduced journey times (between Liverpool, Manchester, Manchester Airport, Sheffield, Leeds and Newcastle) set out in the HS3 journey time specification established by 'One North' (see Figure 1).

2. NPR CAPACITY FOR INCREASED TRAIN FREQUENCY

The routes and stations proposed for the HS3/Northern Powerhouse Rail scheme must provide the extra capacity for:

a) new NPR intercity services operating at the specified frequency;
b) step-change increased frequency in more local services (see Item 3);
c) increased freight services (see Item 7).

3. NPR STATION LOCATION AND CONFIGURATION

The stations (either new stations, or upgrades of existing facilities) proposed for HS3/Northern Powerhouse Rail must provide the extra capacity necessary to operate both the envisaged increased rail services stipulated by the HS3 Specification and the required step-change increase in local services. As a broad guideline, there should be an aspiration for local services to be doubled in frequency.

This would generally require:

a) city centre stations, fully integrated with local transport networks and with HS2;
b) where practicable, intercity services and local services operating on different tracks; and
c) 'through' (rather than terminus) configuration.

4. LONGER-DISTANCE NPR JOURNEYS

The HS3/Northern Powerhouse Rail scheme must offer enhanced 'through' journeys on longer-distance routes e.g. Liverpool to Hull or Newcastle, that are not covered explicitly in the HS3 Specification. It would not be acceptable for (say) the Liverpool-Manchester NPR route to terminate at Manchester Piccadilly, whilst the Manchester-Leeds NPR route starts from Manchester Victoria.

5. INCLUSION OF SECOND-TIER CENTRES AND OTHER COMMUNITIES/ NORTHERN POWERHOUSE NETWORK CONNECTIVITY

The benefits of the HS3/Northern Powerhouse Rail scheme must extend from the primary centres (i.e. Liverpool, Manchester, Manchester Airport, Sheffield, Leeds and Newcastle) to create a network covering the 'second-tier' centres (e.g. Bradford, York, Warrington, Preston, all in the 100,000 – 500,000 population range), and also to less populous/more peripheral communities, that are not addressed explicitly in the HS3 Specification.

For the purposes of testing performance against this Requirements Statement, the following second-tier centres have been considered:

> Bradford, Chester, Crewe, Darlington (for Teesside), Doncaster, Huddersfield, Hull, Preston, Stockport, Warrington, York.

6. INTEGRATION OF NPR WITH HS2

HS3/Northern Powerhouse Rail services must be integrated with those of HS2 to ensure seamless links to neighbouring cities outside the Northern Powerhouse region e.g. Nottingham, Derby, Leicester, Stoke, Edinburgh and Glasgow.

7. NPR VISION FOR RAILFREIGHT

The HS3/Northern Powerhouse Rail scheme must offer a holistic vision for transformed railfreight links across the North. As a minimum, the scheme must address the following existing deficiencies:

a) the congestion on existing transpennine road routes, in particular the A628T 'Woodhead' road between Manchester and Sheffield;
b) the lack of capacity on existing transpennine rail routes;
c) the lack of any east-west cross-Manchester routes avoiding Piccadilly and Victoria stations;
d) the restricted structure gauge existing on all routes, that prevents the operation of 'W12' container traffic and other large wagon formats;
e) the poor connectivity of the region's ports (in particular Liverpool, Immingham, Hull and Teesport) to their hinterlands;
f) the limited extent of these hinterlands, generally restricted by the lack of capacity on transpennine rail routes.

The ideal solution would be freight services operating on separate tracks, largely segregated from passenger operations.

8. MINIMISED DEPENDENCY UPON HS2

The HS3/Northern Powerhouse Rail scheme should be a self-standing project, with minimised dependency upon and predetermination by HS2 and other projected schemes. This is essential both to optimise the performance of HS3/Northern Powerhouse Rail in connecting Northern communities, and also to enable its earliest completion.

Where conflicts exist between established HS2 proposals and the requirement for optimised connectivity between Northern communities, these elements of HS2 should be reviewed and amended as necessary to ensure full integration and optimum overall performance.

9. A COMPLETE VISION FOR IMPROVED RAIL LINKS BETWEEN THE MAJOR COMMUNITIES OF THE NORTHERN POWERHOUSE

The HS3/Northern Powerhouse Rail scheme must offer a complete vision for achieving:

a) the network of accelerated routes between the principal centres of the North, as set out in the HS3 Specification.
b) equivalent benefits for railfreight links across the Northern Powerhouse region.
c) the wider stipulations of this Requirements Statement.

If some routes have been prioritised over others, the basis for this choice must be made clear.

10. TECHNICAL EXCELLENCE FOR THE NORTHERN POWERHOUSE

It is naturally assumed that the HS3/Northern Powerhouse Rail scheme that is finally adopted will constitute technical best practice in providing an optimised regional and national railway network, and will thus maximise the opportunities for sustainable economic growth. In this case 'technical best practice' would be represented by the technical solution best able to:

a) meet the HS3 Specification; and
b) fulfil all the other rail transport requirements set out above.

‘10 Smart Questions’ regarding Northern Powerhouse Rail (NPR) proposals published by Transport for the North (TfN) January 2018

1. NORTHERN POWERHOUSE RAIL JOURNEY TIMES

Can the routes proposed by TfN meet the HS3 journey time specification?

2. NPR TRAIN FREQUENCY

Can TfN’s proposed routes and stations provide the extra capacity both for new NPR services operating at the specified frequency, and also for step-change growth in more local services?

3. NPR STATION LOCATION AND CONFIGURATION

Do the stations proposed by TfN provide the extra capacity necessary to operate both the envisaged increased rail services stipulated by the HS3 Specification and the required step-change increase in local services? This generally requires city centre stations fully integrated with local transport networks and with HS2, and ‘through’ (rather than terminus) configuration.

4. LONGER-DISTANCE NPR JOURNEYS

Do the TfN proposals offer enhanced ‘through’ journeys on longer-distance routes e.g. Liverpool to Hull or Newcastle, that are not covered explicitly in the HS3 Specification?

5. INCLUSION OF SECOND-TIER CENTRES AND OTHER COMMUNITIES

How will the TfN proposals extend the benefits of Northern Powerhouse Rail to second-tier centres e.g. Bradford, York, Warrington, Preston, and also to less populous/ more peripheral communities? If these centres are bypassed or otherwise excluded, how will adverse economic impacts be avoided?

6. INTEGRATION OF NPR WITH HS2

How will Northern Powerhouse Rail be integrated with HS2 to ensure seamless links to neighbouring cities outside the Northern Powerhouse region e.g. Nottingham, Derby, Leicester, Stoke, Edinburgh and Glasgow?

7. TfN VISION FOR RAILFREIGHT

How will the TfN proposals deliver benefits for railfreight, noting in particular the requirement of the proposed Liverpool Superport for improved cross-Manchester and transpennine freight links?

8. MINIMISED DEPENDENCY UPON HS2

Can the TfN proposals be developed to deliver optimum results without dependency upon or predetermination by the established HS2 proposals?

9. TfN VISION FOR IMPROVED RAIL LINKS BETWEEN PRINCIPAL CENTRES OF THE NORTHERN POWERHOUSE

Do the TfN proposals offer a complete vision for achieving the network of accelerated routes and enhanced railfreight links between the principal centres of the North, as set out in the HS3 Specification? If some routes have been prioritised over others, on what basis was this choice made?

10. TECHNICAL EXCELLENCE FOR THE NORTHERN POWERHOUSE

Do the TfN proposals represent the best technical solution to meet the HS3 Specification and fulfil all the other rail transport requirements set out above, that are necessary to ensure sustainable economic growth in the Northern Powerhouse Region?

APPENDIX E1

Adherence to 'One North' Journey Time Targets (ref 7.1.1)

The journey times set out in Table E1.3 are based upon the routes depicted in Figures E1.1 and E1.2.

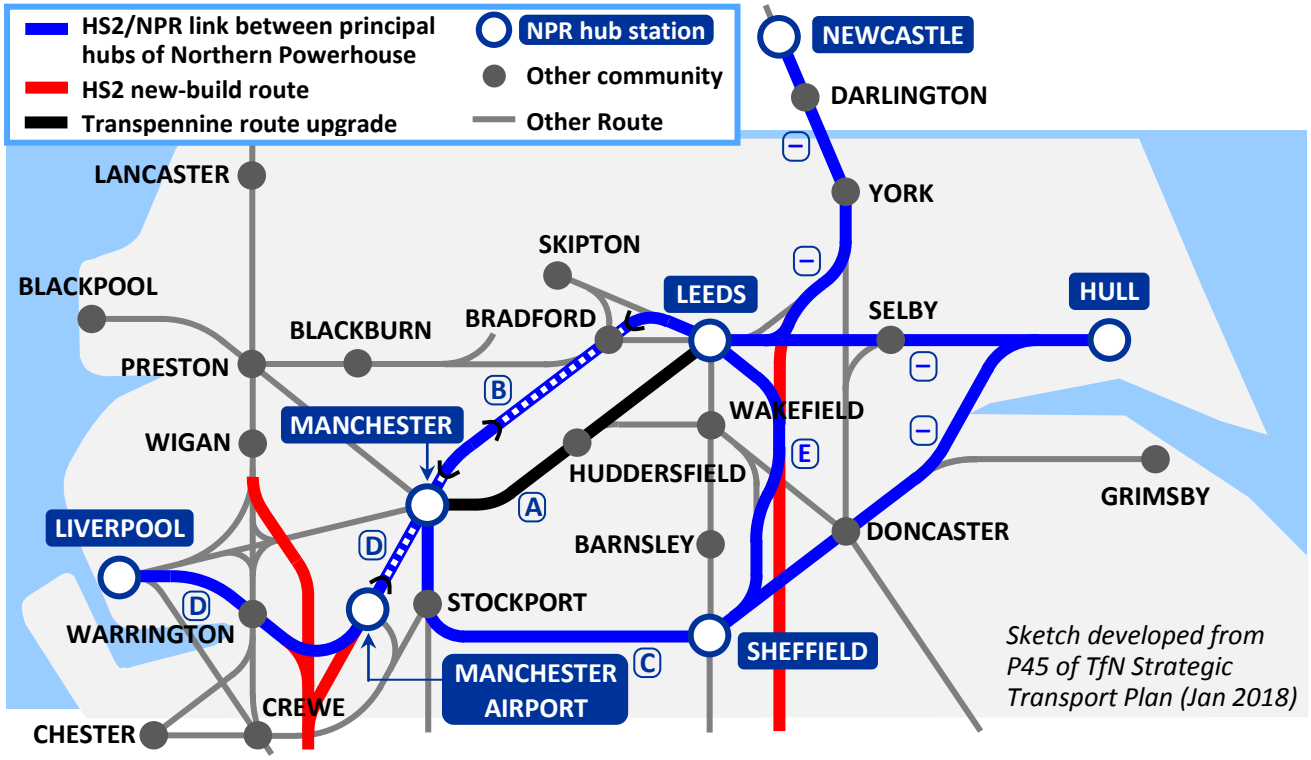


Figure E1.1 : NPR Routes Analysed to Determine Intercity Journey Times

(See Figure A (E1.6), Figure B (E1.7), Figure C (E1.9), Figure D (E1.11) and Figure E (1.13))

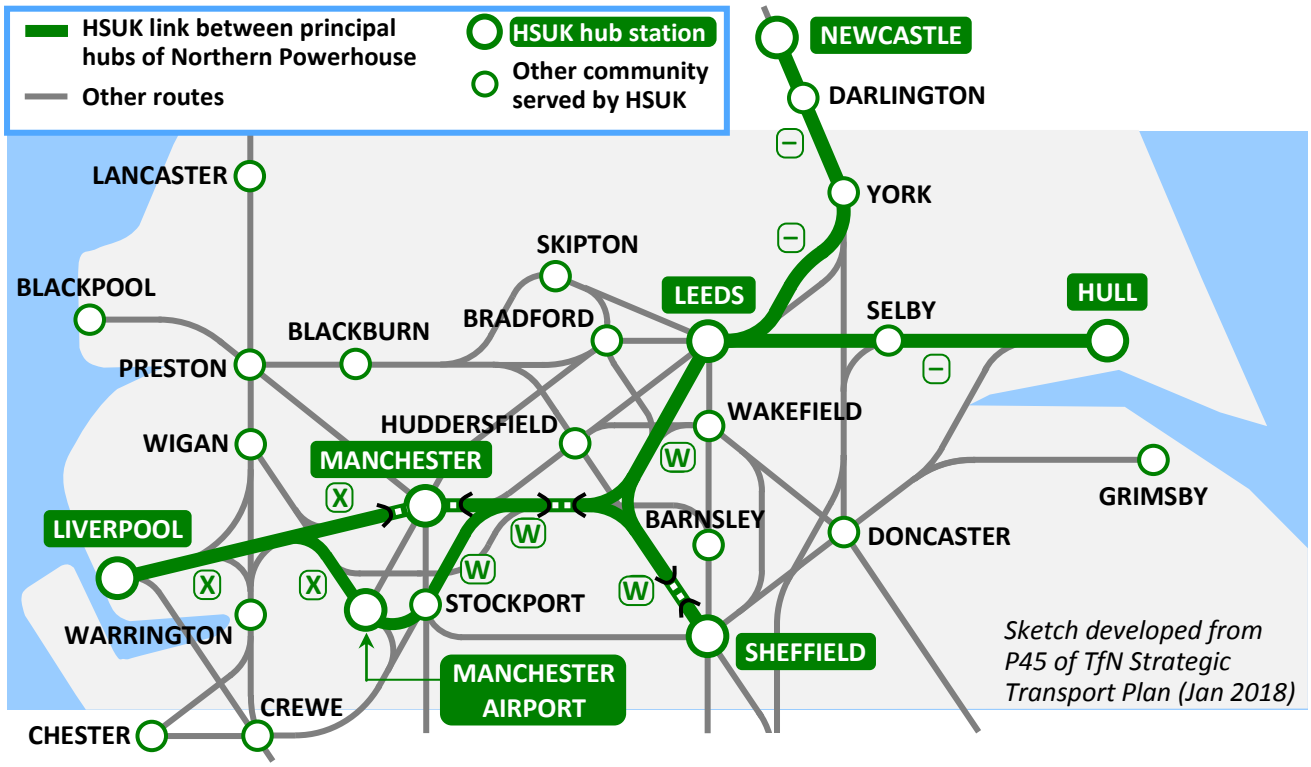


Figure E1.2 : HSUK Routes Analysed to Determine Intercity Journey Times

See Figure W (E1.15) and Figure X (E1.17)

Journey between Northern Powerhouse cities	**Existing journey time** (mins)	**Specified journey time** (mins)	**Specified train freq[v]** (tph)	**NPR journey time** (mins)	**Further Information Provided in Section…**	**HSUK journey time** (mins)	**Further Information Provided in Section…**
Liverpool - Manchester	**32**	**20**	**6**	**28**	**E1.3**	**19**	**E1.6**
Manchester - Sheffield	**48**	**30**	**6**	**40**	**E1.2**	**23**	**E1.5**
Manchester - Leeds	**49**	**30**	**6**	**30**	**E1.1**	**26**	**E1.5**
Sheffield - Leeds	**40**	**30**	**6**	**28**	**E1.4**	**19**	**E1.5**
Manchester – MAN Airport	**13**	**10**	***high***	**13**	**E1.3**	**13**	**E1.5/6**
Leeds – MAN Airport	**62**	**40**	**??**	**47**	**E1.1/3**	**37**	**E1.5**
Sheffield – MAN Airport	**73**	**30**	**2**	**60**	**E1.2/3**	**34**	**E1.5**
Liverpool – MAN Airport	**65**	**30**	**2**	**28**	**E1.3**	**26**	**E1.6**
Leeds - Newcastle	**87**	**60**	**4**	**70**	**–**	**51**	**–**
Leeds - Hull	**55**	**45**	**2**	**??**	**–**	**??**	**–**
Sheffield - Hull	**86**	**60**	**2**	**??**	**–**	**??**	**–**

Journey time meeting HS3 Specification

Journey time failing to meet HS3 Specification

Table E1.3 : NPR & HSUK Performance in meeting 'One North' Journey Time targets

General notes:

- All journey times include a standard 'dwell time' allowance of 2 minutes at through stations.
- NPR journey times via Manchester Piccadilly terminus (i.e. Sheffield to Manchester Airport) are enhanced by 3 minutes for longer standing time in platforms.
- Other NPR journeys through Manchester (i.e. Leeds to Manchester Airport) assume a 'through' station with underground platforms located below Manchester Piccadilly.
- NPR Journey times to Manchester Airport include 8 minute allowance for transfer from proposed 'Manchester Airport' station on the HS2 Manchester spur to the existing Manchester Airport station, located in a centroidal position between all 3 airport terminals.
- Neither NPR nor HSUK are capable of reducing existing journey times from Manchester to Manchester Airport, therefore the existing journey time is quoted.
- Neither TfN nor HSUK have put forward detailed proposals for routes to Hull.

These journey time comparisons are informed by:

- Detailed route design undertaken by HSUK in the development of the HSUK scheme.
- Publicly available information on HS2 Ltd's proposals for the HS2 'Y-network'.
- TfN's own proposals as published in the January 2018 *Strategic Transport Plan*.
- Calculation of journey times for HSUK routes, validated against published timings for HS2.

HSUK journey times are developed from detailed route alignment design, undertaken to 1:25,000 scale. This design (augmented where necessary by vertical alignment design) defines the horizontal alignment in terms of straights, transitions and circular curves. This allows the speed capability of a route to be

designed at any point along its length. With due allowance for the train's acceleration and deceleration, it is possible to calculate journey times for any element of the HSUK network. HSUK's bespoke software has been validated against published route data and published timings for HS2's proposed routes from London to Birmingham, Manchester and Leeds.

HSUK's methodologies for the calculation of journey times are equally applicable to the Northern Powerhouse Rail new build routes proposed by Transport for the North. Where the TfN *Strategic Transport Plan* shows an NPR route (e.g. Manchester to Liverpool) following an established HS2 route (e.g. the HS2 Manchester Spur and the trunk route northwards towards Wigan), the route is already partially defined. The remainder of the route, following the M62 to Liverpool, can then be 'borrowed' from the HSUK route design library. From this composite route, a journey time can then be calculated.

In other cases, where the NPR route is based upon an upgrading of an existing route (e.g. Manchester to Sheffield), a slightly different methodology has been adopted:

- Validate calculation methodology by using route data taken from Network Rail Sectional Appendix to derive existing journey time.
- Review Ordnance Survey mapping to determine radii of curvature for full length of route.
- Calculate maximum possible speed for each curve (assuming that it is feasible to upgrade the route to the maximum potential speed of each curve).
- Calculate journey time for 'upgraded' route.
- (Assuming that no major realignment on the surface is possible), develop options for new tunnelled routes to bypass the curves, and thereby create a new alignment that is shorter and straighter, to attain the specified journey time.

It should be noted that the 'upgraded' journey time is essentially a theoretical concept. It assumes that the route can be upgraded for express passenger traffic to the maximum potential of the track geometry, and that the needs of other traffic (e.g. freight and local passengers) can also be accommodated. In most cases however, the multiple needs of a mixed-traffic railway which have so far prevented the route from being upgraded to the maximum potential of the track geometry will continue to apply.

No allowance has been made for tilting trains. These can operate at up to 15% higher speed around curves, but calculations demonstrate that these will only offer relatively small (around 5%) additional journey time savings. In practical terms, the journey time that will be achieved from the upgrading exercise is likely to be around 10% greater than the theoretical calculated journey time. This margin of difference is likely to exceed any gains that will accrue from the use of tilting rolling stock.

Without exception, even the calculated journey time for the upgraded route – which represents the shortest theoretically possible journey time – will be considerably greater than the journey time targets laid out in the HS3 specification. It is then necessary to introduce a further intervention to achieve the specified journey time.

Given that the curves on existing routes are generally dictated by the topography, the only intervention that can overcome the topography in an environmentally acceptable manner will be a long 'base' tunnel. This will create the shorter and straighter route capable of accommodating the much higher speeds (assumed to be 230km/h maximum, contrary to the stated TfN preference for 200km/h maximum speed, as noted in Section 4.3) necessary to meet the journey time target.

E1.1 Proposed NPR Manchester-Leeds route

Manchester to **Leeds**	Journey Time required by HS3 Specification	**30**	Journey Time offered by Northern Powerhouse Rail	**30**

Over the past 2 years, press reports have consistently indicated that Transport for the North's initial strategy to achieve a 30 minute journey time from Manchester to Leeds was focussed upon an upgrade of the existing 'Diggle' route via Huddersfield. These reports also indicated that NPR services on this route would depart from Manchester Victoria.

To reduce an existing journey time along a well-engineered main line route from 49 minutes to 30 minutes always seemed an improbable prospect, and impossible to achieve without major interventions. TfN has never offered any indication of any interventions that have been developed to achieve the required 39% journey time reduction, and instead it has been necessary to:

a) determine the maximum feasible speed around the curves of the existing route, and thus calculate the minimum achievable journey time through an on-line upgrade.
b) develop the further interventions necessary to achieve the specified journey time.

Calculations indicate that a reduced journey time of 40 minutes (i.e. an 18% reduction), with a single stop at Huddersfield, can be achieved if the route is upgraded to the maximum potential of the track geometry. This is broadly in line with Network Rail's current plans to upgrade the route, although the following questions remain outstanding:

- Can the enhanced journey times be achieved with the less powerful electro-diesel hybrid rolling stock that has been proposed in lieu of the deferred transpennine electrification, with conventional electrified trains operating?
- Are the enhanced journey times and increased frequencies compatible with the operation of local services to stations that will not be served by Northern Powerhouse Rail?
- How will the necessary works be undertaken without causing unacceptable disruption to services?

	Route Section	**Length**	**HSUK Analysis of works necessary for specified journey time**
1	Manchester Victoria to Clayton Bridge	5km	Existing route upgraded to 4 tracks, and accelerated to with major track realignment at Miles Platting junction.
2	Clayton Bridge to Diggle	15km	New route including 10km long tunnel and 3km long viaduct; 230km/h maximum speed assumed.
3	Diggle to Marsden	5km	Redundant bores of Standedge Tunnel reinstated, with clearance works as necessary.
4	Marsden	2km	New tunnel 1.5km long to bypass existing curves at Marsden.
5	Marsden to Heaton Lodge Jn	15km	Existing 2-track route from Marsden through Huddersfield to Heaton Lodge Junction reinstated to 4 tracks. Potential to increase speed limited by reintroduction of 4 tracks.
6	Heaton Lodge Jn to Farnley	15km	New route with tunnel 14km long; 230km/h maximum speed assumed.
7	Farnley to Leeds	3km	Route upgraded to 4 tracks, no increase in speed.

Table E1.4 : Works for NPR Manchester – Leeds Route via Huddersfield (ref Figure A)

To gain the further 10 minutes' savings to achieve the specified journey time of 30 minutes, the suite of interventions listed in Table E1.4 above, and illustrated in Figure A (E1.6), is deemed necessary.

With an overall requirement for nearly 30km of new or upgraded tunnel (with 2 sections of tunnel both longer than any existing UK main line tunnel), it is believed that Transport for the North has switched its focus to other routes where a similar length of tunnel might create greater benefits (and at the same time avoid the self-evident incompatibility of NPR services operating from different Manchester stations). This logic path led naturally to TfN's consideration of an alternative transpennine route via Bradford.

Such a route – which springs from a similar consideration of the much slower and more circuitous 'Calder Valley' route, running via Halifax and Bradford Interchange – is set out in Figure B (E1.7) and summarised below in Table E1.5.

	Route Section	**Length**	**HSUK Analysis of works necessary for specified journey time**
1	Manchester Picc. to Miles Platting	3km	New tunnel 2km long from underground platforms at Manchester Piccadilly to near Miles Platting Junction.
2	Miles Platting to Gale Jn	22km	Existing 'Calder Valley' route from Miles Platting Junction through Rochdale to Littleborough upgraded to 4 tracks and accelerated 160/200km/h operation.
3	Gale Jn to Calverley Jn	35km	New tunnel 33km long from Littleborough to Calverley on Aire Valley line; 230km/h maximum speed assumed.
4	Potential New NPR Station at Halifax??	--km	Routeing of new tunnel close to Halifax raises possibility of new underground station to improve Halifax's current poor connectivity.
5	New NPR Station at Bradford	--km	New station at Bradford, most likely to be underground. Diagram assumes station integrated with existing Bradford Interchange Station but no information so far released as to precise location.
6	Calverley Jn to Leeds	11km	Existing 2-track Aire Valley route from Calverley to Leeds reinstated to 4 tracks (but no increase in line speed). Station recently built at Kirkstall Forge to be reconstructed to accommodate 4 tracks.

Table E1.5 : Works for NPR Manchester – Leeds Route via Bradford (ref Figure B)

HSUK's analysis indicates that to be compatible with onward services to Liverpool (see Section E1.3), TfN's chosen route will start from underground platforms at Manchester Piccadilly. It seems likely to follow the existing 'Calder Valley' route via Rochdale, which would be upgraded to higher speed and provided with 4 tracks (initial review of this route indicates no major issues arising). From Littleborough, the route would adopt a tunnelled alignment, with stations at Bradford and (potentially) also at Halifax.

There is currently no indication from TfN of a favoured location for Bradford's Northern Powerhouse Rail station. From a connectivity perspective, the station would be ideally located below the existing terminus stations at either Bradford Interchange or Bradford Forster Square (and it should be noted that there is no prospect of NPR achieving an improved connection between the stations). However, from a cost perspective, other locations may be favoured, especially if they were to permit surface construction – but this would of course be at the expense of a poorly-connected peripheral parkway location.

The tunnel would then emerge into the Aire Valley at Calverley, and follow the existing main line to Leeds. To avoid conflict with local passenger and anticipated freight traffic (see Section 7.1.7) and also achieve the specified service frequency it would be necessary to restore the original 4-track alignment, and this would require complete reconstruction of the recently-built Kirkstall Forge station.

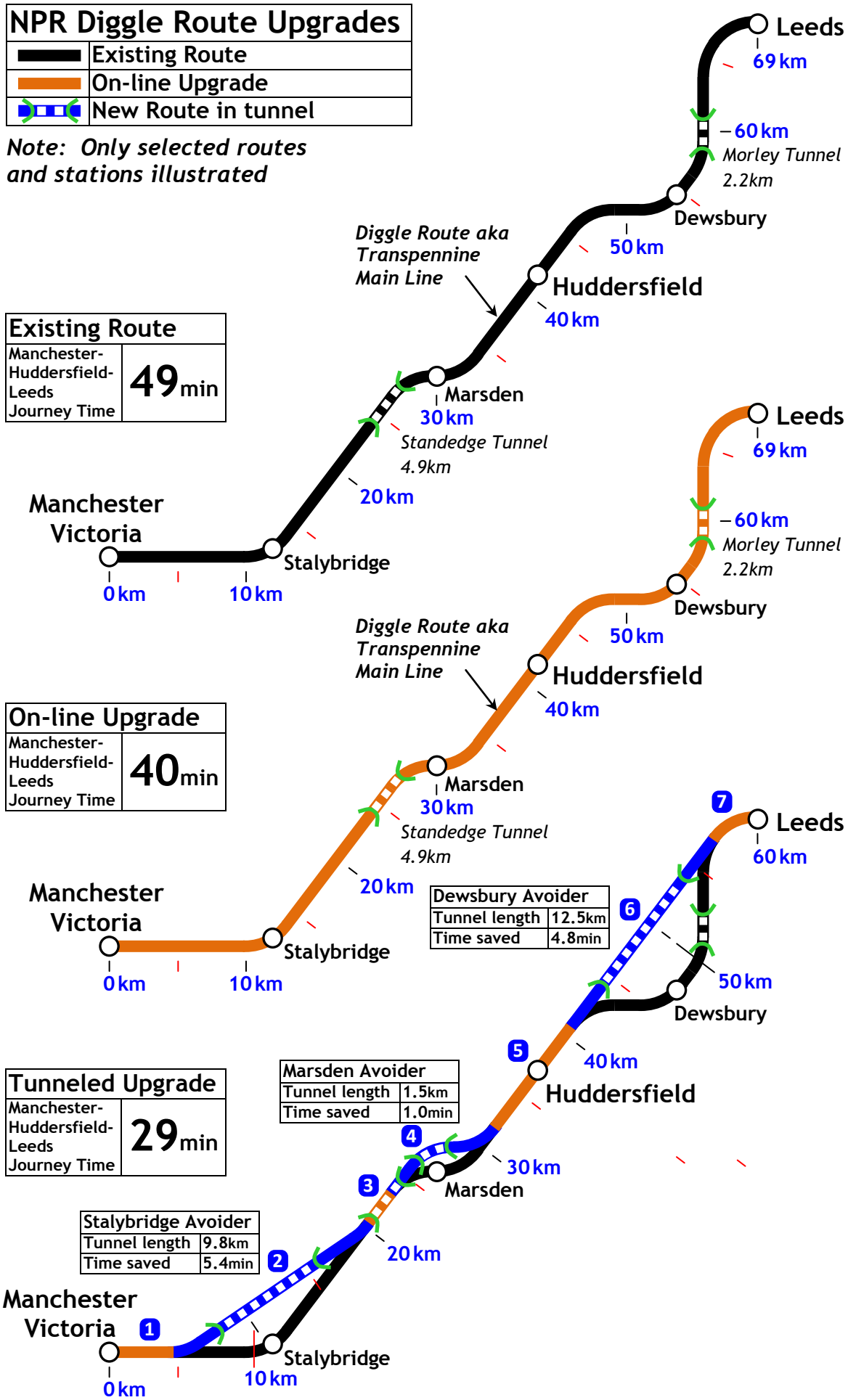


Figure A (E1.6) : NPR Journey Time Performance along Manchester-Leeds 'Diggle' route

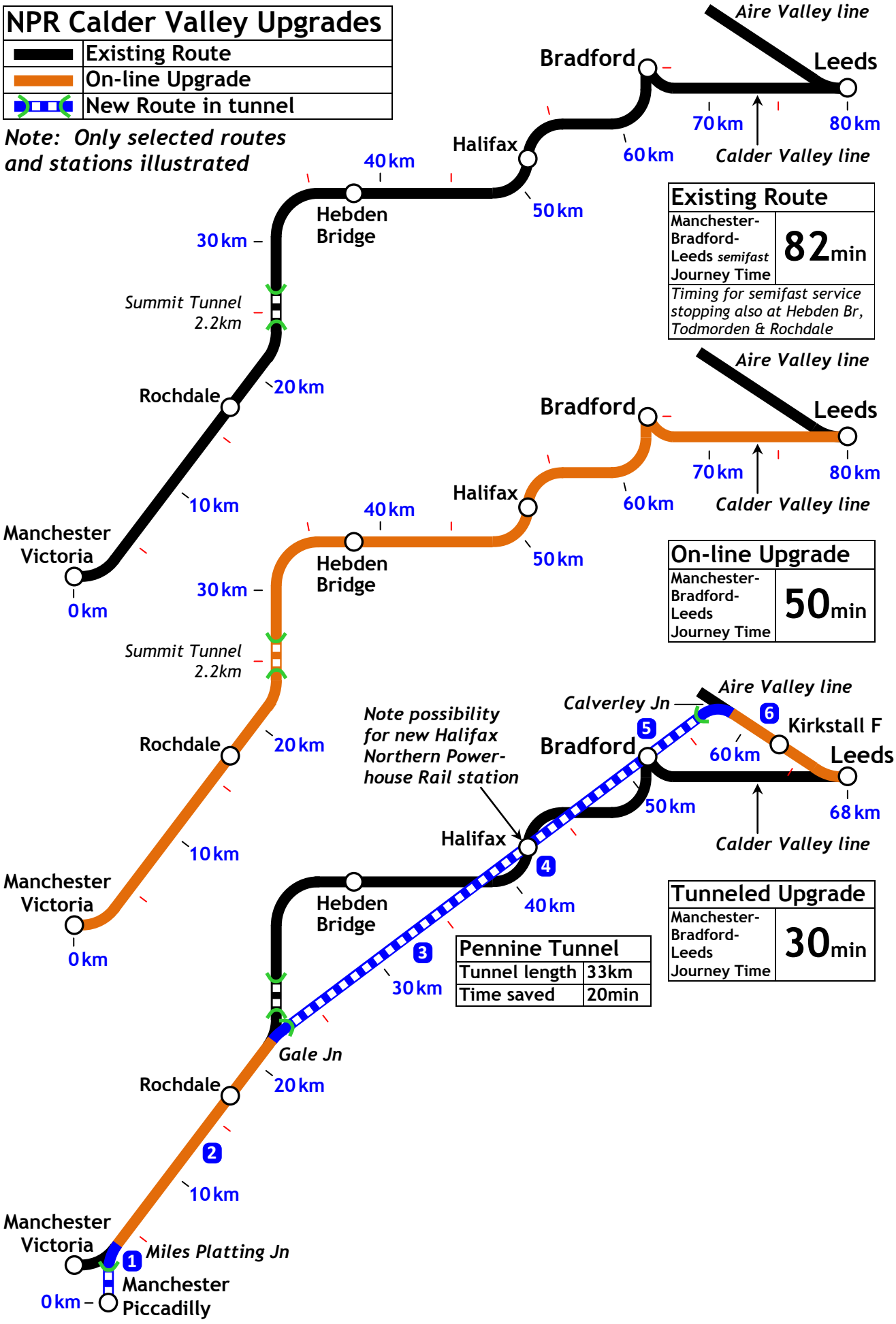


Figure B (E1.7) : NPR Journey Time Performance along Manchester-Leeds corridor

E1.2 Proposed NPR Manchester-Sheffield route

Manchester to **Sheffield**	Journey Time required by HS3 Specification	**30**	Journey Time offered by Northern Powerhouse Rail	**40**

HSUK analysis of the existing 'Hope Valley' route from Manchester via Stockport to Sheffield indicates that a 40 minute journey time is the best achievable through an online upgrade of the existing route. All upgrades would be concentrated on the 'transpennine' sections of route; sections along the existing London-centric West Coast Main Line (from Manchester through Stockport to Edgeley Junction, and along the Midland Main Line (from Dore to Sheffield) are deemed incapable of generating significant further journey time savings.

With a shortfall of 10 minutes between the 40 minute 'upgraded' journey time and the 30 minute target set by 'One North', it is necessary (as with the other transpennine routes under consideration) to contemplate major tunnelled interventions to achieve the extra journey time savings. Again, a tunnel around 33km long from New Mills to Dore will be required. Such a tunnel – longer by far than the longest tunnel currently existing on the UK rail network – would avoid any incursion into the Peak District National Park.

However, for the purposes of the connectivity analyses undertaken in this report, the Manchester-Sheffield route will continue to be considered as an upgraded route, with a journey time of 40 minutes, until such time as Transport for the North make a definitive declaration that they are contemplating construction of a new route broadly in accordance with Table E1.8 and Figure C (E1.9) below. Only with such a route can Northern Powerhouse Rail offer both the specified accelerated journey time and the conflict-free route required to achieve both this journey time and the specified 6 train per hour service frequency.

	Route Section	Length	HSUK Analysis of works necessary for specified journey time
1	Manchester Picc. to Edgeley Junction	10km	No practicable upgrade for existing 4-track route from Manchester Piccadilly through Stockport to Edgeley Junction.
2	Edgeley Junction to Hazel Grove	4km	Existing 2-track route from Edgeley Junction to Hazel Grove upgraded to 4 tracks to avoid conflicts with local traffic.
3	Hazel Grove to New Mills	8km	Hazel Grove Chord upgraded to 2 tracks and existing 2-track route to New Mills resignalled to allow 200km/h operation.
4	New Mills to Dore	34km	New tunnel 33km long from New Mills to Dore near Sheffield; 230km/h maximum speed assumed.
5	Dore to Sheffield	6km	No upgrade required for existing 2-track route from Dore to Sheffield.

Table E1.8 : Works for NPR Manchester – Sheffield route via Hope Valley (ref Figure C)

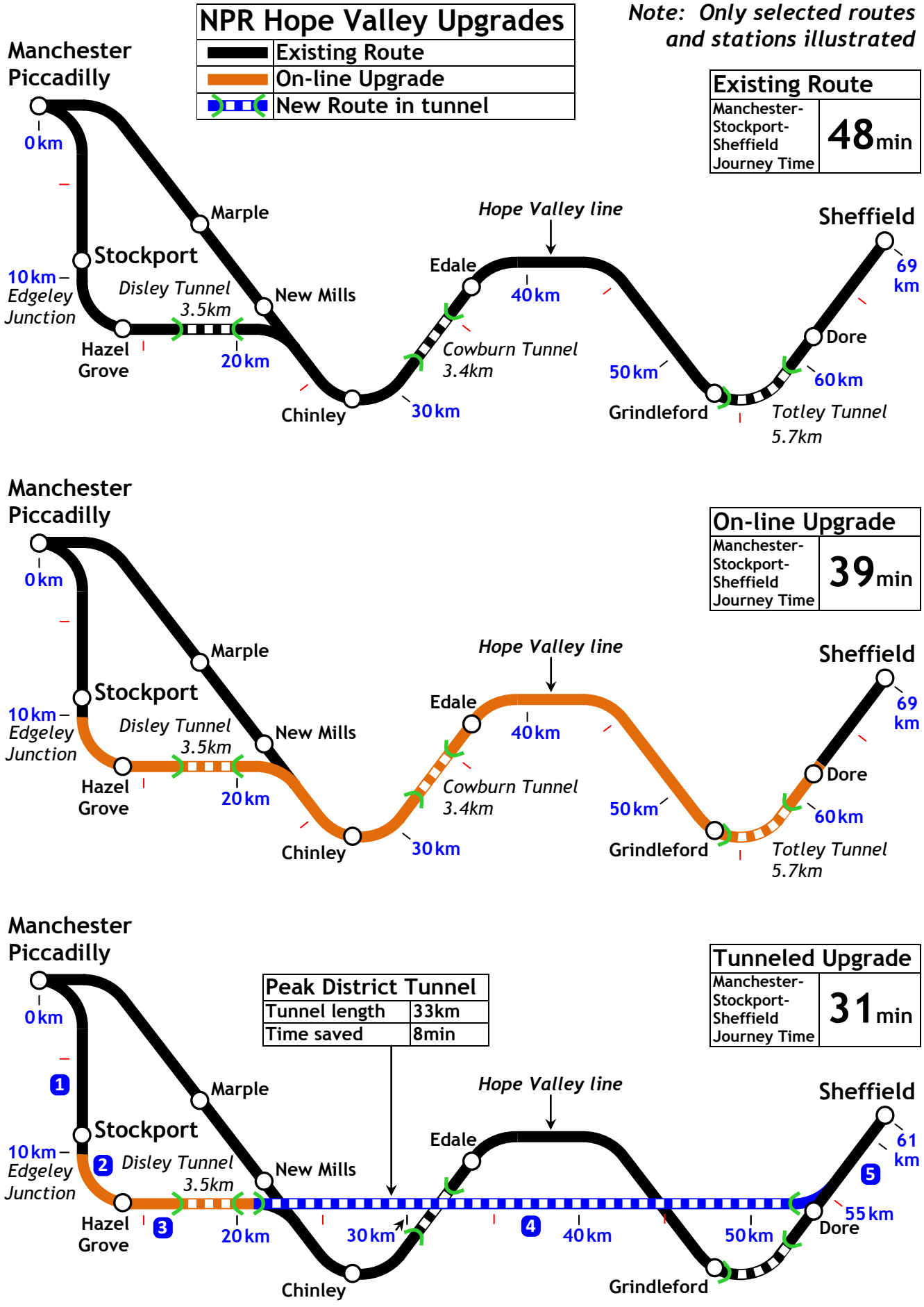


Figure C (E1.9) : NPR Journey Time Performance along Manchester-Sheffield corridor

E1.3 Proposed NPR Liverpool-Manchester route

(Route to Manchester Airport also illustrated)

Liverpool to **Manchester**	Journey Time required by HS3 Specification	**20**	Journey Time offered by Northern Powerhouse Rail	**28**

HSUK analysis confirms that the 28 minute Liverpool-Manchester journey time claimed by TfN for its proposed new-build route from Liverpool-Manchester is achievable. The route assumed for this analysis is a composite, comprising the HS2 Manchester Spur, other sections of HS2 and sections of HSUK following the M62. The calculated journey time includes a stop at Manchester Airport but does not include any Warrington stop.

The assumed NPR Liverpool-Manchester route is set out in Figure D (E1.11) and summarised below in Table E1.10.

	Route Section	Length	HSUK Analysis of works necessary for specified journey time
1	Liverpool Lime Street to Edge Hill	2km	No practicable upgrade for existing 4-track route from Liverpool Lime Street to Edge Hill
2	Edge Hill to Culcheth Jn	29km	New 2-track route from Edge Hill (generally as per HSUK alignment) to proposed HS2 route at Culcheth.
3	Culcheth Jn to Bucklow Triangle	12km	NPR Liverpool-Manchester route via proposed HS2 route from Culcheth to triangle junction with HS2 Manchester Spur.
4	Bucklow Triangle to Manchester Airport	10km	HS2 Manchester Spur adopted as NPR Liverpool-Manchester route via remote Manchester Airport station.
5	Manchester Airport Shuttle Link	2km	Shuttle connection from remote HS2 Manchester Airport station to airport terminals.
6	Manchester Airport to Manchester Picc.	14km	HS2 Manchester Spur adopted as NPR Liverpool-Manchester route from Manchester Airport station through HS2 South Manchester tunnel 12km long to HS2 terminus at Manchester Piccadilly.
7	Spur to Manchester Picc. underground	4km	New tunnel connecting HS2 Manchester spur to proposed NPR underground platforms at Manchester Piccadilly.

Table E1.10 : Works for NPR Liverpool – Manchester Route (ref Figure D)

Whilst the Manchester Airport station can be linked relatively easily to the airport terminals by means of a dedicated shuttle link (note the 8 minutes of additional time allocated for this connection), the proposed NPR Warrington station (presumed to be a parkway facility station located either north or south of the town) cannot practicably be transformed into an acceptable city centre station by means of a dedicated shuttle connection. Under TfN proposals, Warrington seems likely to be left with 3 entirely separate stations – Central, Bank Quay and Northern Powerhouse. Accordingly, the presumed Northern Powerhouse Rail station for Warrington has not been accepted in the wider connectivity analysis set out in Sections 7.1.5 and 7.1.6.

Transport for the North's failure to meet the specified 20 minute journey time for its Liverpool-Manchester route is directly attributable to its proposed circuitous routeing via Manchester Airport. This is in turn a consequence of TfN developing its routes with the primary aim of conforming with established HS2 routes, rather than adhering to the detailed HS3 journey time specification originally developed by 'One North'.

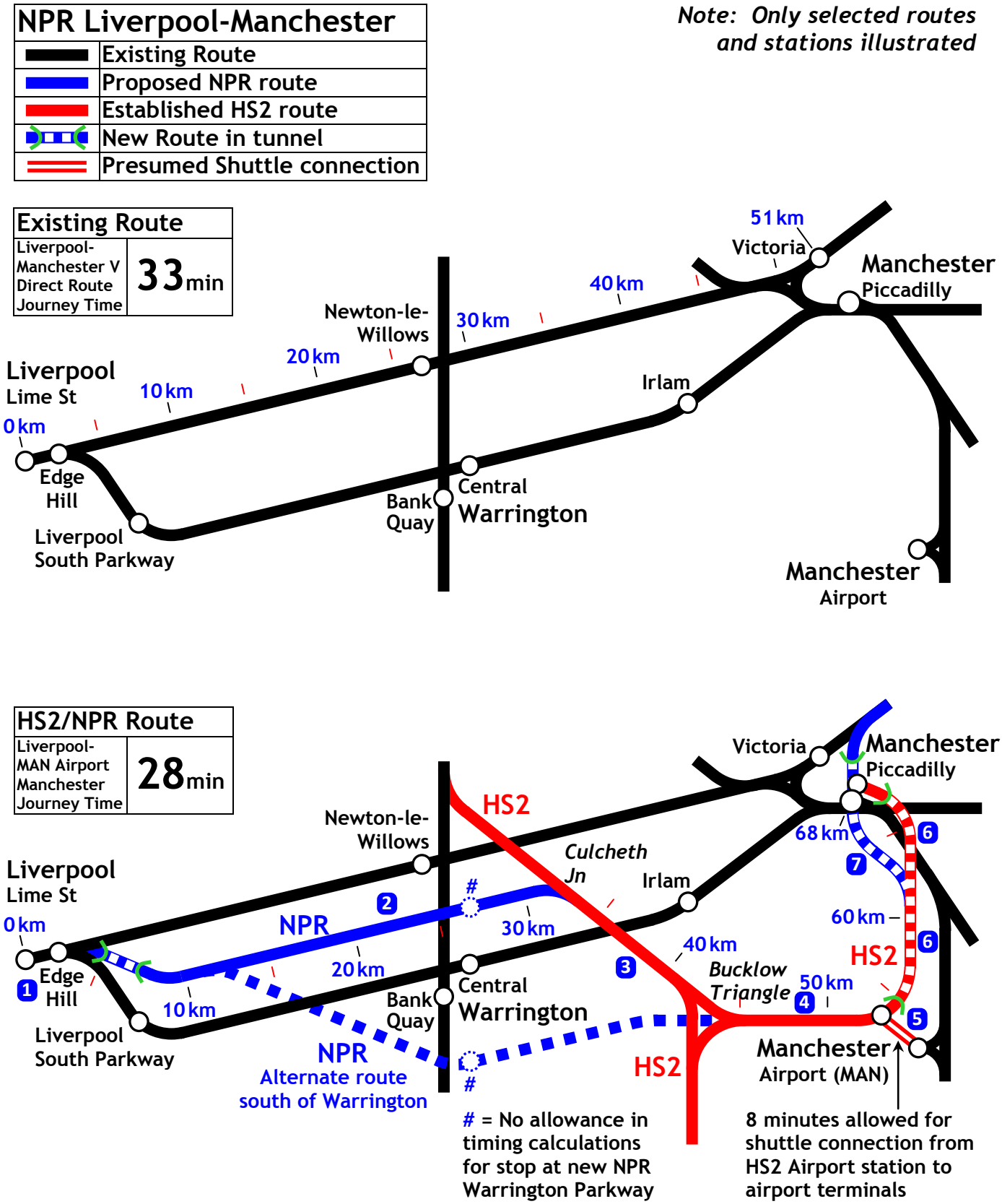


Figure D (E1.11) : NPR Journey Time Performance along Liverpool-Manchester corridor

E1.4 Proposed NPR Sheffield-Leeds route

Sheffield to **Leeds**	Journey Time required by HS3 Specification	**30**	Journey Time offered by Northern Powerhouse Rail	**28**

HSUK analysis confirms that the 30 minute journey time claimed by TfN for its proposed route from Sheffield to Leeds is achievable, so long as the upgraded section of existing route from Sheffield to Thurnscoe comprises 4 tracks. This is essential both to achieve the specified 6 train per hour service frequency, and also to allow local services (for instance the hourly Sheffield-Leeds stopping train which serves Bolton-on-Dearne, Goldthorpe, Thurnscoe and Moorthorpe) to continue to operate, with the potential to be increased in frequency to the half-hourly standard that applies on most other commuter routes in Yorkshire.

This analysis takes no account of any HS2 parkway station that might be constructed in the vicinity of Hemsworth. This would have the effect of increasing journey times by around 4 minutes.

At Leeds, NPR services from Sheffield can either terminate in the 5 new terminus platforms proposed for the HS2 station, or alternatively transfer to the existing network and follow a more circuitous route to enter the existing station from the west. These services could then continue to York and Newcastle.

The assumed NPR Sheffield-Leeds route is set out in Figure E (E1.13) and summarised below in Table E1.12.

	Route Section	Length	Works necessary to achieve specified journey time
1	Sheffield Midland to Clayton Junction	27km	Existing 2-track route from Sheffield Midland to Thurnscoe upgraded (or restored) to 4 tracks to separate NPR high speed services from local services. Spur link to HS2 at Clayton Junction.
2	Clayton Jn to Woodlesford Jn	22km	HS2 route from trunk route from Clayton Junction to Woodlesford Junction adopted for NPR Sheffield-Leeds route.
3	Woodlesford Jn to HS2 station, Leeds	12km	NPR Sheffield-Leeds route via proposed Leeds Spur to HS2 terminus platforms at Leeds Station.
4	Connection at Holbeck to NR	--km	Holbeck connection to Network Rail allows through route at Leeds Station and onward links to York and Newcastle.

Table E1.12 : Works for NPR Sheffield – Leeds Route (ref Figure E)

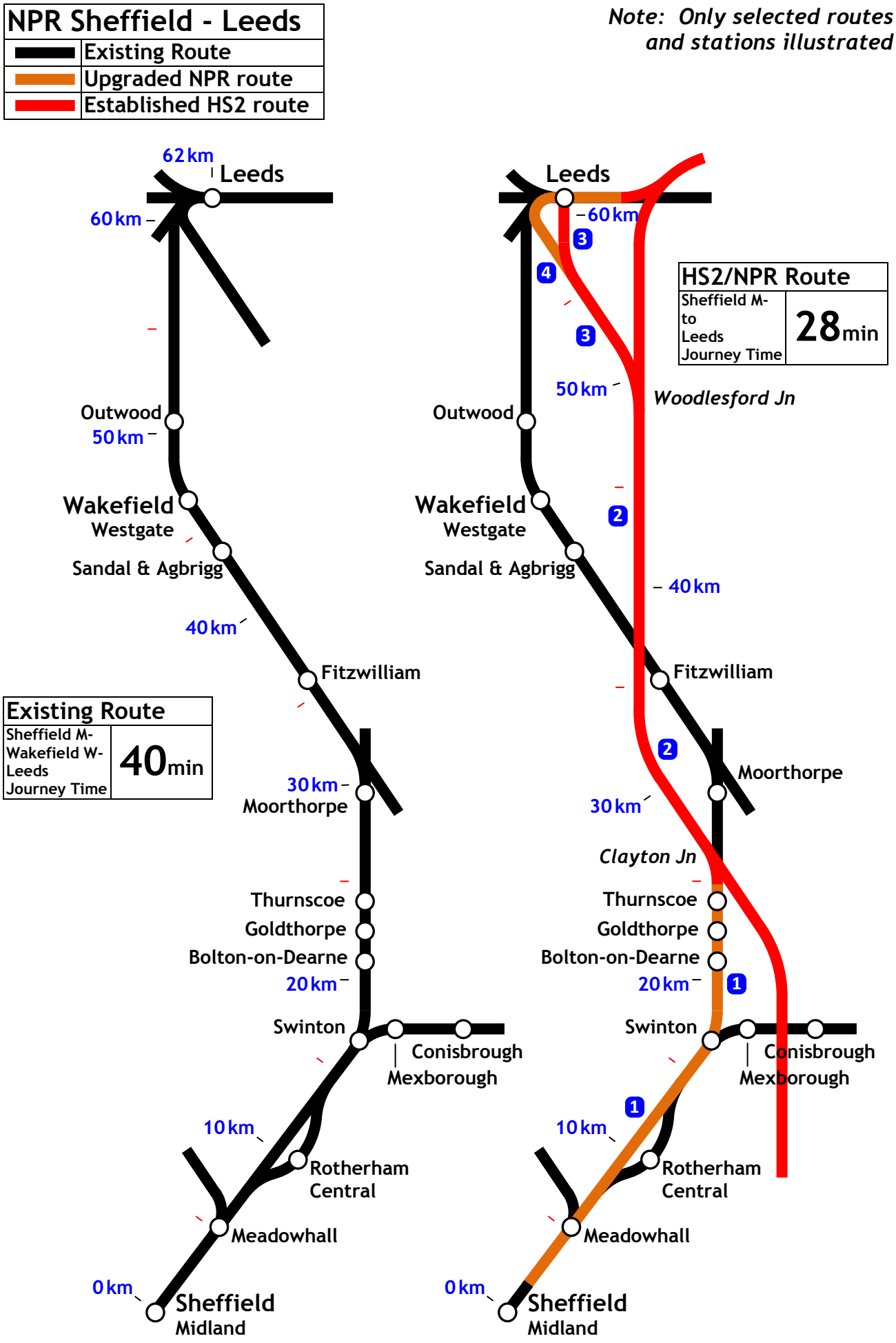


Figure E (E1.13) : NPR Journey Time Performance along Sheffield-Leeds corridor

E1.5 Proposed HSUK routes linking Manchester, Sheffield & Leeds
(Routes to Manchester Airport also illustrated)

Manchester to **Leeds**	Journey Time required by HS3 Specification	**30**	Journey Time offered by High Speed UK	**26**
Manchester to **Sheffield**	Journey Time required by HS3 Specification	**30**	Journey Time offered by High Speed UK	**23**
Sheffield to **Leeds**	Journey Time required by HS3 Specification	**30**	Journey Time offered by High Speed UK	**19**

HSUK's new lines, from Manchester to Penistone via Woodhead, and from Sheffield to Leeds via Penistone, will form a '3-pointed star' of new routes. These routes will mostly comprise new-build high speed lines; only sections approaching central Manchester and Leeds will comprise 4-tracked or restored routes. This will enable HSUK to offer the 2 extra tracks, segregated from local traffic, necessary to meet the capacity and journey time requirements of the Northern Powerhouse. The restoration of the former Woodhead route, to provide enhanced freight and local passenger links between Greater Manchester and South Yorkshire, will be completely independent of HSUK's proposed high speed intercity links.

HSUK's new-build high speed lines will have a speed capability of around 250km/h, and will be mostly constructed on the surface, with 6km being the maximum length of tunnel. At the legendary Woodhead crossing of the Pennines, schemes are under development to provide tunnels for 4 railway tracks and the National Grid cables that are currently in place (in the existing tunnel constructed in 1954).

	Route Section	**Length**	**Works necessary to achieve specified journey time**
1	Manchester Picc. to Ashburys	3km	New tunnel from new underground platforms at Manchester Piccadilly, joining existing route at Ashburys.
2	Ashburys to Hattersley	11km	Existing 2-track route from Ashburys via Guide Bridge to Hyde North reinstated to 4 tracks, existing route from Hyde North to Hattersley upgraded to 4 tracks.
3	Hattersley to Penistone Triangle	29km	New 2-track route from Hattersley to Penistone Triangle running parallel to restored Woodhead route from Hadfield to Penistone. Woodhead Tunnels reengineered as 4-track transpennine crossing.
4	Penistone Triangle	13km	Penistone Triangle provides 3-way connection between HSUK routes to/from Manchester, Leeds and Sheffield.
5	Penistone Triangle to Cottingley	27km	New 2-track route from Penistone Triangle to Cottingley near Leeds, partly following corridor of M1.
6	Cottingley to Leeds	4km	Existing 2-track route through Cottingley Station upgraded to 4 tracks, and abandoned Farnley Viaduct restored as dedicated HSUK route to Leeds Station. No conflict with local traffic.
7	Spur to Bradford	--km	Spur to Bradford at Calder Grove Junction (via restored Horbury Chord and Spen Valley route, and upgraded route via Healey Mills)
8	Penistone Triangle to Sheffield Victoria	19km	New 2-track route from Penistone Triangle to Sheffield Victoria, running parallel to restored Woodhead route from Penistone to Sheffield. Note 6km long tunnel on northern approach to Sheffield.
9	Eastern access to Manchester Airport	--km	Upgrade of existing route from Guide Bridge to Stockport, and new route from Stockport-Crewe line to the existing Manchester Airport station.

Table E1.14 : Works for HSUK Manchester – Sheffield – Leeds Routes (ref Figure W)

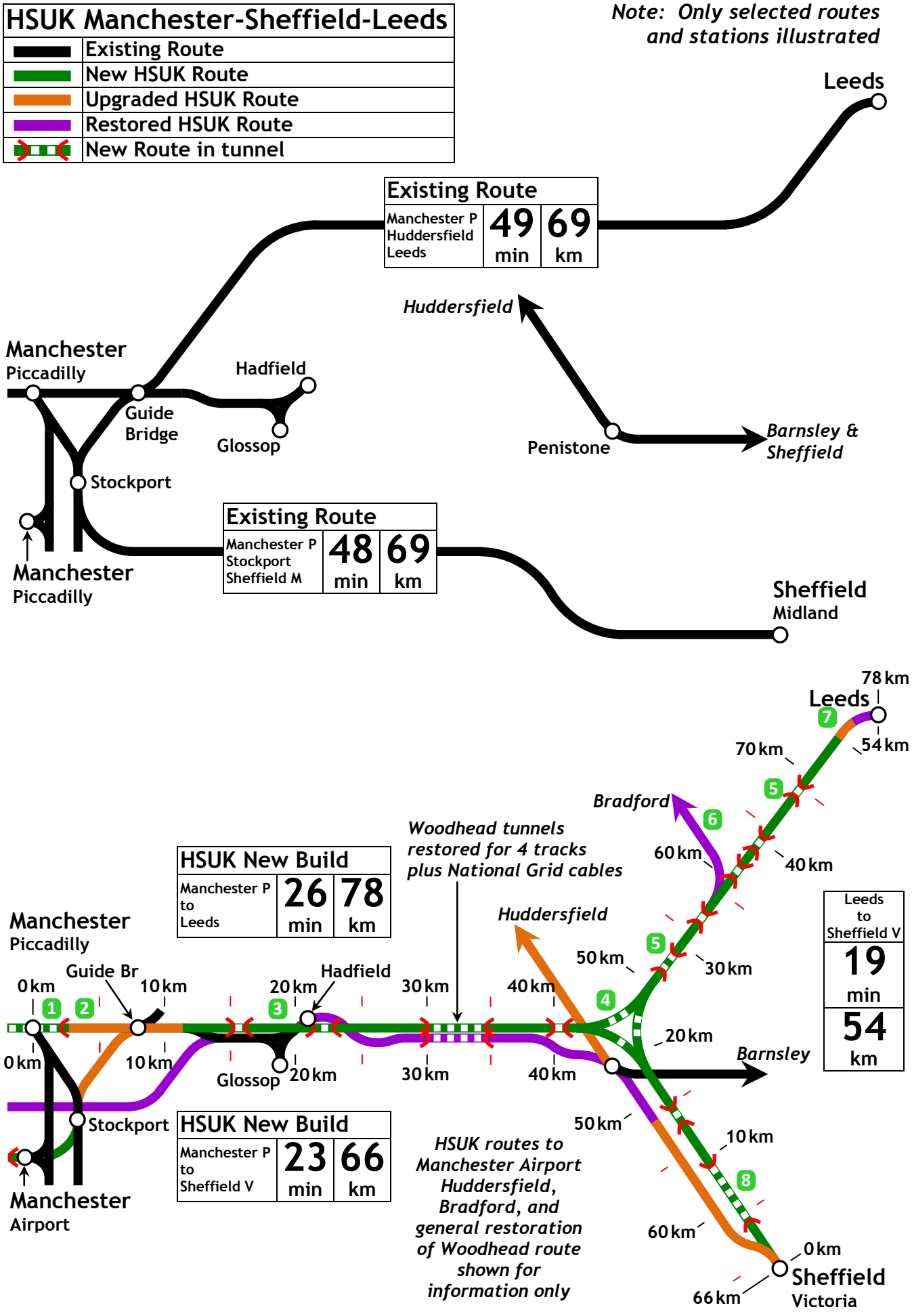


Figure W (E1.15) : HSUK Journey Time Performance on Manchester-Sheffield-Leeds routes

E1.6 Proposed HSUK Liverpool-Manchester route

(Route to Manchester Airport also illustrated)

Liverpool to **Manchester**	Journey Time required by HS3 Specification	**20**	Journey Time offered by High Speed UK	**19**

HSUK only beats the HS3 specification by a) remaining true to the design principles of the original 1830 Liverpool-Manchester Railway, for a direct railway between the two cities with no intermediate stops, and b) operating at its full design speed of 360km/h. A journey time of 21 minutes will apply if services were to operate at the lesser maximum speed of 230km/h assumed in the analysis of Northern Powerhouse Rail.

The HSUK route at its western end will follow the M62 and at its east end, it will follow the 'Chat Moss' section of the Liverpool-Manchester route. It will then continue into Manchester along the existing route, upgraded to 4-tracks, and pass under the city centre in a new tunnel, to enter tunnelled platforms at Manchester Piccadilly.

HSUK avoids HS2's and Northern Powerhouse Rail's circuitous Liverpool-Manchester routeing by developing separate routes to serve Manchester Airport and Warrington.

	Route Section	**Length**	**Works necessary to achieve specified journey time**
1	Liverpool Lime St to Edge Hill	2km	No practicable upgrade for existing 4-track route from Liverpool Lime Street to Edge Hill.
2	Edge Hill to Kenyon	28km	New 2-track route from Edge Hill following M62 corridor, rejoining corridor of existing Liverpool-Manchester railway at Kenyon.
3	Kenyon to Patricroft	13km	New 2-track route following corridor of existing Liverpool-Manchester railway from Kenyon to M60 crossing near Patricroft
4	Patricroft to Eccles	7km	Existing 2-track route from M60 crossing near Patricroft to Eccles reinstated to 4 tracks.
5	Castlefield to Manchester Picc.	3km	New tunnel from Castlefield to new underground station at Manchester Piccadilly.
6	West & east-facing Warrington chords	--km	New chord lines linking West Coast Main Line, Warrington Bank Quay and Chester to HSUK direct Liverpool-Manchester route.
7	Western access to Manchester Airport	--km	Restoration of abandoned Cheshire Line Committee routes and new route from Altrincham to the existing Manchester Airport station.

Table E1.16 : Works for HSUK Liverpool – Manchester Route (ref Figure Y)

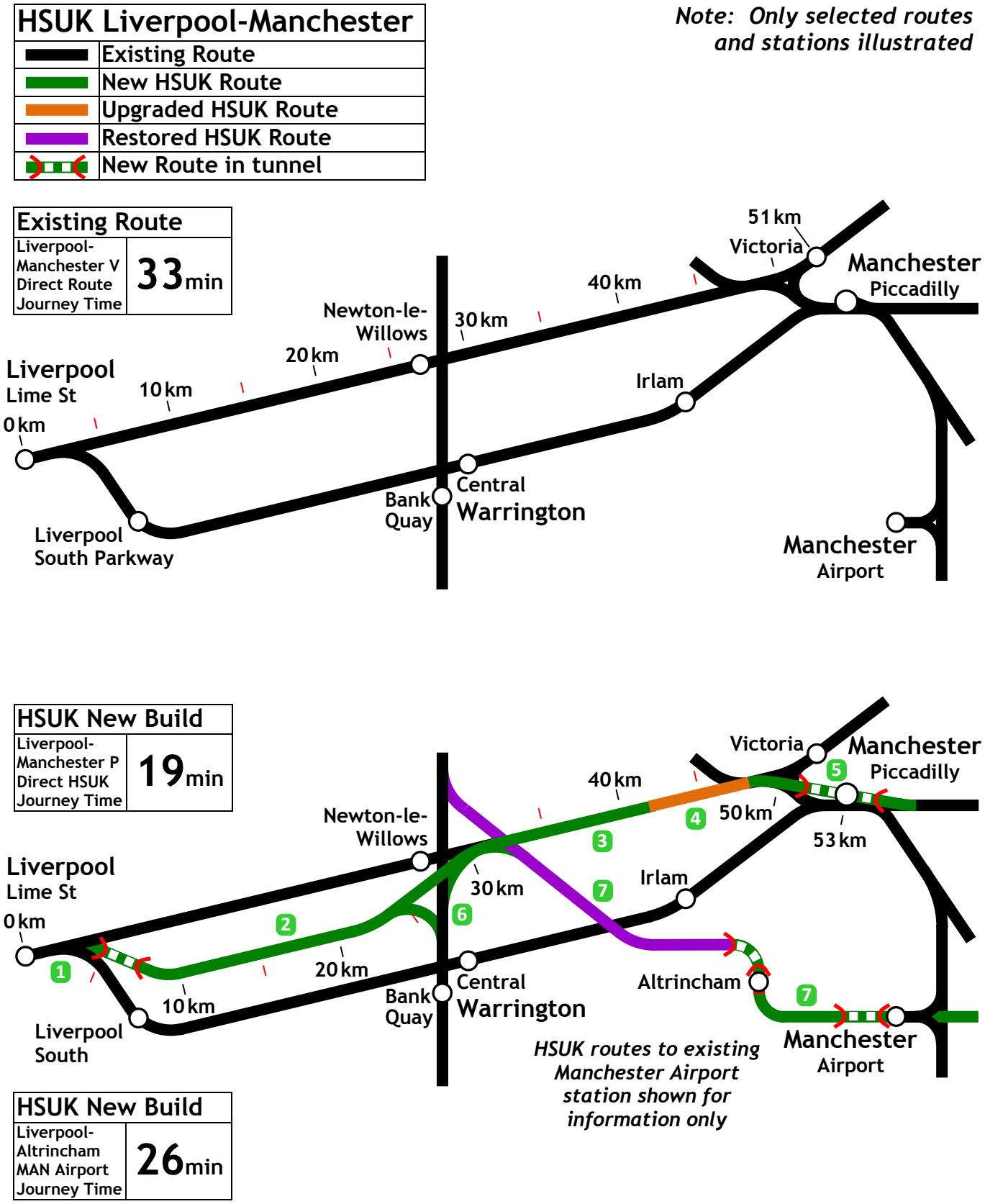


Figure X (E1.17) : HSUK Journey Time Performance along Liverpool-Manchester corridor

APPENDIX E2

Increased Capacity for Enhanced NPR and HSUK Services (ref 7.1.2)

The capabilities of Northern Powerhouse Rail and High Speed UK to deliver the step change increase in capacity to meet the connectivity needs of the Northern Powerhouse are set out in Table E2.1 below. This documents the ability of each primary intercity route to offer an extra pair of tracks and thus allow express (high speed) passenger traffic to be segregated from slower speed local traffic and freight.

For further information refer to the route diagrams (Figures A – E and W – X) and associated tables in Appendix E1.

Primary Route between Northern Powerhouse cities	**Northern Powerhouse Rail** 2 New Tracks provided? Refer to Appendix E1		**High Speed UK** 2 New Tracks provided? Refer to Appendix E1	
Liverpool - Manchester	Yes	Except for approaches to Liverpool Lime Street. Ref **Figure D**	Yes	Except for approaches to Liverpool Lime Street Ref **Figure X**
Manchester - Sheffield	No	Under current upgrade plans, most of route will remain a 2-track railway. Ref **Figure C**	Yes	HSUK route from Sheffield to Leeds meets transpennine route via Woodhead to Manchester to form '3-pointed star' of high speed lines, with 2 new tracks for full length. (Existing Woodhead route also restored to provide 2 new tracks for freight.) Ref **Figure W**
Manchester - Leeds	Yes	4-tracking assumed along Aire Valley and Manchester-Rochdale routes. Ref **Figure B**	Yes	
Sheffield - Leeds	??	Unsure whether upgrade plans north of Sheffield include full-length 4-tracking. Ref **Figure E**	Yes	
Leeds - Newcastle	No	Upgrade plans assumed not to include extra tracks/new routes from York to Newcastle	Yes	2 new tracks planned for full length between Leeds and Newcastle

Table E2.1 : NPR & HSUK Provision of New Tracks on Primary Intercity Routes

APPENDIX E3

Northern Powerhouse Rail and HSUK Station Proposals (ref 7.1.3)

E3.1 NPR/HSUK Proposals for Leeds

The layout of HS2 and Northern Powerhouse Rail routes in Leeds, and in its immediate vicinity, is illustrated in Figure E3.1. This shows:

- the trunk route of the new HS2 high speed line passing just to the east of the city.
- an HS2 spur entering Leeds from the southeast, and finishing at new terminus platforms built at right-angles to the existing Leeds station.
- Northern Powerhouse Rail services entering Leeds station along its existing radial routes.
- the new-build NPR transpennine route from Manchester and Bradford on its presumed alignment, joining the existing Aire Valley line to the west of Leeds.
- connections from NPR routes to the east of Leeds, to both HS2 spur and HS2 trunk route.

Additionally, it is assumed that the existing Aire Valley line and the route east of Leeds station to Cross Gates will need to be 4-tracked to accommodate new, faster and more frequent Northern Powerhouse Rail services.

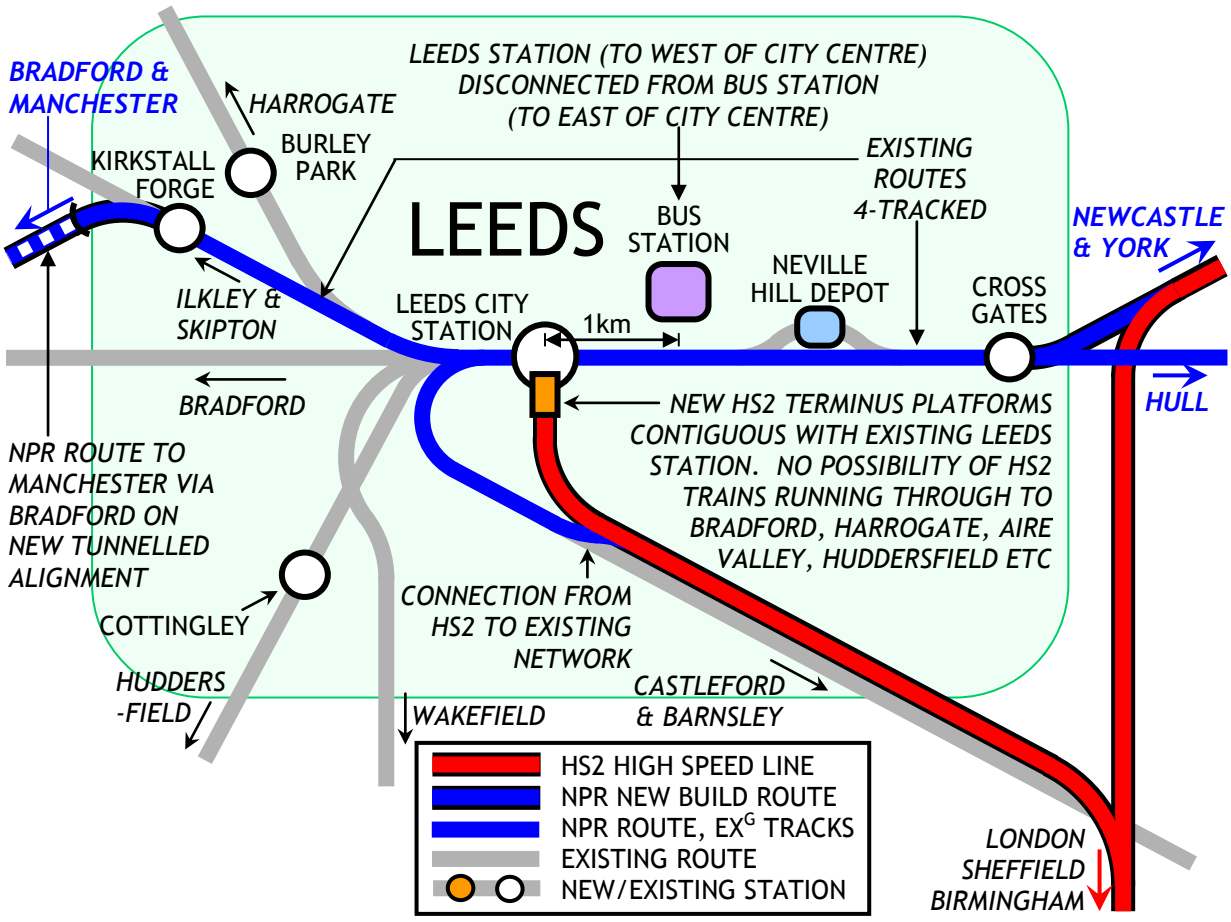


Figure E3.1 : HS2 and NPR Scheme for Leeds

The proposed arrangements at Leeds for HS2 and Northern Powerhouse Rail services raise several major concerns:

- The addition of 5 new HS2 platforms at Leeds station will do very little to relieve existing congestion at Leeds station. The HS2 platforms can only be used for services to London, Birmingham and Sheffield – all other services must continue to use the existing platforms.
- Moreover, the terminus HS2 platforms will not permit through operation of HS2 services beyond Leeds to destinations such as Harrogate, Bradford and Skipton, all of which currently enjoy intercity services extending north- and westwards from Leeds. The proposed connection from the HS2 spur to the southeast of Leeds will only be useful for Sheffield-Leeds Northern Powerhouse Rail services to continue to York and Newcastle.
- The introduction of HS2 will have the effect of eliminating[29] only one of the 37 trains per hour that currently operate through Leeds, while Northern Powerhouse Rail is set to greatly increase[30] train frequencies through Leeds.
- No plans have so far been put forward to explain how NPR services can be efficiently segregated from local passenger and freight services, to minimise conflicts and optimise capacity.
- There are no proposals for Leeds station to be physically expanded to accommodate either the specified additional NPR services, or any corresponding increase in local services. The Leeds Station Masterplan being developed by Leeds City Council only addresses the proposed new HS2 platforms; it makes no allowance for expansion in other areas, necessary to accommodate other planned new services. In any case this expansion would appear impracticable without unacceptable demolition of city centre real estate.
- The current proposals, both HS2 and NPR, do nothing to address the essential dysfunction at Leeds station, whereby 6 routes approach from the west, and only a single route approaches from the east. This leaves the station performing primarily as a terminus, with trains occupying platforms for a much greater period than if they were running through. This explains why Leeds – despite having more platforms (17) than any other provincial English station – is still one of the most congested stations on the UK network.

It is plain, from consideration both of the current HS2 and Northern Powerhouse Rail proposals, and of their historical development (as noted in Sections 3.5 and 3.6), that there has been no holistic and integrated development of a single unified scheme that might deliver optimised capacity[31] and connectivity for Leeds.

The extent of this planning failure only becomes truly apparent upon review of the alternative HSUK scheme for Leeds, as shown in Figure E3.2. The HSUK scheme addresses all of the primary issues, both with the existing network and with the HS2 and NPR proposals, that have been identified in the preceding paragraphs:

[29] Under HS2 proposals, the only change in 'classic' services to Leeds will be a reduction in intercity services to London from 2 trains per hour to a single train – see Table 23 of *HS2 Regional Economic Impacts*, Table E6.2, Appendix E6.

[30] As shown in Figure 6, the specification developed by Transport for the North requires the following service frequencies from Leeds: 6 trains per hour (tph) to Sheffield, 6tph to Manchester, 2tph to Hull, 4tph to Newcastle.

[31] There is a further irony, in that any 4-tracking of the Aire Valley line – considered necessary to facilitate both the presumed NPR transpennine route via Bradford and increased transpennine freight services routed via a reopened Skipton-Colne line – will require the demolition and reconstruction of the recently-opened station at Kirkstall Forge. This station was built across the entire width of the original 4-track Aire Valley line, with no allowance (despite verbal warnings made to Network Rail) for future restoration of 4 tracks to allow for fast non-stop services.

- Through the restoration of the abandoned Farnley Viaduct to the south-west, and through the 4-tracking of the existing route to the east, a reserved route can be created for 'through' high speed intercity traffic, free of conflicts with local passenger and freight traffic.
- A separate route will be created for terminating high speed services, to high level platforms constructed above the car park immediately north of the station.
- These platforms will also be connected to the Harrogate and Aire Valley lines, to allow through services to replicate existing through operation of intercity services.
- The 4-track route east of Leeds station will allow new stations to be opened at 'Leeds Minster' and at Neville Hill, and possibly also at Osmondthorpe. The Leeds Minster station will be close to the city's bus station, and will greatly improve bus/rail integration.
- Construction of a new link from Stourton to Neville Hill will allow many of the services which currently approach Leeds station from the west and terminate there to approach instead from the east. Rather than terminate at Leeds and consume valuable platform capacity, these services can then continue to destinations such as Bradford and Huddersfield. With many more through services operating, the capacity of Leeds station will be vastly increased. The proposed integration and through running of local services is shown on Figure E3.2.
- Construction of the Stourton-Neville Hill link will also give access to a large area of industrial land on which a new rolling stock depot can be established, and thereby allow the existing cramped Neville Hill site to be developed for housing, close to the proposed Neville Hill station.

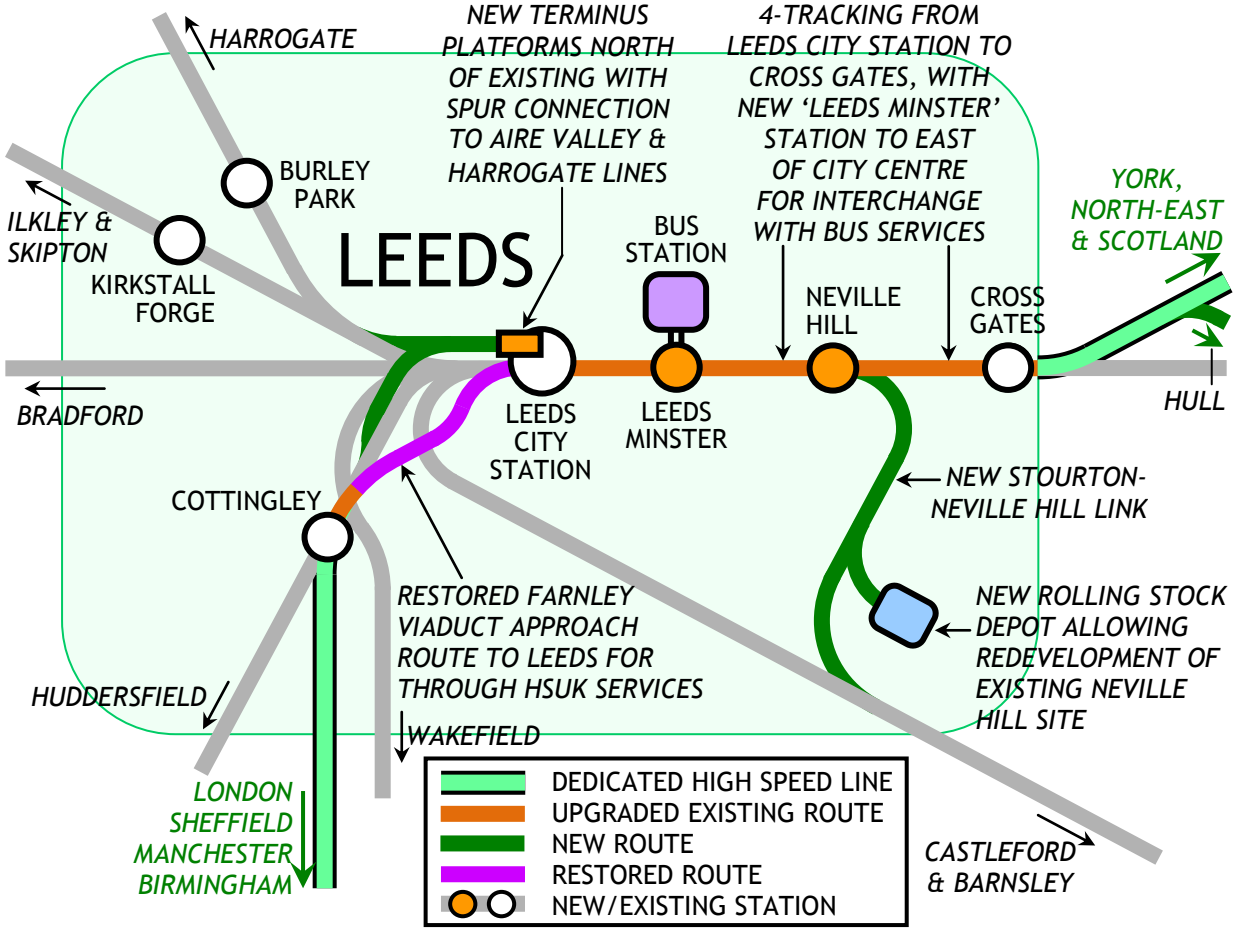


Figure E3.2 : HSUK Scheme for Leeds

Figure E3.3 below illustrates both the segregation of HSUK high speed services from local traffic, and also the revised operation of local services that is made possible both by the 4-tracking east of Leeds station, and also by the opening of the proposed Stourton-Neville Hill link. With these interventions in place, it appears feasible to double service frequencies on most if not all local routes.

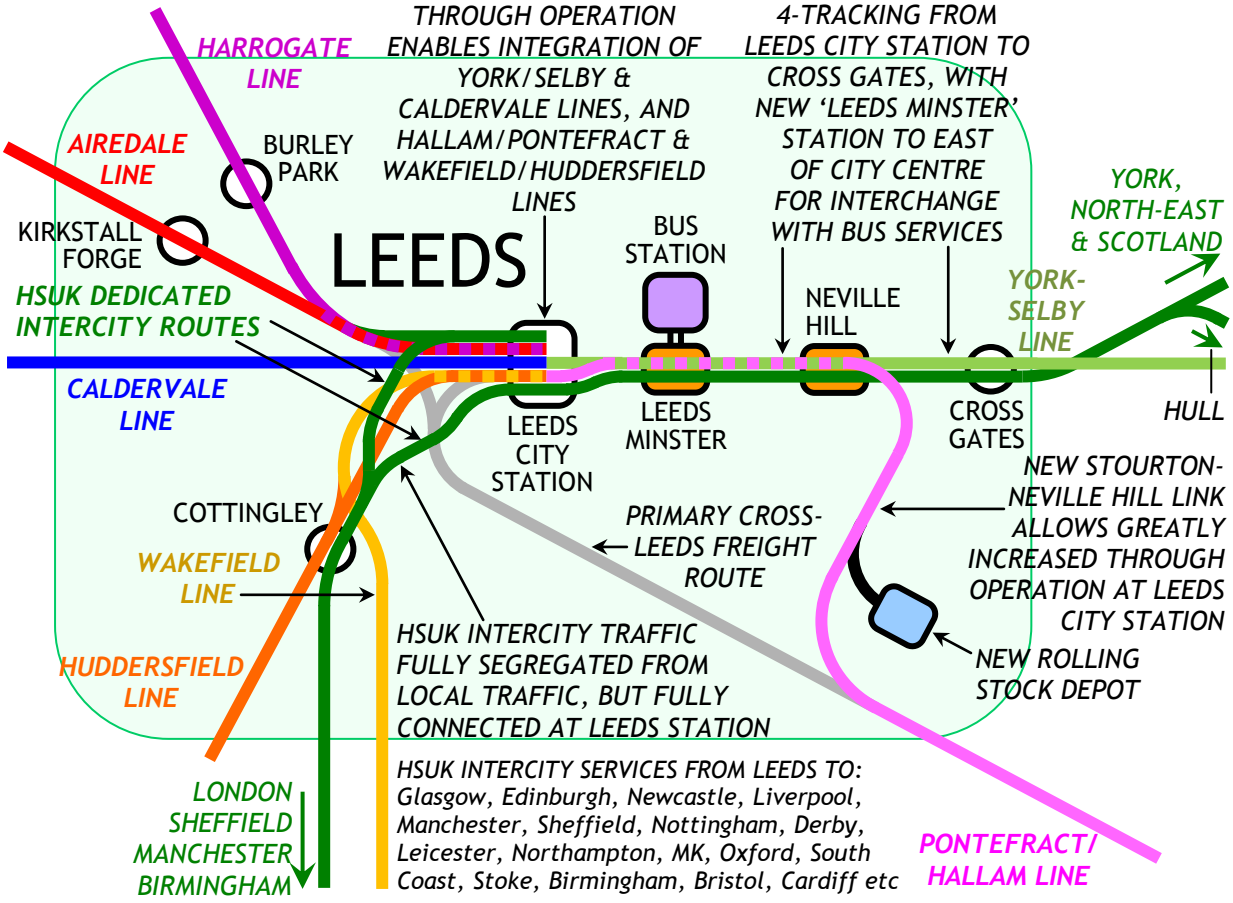


Figure E3.3 : HSUK Proposed Transformation of Local Services in Leeds

E3.2 NPR/HSUK Proposals for Sheffield

So far, there are few detailed proposals to explain how either Northern Powerhouse Rail or HS2 services will be accommodated at Sheffield Midland station. The following services are predicted to operate, with Northern Powerhouse Rail and HS2 in place:

- 6 NPR trains per hour from Sheffield to Leeds;
- 6 NPR trains per hour from Sheffield to Manchester;
- 2 NPR trains per hour from Sheffield to Hull;
- 2 HS2 trains per hour to London;
- 2 HS2 trains per hour to Birmingham.

With only small reductions predicted in residual 'classic' services, it is difficult to see how both the increased service levels and increased local services can be accommodated, without any requirement to physically expand the existing station.

There is also a wider concern that Sheffield Midland station is incompatible with the city's need to be at a pivotal position in either the regional or the national rail network. Sheffield Midland points naturally towards the Hope Valley route, yet – as is demonstrated in Appendix E1.2 of this report – adoption of this route is not conducive to achieving efficient and economic transpennine links.

Also, the changes in HS2 routeing strategy announced in July 2016 (see Item 3.6.1) have proved very difficult to efficiently integrate with the Midland Main Line that serves Sheffield Midland. Connection points to HS2 will be located 25km north of the city, and 40km south. Essentially, the effect has been to place Sheffield on a very long siding.

HSUK's proposed Sheffield station (see Figure E3.4), to be constructed on the site of the former Sheffield Victoria, avoids most of the problems of Sheffield Midland. Sheffield Victoria's south-east to north-west orientation is well aligned with HSUK's onward routes to Manchester and Leeds, and its location on a through trunk route rather than on a loop will make Sheffield Victoria an attractive calling point on long-distance intercity journeys.

To enable full integration between local services and HSUK intercity services, new interchange platforms will be constructed on the existing route into Sheffield Midland, close to the location of the former Attercliffe Road station. This will allow passengers from outlying communities such as Rotherham and Barnsley easy access to HSUK's high speed services.

It is acknowledged that while neither Sheffield Midland nor Sheffield Victoria stations are located especially close to the city centre, Victoria is considerably further from the city centre, at 1.1km (or 0.75 miles). This issue would be best addressed by extending Sheffield's tram network to serve Sheffield Victoria, and this is also shown in Figure E3.4.

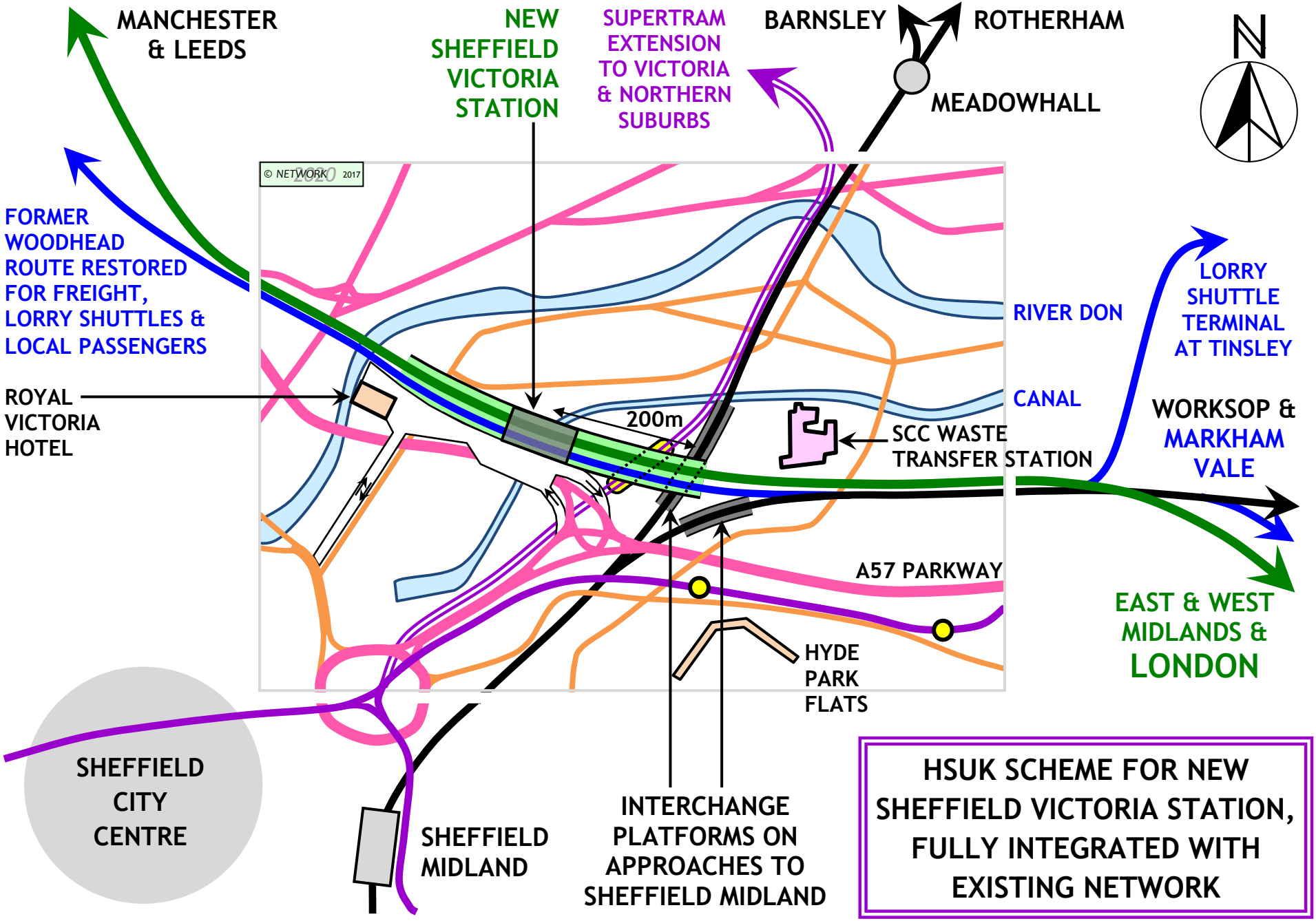


Figure E3.4 : HSUK Scheme for restored Sheffield Victoria

E3.3 NPR/HSUK Proposals for Bradford

The Northern Powerhouse Rail scheme for Bradford, as illustrated in Figure E3.5, is based upon HSUK's 'reverse engineering' of TfN's stated intention for a Manchester-Bradford-Leeds transpennine route, capable of offering a 30minute journey time between Manchester and Leeds. This assumed route would pass under Bradford by means of a tunnel on an approximate south-west/north-east alignment, and emerge into the Aire Valley near Calverley, and follow the existing line into Leeds.

So far, there is no indication of where Bradford's NPR station would be located. Underground stations at either of the city's existing terminus stations (Interchange and Forster Square) appear to be possible; however, if a site were to emerge where surface construction might be practicable, then it is possible that economics might dictate that this site would be adopted. This would then leave Bradford in the highly undesirable situation of having 3 different stations, all disconnected from each other.

Under the TfN proposals, the best that Bradford can hope for is an NPR station that is integrated with one or the other of its two terminus stations; there is certainly no prospect of the NPR initiative achieving efficient integration and through running between Interchange and Forster Square.

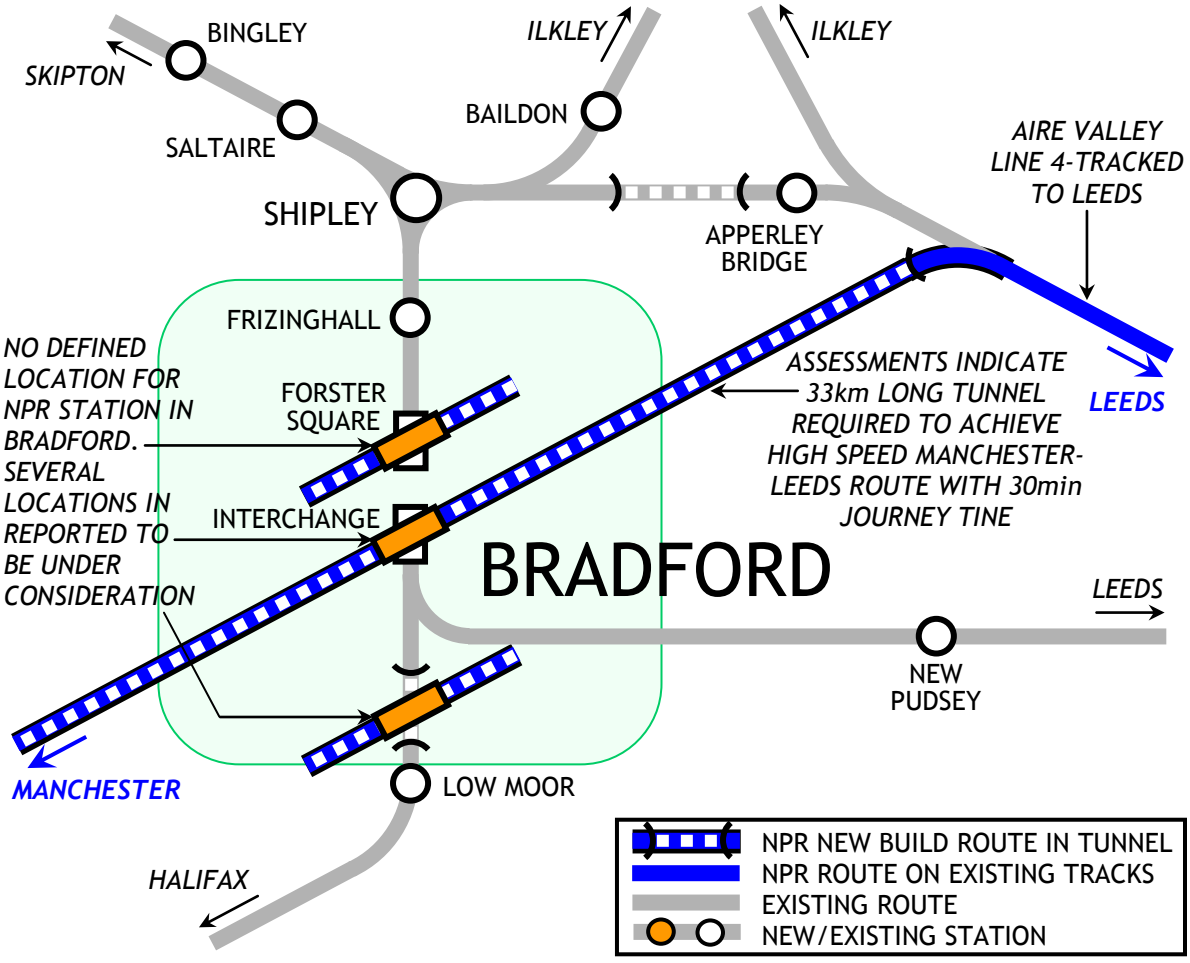


Figure E3.5 : NPR Proposed Transpennine Tunnel & Possible Bradford Station Locations

HSUK's radically different strategy to bring high speed rail services to Bradford is illustrated in Figure E3.6. This embodies the following key features:

- restoration of the abandoned Spen Valley route to allow high speed services to diverge from the HSUK trunk route near Wakefield, and to approach Bradford from the south;
- construction of a new 'Crossrail' link between Bradford's Interchange and Forster Square termini with a new 'Bradford Central' station on the site of the former Bradford Exchange.

Although the Westfield shopping centre stands in the way of a 'Crossrail' link between Bradford's two terminus stations, this is not considered to comprise an insurmountable obstacle. The majority of the development is only two storeys high, and the new railway would pass across at the level of the rooftop car park. It should be possible to construct the new link without undue disruption or risk to the shopping centre beneath.

With the Crossrail link in place, rail services to the entire Bradford District will be transformed:

- HSUK services from London and Sheffield, approaching Bradford from the south via the restored Spen Valley line, will continue up the Aire Valley to Skipton and onwards (via the restored Skipton-Colne route) to East Lancashire and Preston.
- 'Calder Valley' local services from Leeds to Halifax will be rerouted via Shipley to take advantage of the faster Aire Valley route and thereby eliminate the need to reverse at Bradford.
- Diversion of longer-distance services will allow more stations to be opened on the direct Leeds-Bradford route via New Pudsey, and integration of this route with Aire Valley services.

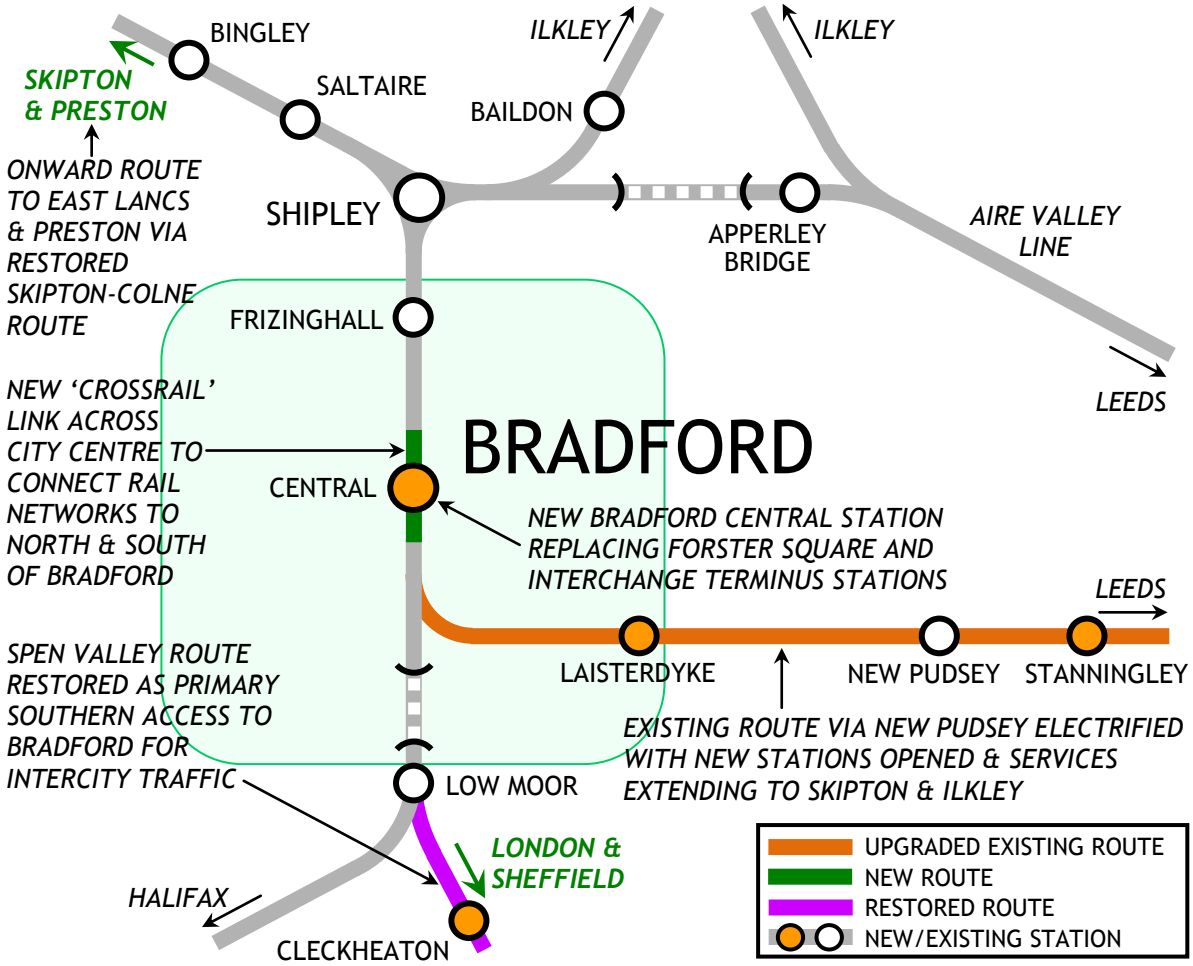


Figure E3.6 : HSUK Scheme for Bradford

E3.4 NPR/HSUK Proposals for Manchester

The layout of HS2 and Northern Powerhouse Rail routes in Manchester, and in its immediate vicinity, is illustrated in Figure E3.7. This shows:

- the HS2 Manchester Spur approaching Manchester Piccadilly in tunnel, from the south;
- the Northern Powerhouse rail new transpennine route from Leeds and Bradford approaching Manchester from the north, along an upgraded Calder Valley route via Rochdale;
- a new north-south cross-Manchester tunnel, with underground platforms at Manchester Piccadilly, and continuing south to a tunnelled junction with the HS2 Manchester spur.

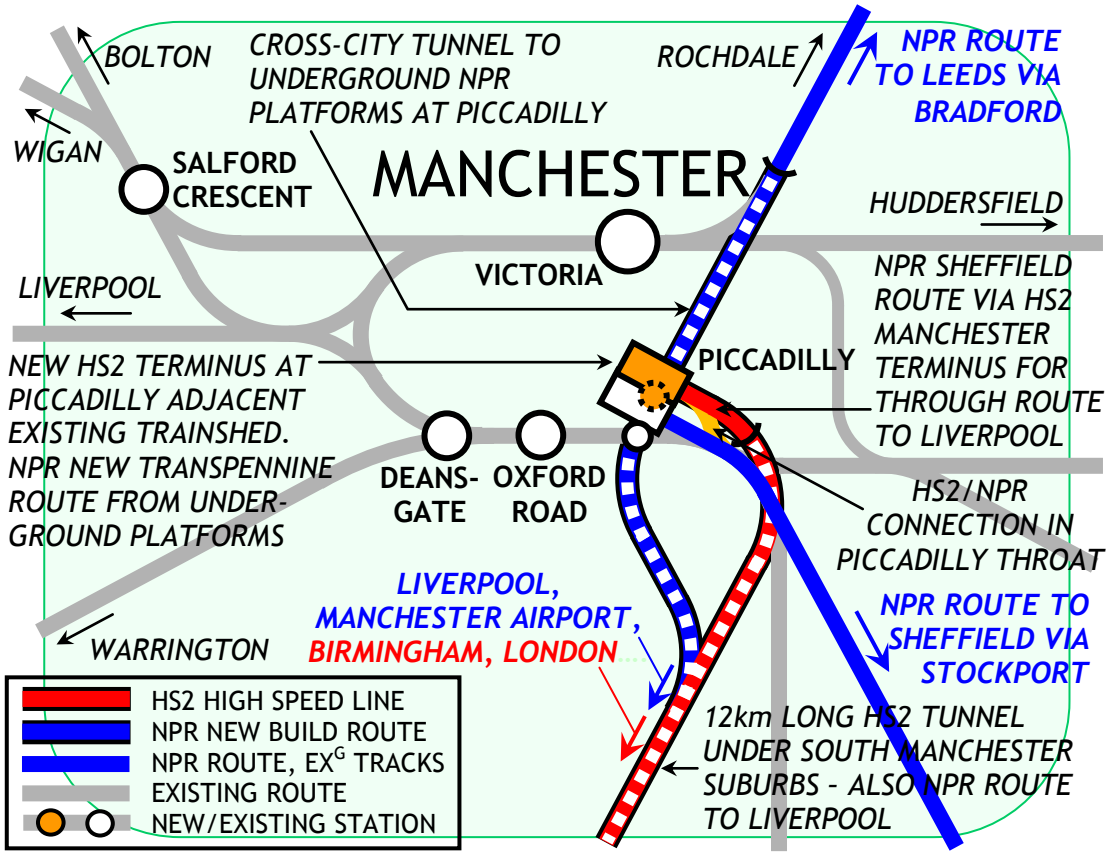


Figure E3.7 : NPR and HS2 Scheme for Manchester

The Northern Powerhouse Rail proposals for Manchester raise several critical concerns:

- It requires a huge length (18km) of tunnelled infrastructure to enable high speed services to reach, and pass through central Manchester.
- The new infrastructure is only usable by long-distance high speed services, and will bring little or no benefit to congested local services.
- The north-south orientation of the NPR cross-Manchester tunnel is fundamentally misaligned with the direct westward route to Liverpool (necessary to achieve the specified 20 minute journey time), and it cannot connect efficiently to the NPR route from Sheffield.

In the TfN *Strategic Transport Plan*, the possibility is also raised[32] of an expanded Manchester Piccadilly terminus, serving both HS2 and Northern Powerhouse Rail routes. On current service predictions, 23

[32] P46, *Strategic Transport Plan*, Transport for the North, January 2018.

trains per hour would arrive and depart from this terminus, with many services on conflicting routes. This option – which is illustrated in Figure E3.8 – is considered impracticable due to both its operational difficulties and the extra journey times that will be caused by a) the need to reverse in the terminus and b) the unavoidable conflicts with other services.

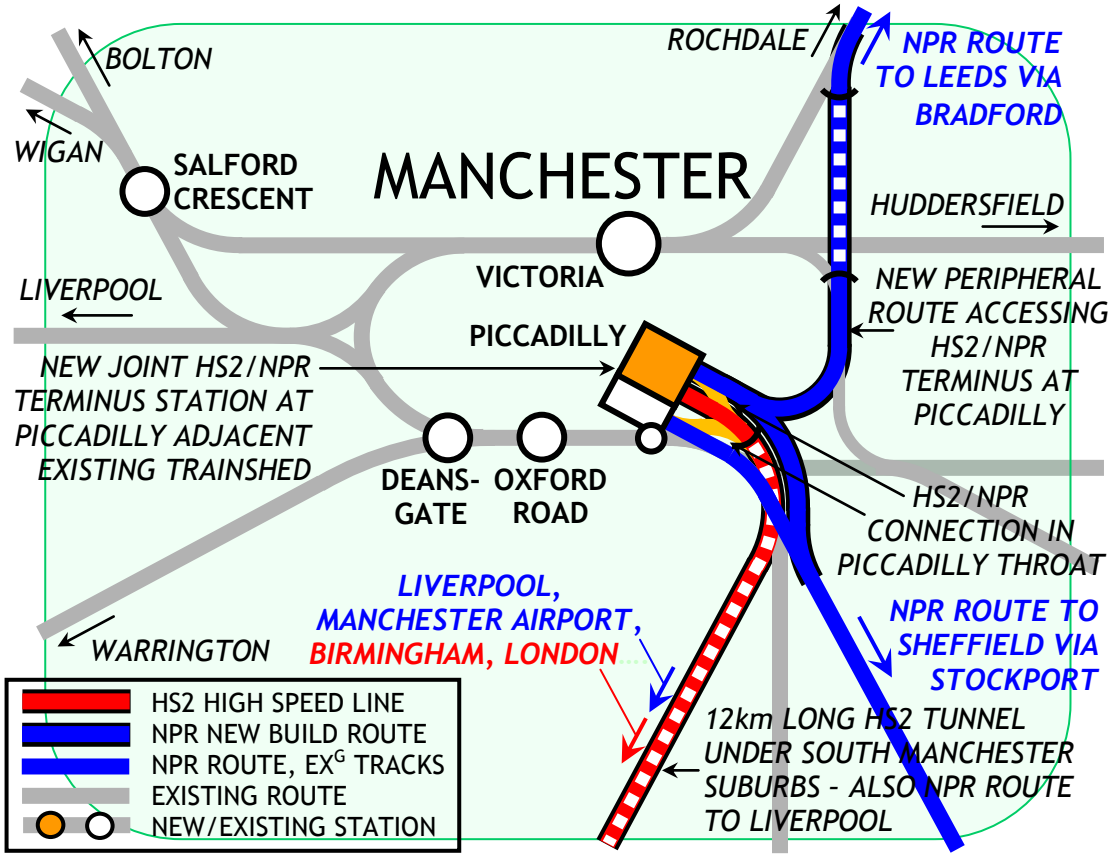


Figure E3.8 : Alternative Scheme for NPR Manchester Terminus

High Speed UK's radically different proposals for Manchester are illustrated in Figure E3.9. The key features of the HSUK scheme are as follows:

- HSUK's primary routes approach the city from west and east along existing routes, upgraded to 4 tracks to allow full segregation between intercity and local traffic.
- From Castlefield in the west to Ashburys in the east, a new tunnelled route will pass under the city centre. This tunnel will also be connected to routes to Stockport and Bolton.
- New tunnelled platforms at Manchester Piccadilly will be fully integrated with the existing station and its tram connections.

The HSUK proposals address the principal concerns identified with the Northern Powerhouse Rail proposals. HSUK's cross-Manchester route:

- is achieved with a much reduced length of tunnel.
- can also be used by local services, and provides major congestion relief for the existing east-west viaduct route between Manchester Piccadilly, Manchester Oxford Road and Deansgate.
- is perfectly aligned with the fundamental Northern Powerhouse imperative for an efficient east-west cross-city link enabling transpennine services from both Sheffield and Leeds to continue through Manchester towards Liverpool, and also achieve optimised journey times on all these routes.

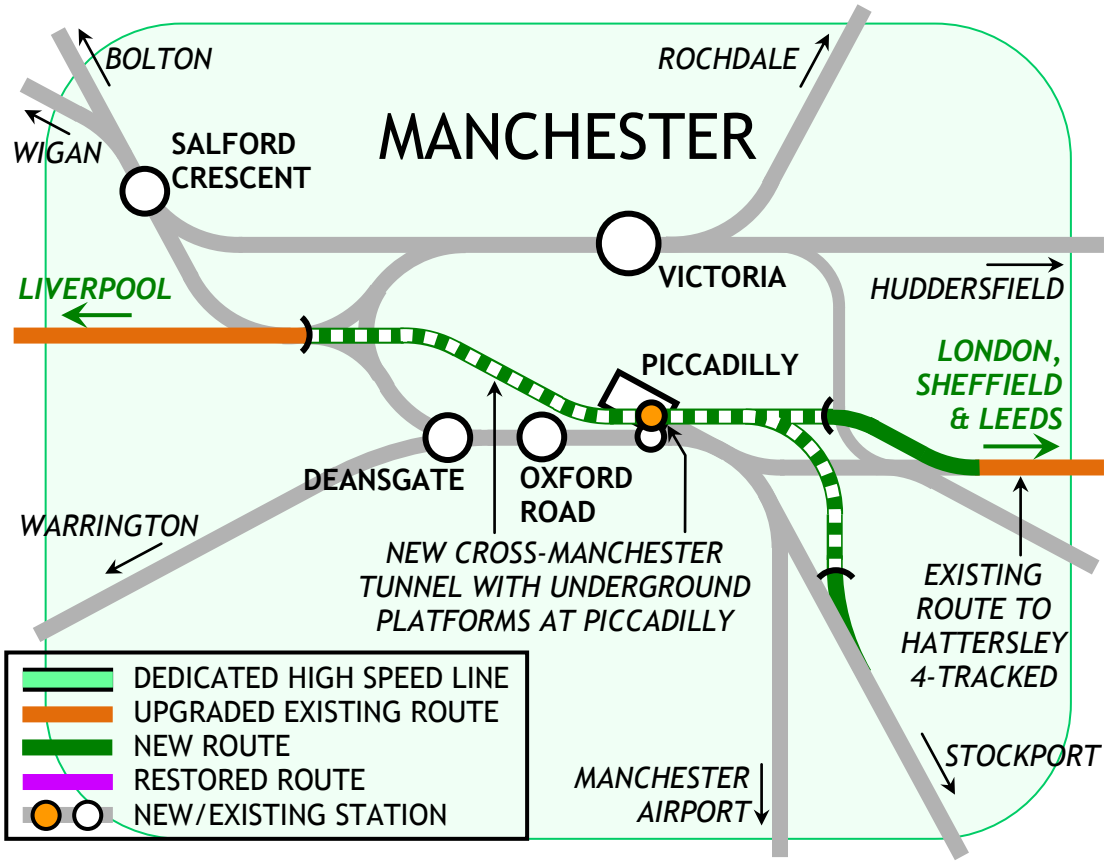


Figure E3.9 : HSUK Scheme for Manchester

E3.5 NPR/HSUK Proposals for Manchester Airport

The layout of HS2 and Northern Powerhouse Rail routes on the south side of the Greater Manchester conurbation is illustrated in Figure E3.10. This shows:

- the HS2 Manchester Spur, with its remote 'Manchester Airport' station (located around 2km from the airport terminals) and a 12km long tunnel approaching Manchester Piccadilly from the south;
- a presumed dedicated shuttle connection between the HS2 Manchester Airport station and airport terminals;
- the trunk HS2 route, passing to the west of the Greater Manchester conurbation;
- a new NPR route to Liverpool, passing either north or south of Warrington;
- the transpennine NPR route from Manchester to Sheffield, running along existing tracks via Stockport, but (despite its relative proximity) lacking any direct link to Manchester Airport.

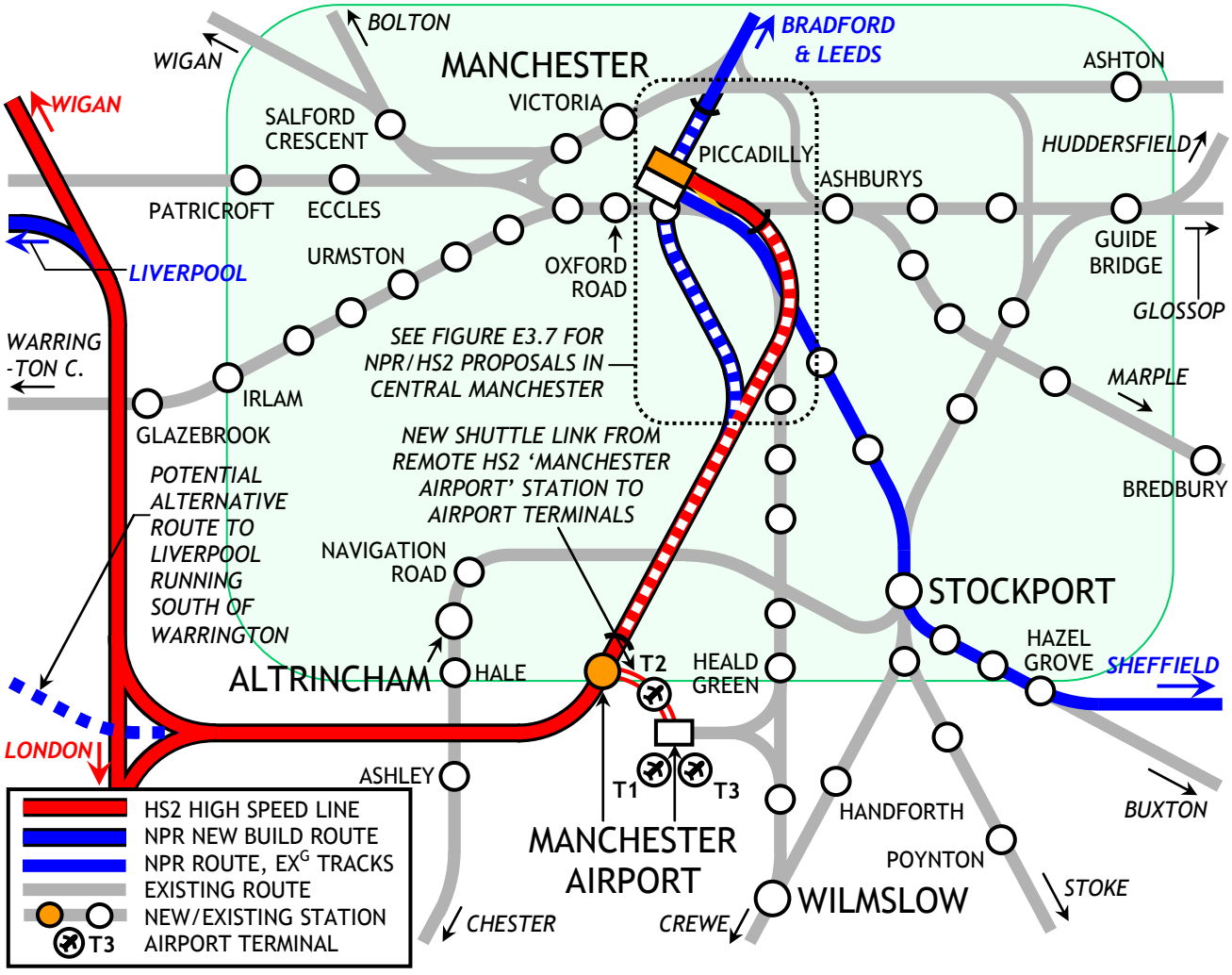


Figure E3.10 : HS2/NPR Proposed Rail Access to Manchester Airport

Figure E3.10 makes plain the principal deficiencies in the proposed NPR routes in the vicinity of Manchester Airport:

- a remote station, reliant on the provision of an as yet unplanned shuttle link;
- very poor connectivity to the primary Manchester-Sheffield NPR route;
- a needlessly circuitous alignment imposed on the Manchester-Liverpool NPR route.

Whilst the Northern Powerhouse Rail proposals will offer radically improved links to certain selected destinations, there is at least an equal number of major communities – for instance Chester, Preston, (central) Warrington, Stockport, Huddersfield and Wakefield – that will not enjoy direct NPR links. These communities, and many other communities, will remain reliant upon slower rail services to Manchester Airport's existing station. By virtue of its configuration as a terminus, this station is highly congested, and it lacks both the capacity and the range of routes that would allow connections to all Northern communities large and small.

The Northern Powerhouse Rail proposals do not meet the basic requirement, to provide efficient and high quality rail links from all principal communities of the North to the North's principal international gateway. As such, Transport for the North has failed in one of its fundamental missions, to transform the international connectivity of the Northern Powerhouse.

It is also significant to note that, taken in combination, the HS2 and Northern Powerhouse Rail proposals will do nothing to ease the passage of east-west freight flows through the Greater Manchester area. The only direct east-west routes that exist pass through central Manchester – either through Victoria or Piccadilly stations – and neither route has any spare capacity for freight. This hugely restricts potential railfreight flows from the Port of Liverpool, and again damages international connectivity.

High Speed UK's radically different proposals for Manchester Airport and for the wider South Manchester area are illustrated in Figure E3.11.

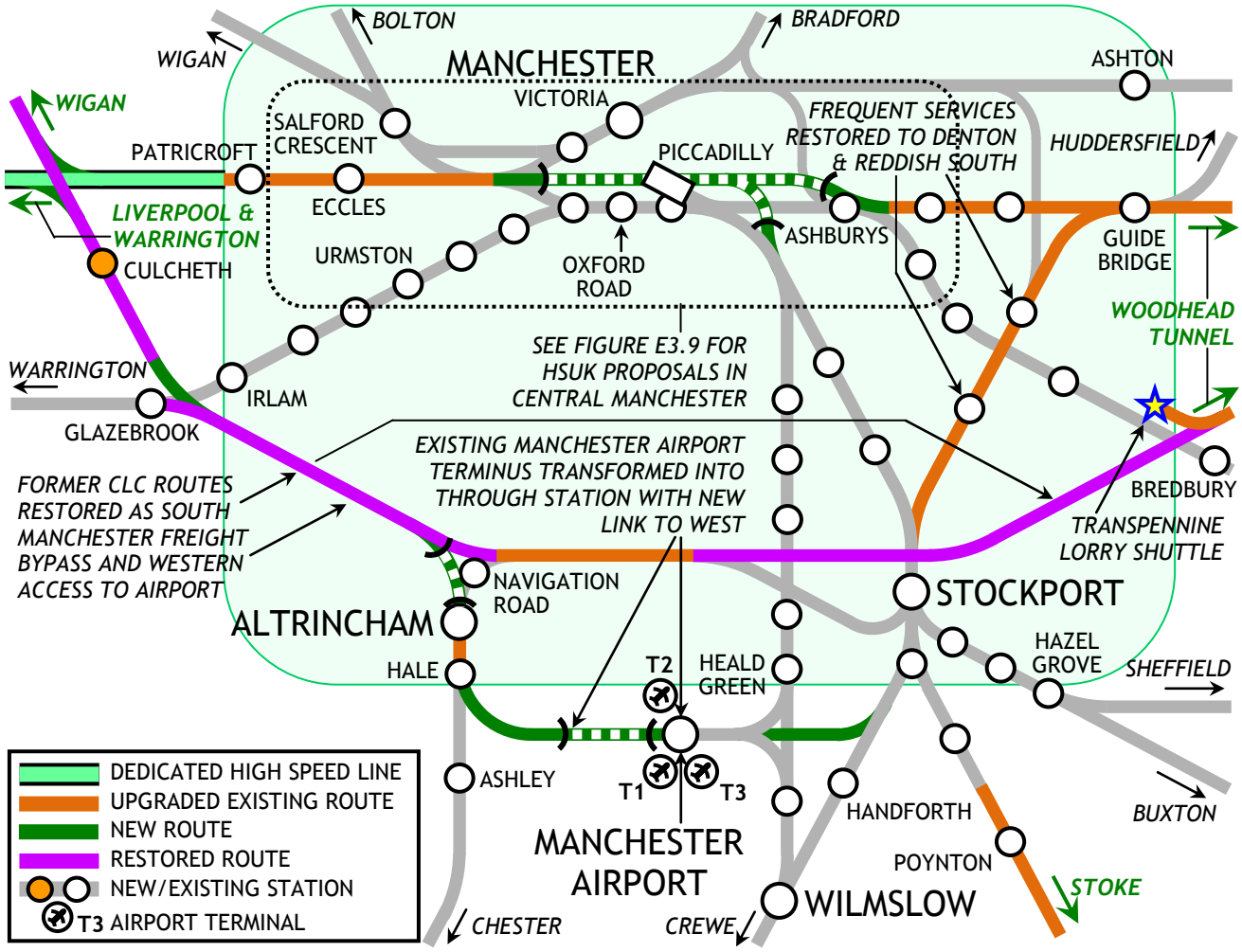


Figure E3.11 : HSUK Proposed Rail Access to Manchester Airport

The key features of HSUK's scheme are as follows:

- A South Manchester bypass for freight traffic will be formed through the restoration of former Cheshire Lines Committee (CLC) routes, including the Tiviotdale route through Stockport. This will connect the restored transpennine Woodhead line to routes to Liverpool.
- The existing terminating branch line into Manchester Airport will be transformed into a through route, linking to HSUK's primary transpennine route at Guide Bridge in the east, and near Culcheth in the west. This will form a complete South Manchester loop.
- From Guide Bridge, the existing route to Stockport will be restored to 2 tracks, and a new link from the Stockport-Crewe line will follow the A555 and connect to the existing airport branch.
- Manchester Airport station will be converted into a 2-track through station, and the route will continue in tunnel under the airport taxiways and under the M56, connecting to the Altrincham-Chester route south of Hale, and onwards via restored routes to rejoin the HSUK route to Liverpool near Culcheth.

The proposed conversion of the existing Manchester Airport terminus into a 'through' station will hugely increase its capacity, through a step-change reduction in standing time. Currently, an incoming train will 'stand' for an average of 16 minutes at a platform, and may be further delayed on its departure as its outbound 'path' may conflict with that of an inbound service. With only 3 platforms, this effectively limits the existing station's capacity to 9-10 trains per hour departing (and the same number arriving).

By contrast, when Manchester Airport is transformed into a 'through' station, trains will 'stand' for no more than 2 minutes (with no conflicts in the immediate vicinity of the station) and the station will have a capacity of around 15 trains per hour departing in both westbound and eastbound directions (i.e. 30 trains per hour , in total). These HSUK services, operating from Manchester Airport's existing centrally-located station along the new South Manchester Loop, will extend to all principal communities of the North.

The new and restored infrastructure created for the new western access to Manchester Airport will also facilitate a restored South Manchester freight bypass. This will enable transpennine freight services routed via the restored Woodhead route to continue past the bottleneck of central Manchester to the Port of Liverpool.

Together the proposed HSUK South Manchester Loop and South Manchester Freight Bypass will achieve a quality of international connectivity across the Northern Powerhouse that neither HS2 nor Northern Powerhouse Rail can come close to matching.

APPENDIX E4

Longer Distance Northern Powerhouse Rail Services (ref 7.1.4)

This report has determined that the performances of High Speed UK and Northern Powerhouse Rail are broadly similar in their capabilities to offer direct links between the principal centres of the Northern Powerhouse. The principal differences between the two schemes lie with the inadequacies of proposals for NPR stations, especially at both Manchester – where Sheffield-Liverpool services will be forced to reverse at terminus platforms at Manchester Piccadilly – and at Manchester Airport – where a dedicated shuttle connection will be required to link the remote HS2 'Manchester Airport' station to the airport terminals.

As detailed in Appendices E3.4 and E3.5, these adverse issues are avoided with the alternative High Speed UK scheme.

High Speed UK							*Direct Connectivity*	Northern Powerhouse Rail						
HSUK Direct Intercity Link														
No HSUK Direct Link			O											
						HU	Hull	HU						
					LS		Leeds		LS					
				LI			Liverpool			LI				
			MA				Manchester				MA			
		MAN	O				MAN Airport				O	MAN		
	NE					O	Newcastle	O					NE	
SH							Sheffield							SH
SH	NE	MAN	MA	LI	LS	HU		HU	LS	LI	MA	MAN	NE	SH

	Shuttle Link at MAN Airport
MP	Via Manchester Pic terminus
	NPR Direct Intercity Link
O	No NPR Direct Link

Figure E4.1 : Direct Intercity Connectivity offered by HSUK and NPR

HSUK's superiority in interlinking the key centres of the Northern Powerhouse is best illustrated by a comparison between the journey times offered by HSUK and NPR (all calculated according to the methodologies set out in Appendix E1). Almost without exception, the better-integrated and more direct intercity routes of the HSUK scheme will offer significantly superior journey times.

High Speed UK							*Journey Times in minutes*	Northern Powerhouse Rail						
						HU	Hull	HU						
					LS	55	Leeds	55	LS					
				LI	47	104	Liverpool	117	60	LI				
			MA	19	26	83	Manchester	87	30	28	MA			
		MAN	13	26	37	94	MAN Airport	103	46	28	13	MAN		
	NE	90	79	100	51	118	Newcastle	137	70	132	102	118	NE	
SH	72	34	23	44	19	76	Sheffield	85	30	73	40	59	102	SH
SH	NE	MAN	MA	LI	LS	HU		HU	LS	LI	MA	MAN	NE	SH

Figure E4.2 : Northern Powerhouse Intercity Journey Times offered by HSUK and NPR

APPENDIX E5

Northern Powerhouse Network Connectivity (ref 7.1.5)

Figure E5.1 : NPR and HS2 Routes Connecting Principal Cities of the North and Extending to Principal Cities in Midlands and Scotland

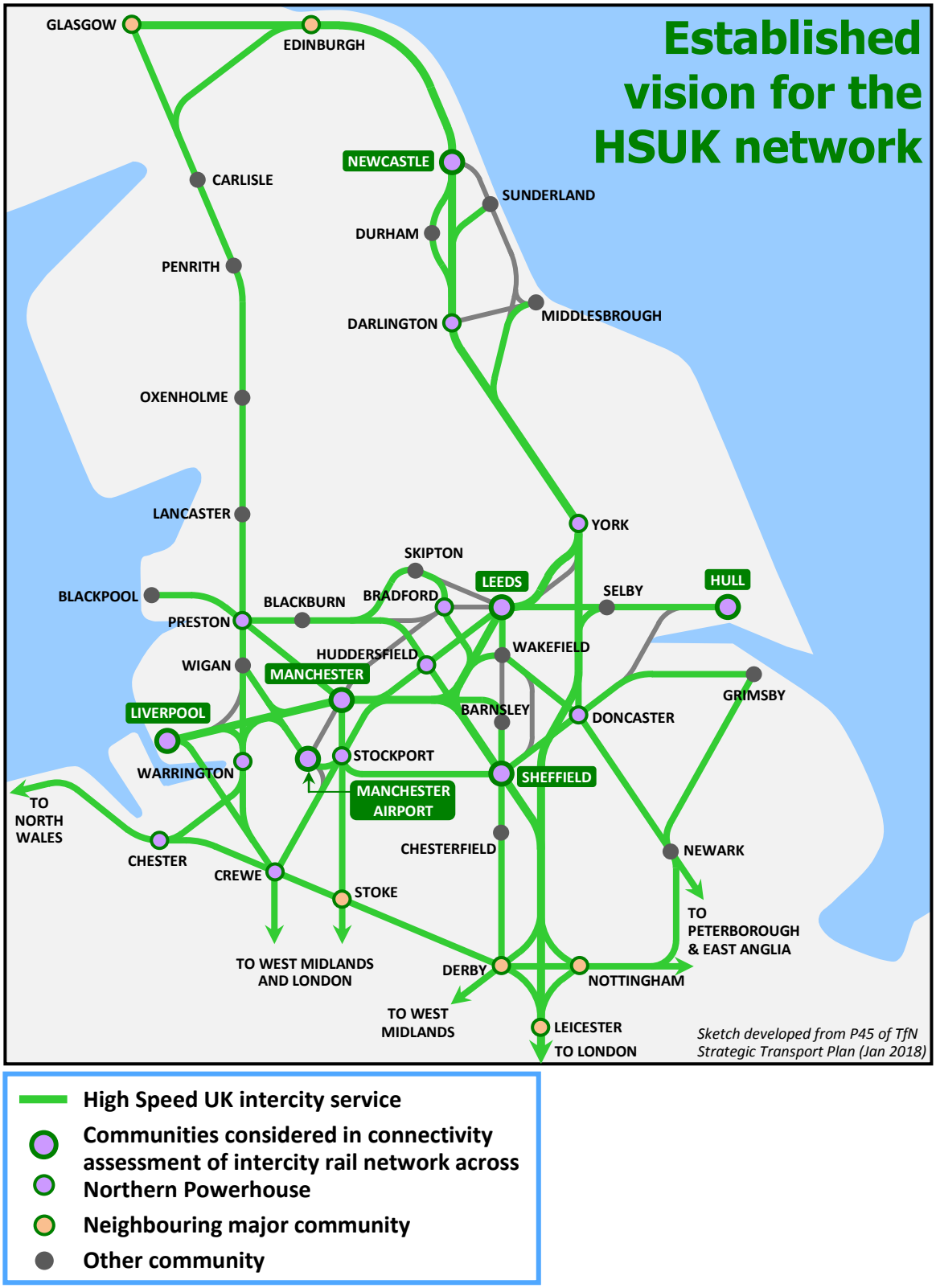


Figure E5.2 : HSUK Routes Connecting Principal Cities of the North and Extending to Principal Cities in Midlands and Scotland

(HSUK proposed intercity services are listed in full in Appendix A1 of HS2 – High Speed to Nowhere, available on www.highspeeduk.co.uk).

Bradford	BD																
Chester		CH															
Crewe			CW														
Darlington	B			DL													
Doncaster					DN												
Huddersfield						HD											
Hull	B						HU										
Leeds	B							LS									
Liverpool	B			B	*MP*		B	B	LI								
Manchester	B			B			B	B		MA							
MAN Airport	B			B	*MP*		B	B			MAN						
Newcastle	B								B	B	B	NE					
Preston													PR				
Sheffield									*MP*		*MP*			SH			
Stockport									*MP*		*MP*				SK		
Warrington																WA	
York	B								B	B	B						YO
	BD	CH	CW	DL	DN	HD	HU	LS	LI	MA	MAN	NE	PR	SH	SK	WA	YO

	Direct intercity link offered by NPR
B	Direct link via HS2 Bradford tunnel
MP	Via Manchester Piccadilly terminus
	Shuttle link at Manchester Airport
	Direct intercity link offered by HS2
	Bypassed by NPR and HS2

Table E5.3 : NPR/HS2 Performance in Connecting Principal Cities of the North

(Locations of cities considered in Northern Powerhouse Connectivity Assessment shown in Figure E5.1)

Table E5.3 demonstrates the poor connectivity offered by NPR and HS2 in interconnecting the principal cities of the North. Together, NPR and HS2 offer only 55 direct intercity links out of a possible total of 136 links between the 17 centres listed (see Figure E5.1 for location of cities, and NPR/HS2 links between these cities).

In these comparisons, it is assumed that:

- Bradford's NPR station will be in a city centre location.
- A dedicated shuttle link will be provided between the remote HS2 Manchester Airport station and the airport terminals.
- Warrington's NPR station will be a parkway station in a peripheral location, failing to meet the 'One North' requirement for city centre stations. Hence Warrington is deemed 'not served by Northern Powerhouse Rail'.

By contrast, HSUK's greatly superior performance is illustrated in Table E5.4, with 103 direct intercity links out of 136 (see Figure E5.2 for location of cities, and HSUK links between these cities). All 16 cities plus Manchester Airport will be served by centrally-located stations, well integrated with local public transport networks.

Bradford	**BD**																
Chester		**CH**															
Crewe			**CW**														
Darlington		**W**		**DL**													
Doncaster					**DN**												
Huddersfield						**HD**											
Hull							**HU**										
Leeds		**W**						**LS**									
Liverpool				**W**			**W**	**W**	**LI**								
Manchester	**W**			**W**			**W**	**W**		**MA**							
MAN Airport				**W**				**W**			**MAN**						
Newcastle		**W**							**W**	**W**	**W**	**NE**					
Preston				**W**				**W**				**W**	**PR**				
Sheffield		**W**							**W**	**W**	**W**		**W**	**SH**			
Stockport	**W**			**W**				**W**				**W**		**W**	**SK**		
Warrington				**W**				**W**				**W**		**W**		**WA**	
York		**W**							**W**	**W**	**W**		**W**		**W**	**W**	**YO**
	BD	CH	CW	DL	DN	HD	HU	LS	LI	MA	MAN	NE	PR	SH	SK	WA	YO

	Direct intercity link offered by HSUK
W	HSUK direct link via Woodhead

Table E5.4 : HSUK Performance in Connecting Principal Cities of the North

(Locations of cities considered in Northern Powerhouse Connectivity Assessment shown in Figure E5.2)

APPENDIX E6

Integration of Northern Powerhouse Rail with HS2 (ref 7.1.6)

	Interregional Links Provided by											
	High Speed 2						High Speed UK					
Bradford						X						W
Chester											W	
Crewe												
Darlington	X	X	X			X						W
Doncaster	X	X	X	X		X						
Huddersfield	X					X						
Hull	X	X	X	X		X						
Leeds	X	X	X			X						W
Liverpool				X			W	W		W	W	
Manchester			X	X			W	W	W	W	W	
MAN Airport			X	X							W	
Newcastle	X	X	X			X						W
Preston									W	W		
Sheffield	X	X	X	X		X						W
Stockport			X	X		X	W	W		W	W	
Warrington	X	X	X	X							W	
York	X	X	X			X						W
	Edinburgh	Glasgow	Derby	Leicester	Nottingham	Stoke	Edinburgh	Glasgow	Derby	Leicester	Nottingham	Stoke
	High Speed 2						High Speed UK					

	HS2 direct intercity link
X	Journey **made worse** by HS2 or HSUK
	HSUK direct intercity link
W	HSUK direct link via Woodhead

A 'journey made worse' is defined as a journey that is a) reduced in service frequency, b) made slower through the addition of 2 or more stops, or c) has new changes of train introduced.

Table E6.1 : NPR/HS2 & HSUK Performance in Interregional Connectivity

(Locations of cities considered in Interregional Connectivity Assessment shown in Figures E5.1 and E.5.2)

Table 23: HS2 services pattern and re-deployment of classic network capacity assumed in the August 2012 economic case

HS2 Captive Services	HS2 Classic-Compatible Services	Classic Network
3tph Euston-Manchester, calling at Old Oak Common and 1tph at Birmingham Interchange.	2tph Euston-Liverpool calling at Old Oak Common and Runcorn, one of which splits/joins a Euston-Birmingham service at Birmingham Interchange, also calling at Stafford. Second also calls at Crewe.	LM WCML services south of Birmingham - net 59 more per day, inc. 26 more Wolverhampton-Euston stopping services (via Birmingham, Coventry, Milton Keynes and other stations), between Milton Keynes/Rugby and Euston and within West Midlands (New Street to Coventry and New Street to Birmingham International).
3tph Euston-Birmingham, calling at Old Oak Common and 2tph at Birmingham Interchange.	2tph Euston-Edinburgh/Glasgow, calling at Old Oak Common and splitting/joining at Carstairs. 1tph calls additionally at Birmingham Interchange and Preston.	ICWC services/LM north of Birmingham - net 87 fewer per day, including merging ICWC Liverpool and Wolverhampton services by diverting Liverpool trains via West Midlands and adding station calls, 19 new Crewe-Euston trains and reduction from 50 to 11 ICWC Manchester-Euston services, excl. three peak services and eight extended

HS2 Captive Services	HS2 Classic-Compatible Services	Classic Network
		to/from Edinburgh. (NB overall Manchester-Euston frequency increased.)
3tph Euston-Leeds, calling at Old Oak Common and two at Toton, two at Sheffield and one at Birmingham Interchange.	1tph provides second hourly service to/from Preston, also calling at Old Oak Common, Crewe, Warrington and Wigan.	MML/Thameslink via MML - net 4 more services per day, including new 16-train Bedford-St Pancras service and a reduction in longer distance MML services between Sheffield, Derby and Nottingham from 60 to 48.
2tph Birmingham-Manchester.	2tph to/from Newcastle, also calling at Old Oak Common and either York or Darlington.	ICEC, Great Northern and TransPennine - net 11 fewer services per day, new 16-train Peterborough-King's Cross service, from 1 to 16 Lincoln-King's Cross trains, reduction from 45 to 16 ICEC Leeds-London services (NB overall Leeds-Euston frequency increased) and 10 fewer ICEC Edinburgh-London services (note ICWC services via Manchester described above).
2tph Birmingham-Leeds, calling at Toton and Sheffield.	1tph providing a second hourly service to/from York, also calling at Old Oak Common and Toton.	CrossCountry services to North East and North West - no change in frequency, additional stops at Birmingham International, Coventry, Sheffield HS, Toton, Alfreton, Macclesfield and Congleton, and some services shortened from Edinburgh/Newcastle to Newcastle/York.
1tph Heathrow-Manchester, calling at Birmingham Interchange.	1tph Birmingham-Edinburgh or Glasgow (in alternate hours), calling at Wigan, Preston, Carlisle and Lockerbie, plus either Lancaster and Penrith, or Oxenholme.	East Midlands local services - no frequency changes, additional stops at Toton, some services to/from Nottingham extended to/from Leicester.
1tph Heathrow-Leeds, calling at Birmingham Interchange, Toton and Sheffield	1tph Birmingham-Newcastle, calling at Toton, Sheffield, York, Darlington and Durham.	Northern England local services - 64 new semi-fast local services per day including 32 Leeds-Doncaster trains, 16 Manchester-Crewe services and 16 Manchester-Stoke trains.

Table E6.2 : Predicted Services on HS2 and Existing Network

(Table 23, pp91-92, *HS2 Regional Economic Impacts*, HS2 Ltd, 2013)

The service reductions identified in Table E6.1 are directly attributable to HS2 Ltd's irresponsible policy of developing services aimed at 'creaming off' lucrative flows between primary cities (e.g. Manchester or Sheffield to London) whilst failing to serve intermediate cities such as Stoke, Derby and Leicester. In a similar fashion, HS2 Ltd's proposed routeing of services to Glasgow and Edinburgh via the corridor of the West Coast Main Line will lead inevitably to the reduction of ECML and CrossCountry services north of Newcastle. This means that services from Yorkshire and North-Eastern cities to Edinburgh and Glasgow will also be greatly degraded. All this is confirmed in HS2 Ltd's own reports, as set out in Table E6.2.

All these problems are avoided by HSUK's design as an integrated national network. High speed services will interlink most principal cities, irrespective of whether they are located inside or outside the Northern Powerhouse region. HSUK will achieve 77 direct city-to-city connections out of a possible 102, while HS2 achieves a derisory score of 2 out of 102.

E6.1 Relative Effectiveness of Transpennine Crossings

High Speed UK's primary transpennine crossing via Woodhead is crucial not just for links between Northern Powerhouse cities, but also for links from Northern Powerhouse cities to neighbouring principal cities, both in Scotland and the Midlands. For instance, HSUK's Woodhead route facilitates links from Liverpool and Manchester to Edinburgh and Glasgow, and from Derby and Leicester to Preston. By contrast, the Northern Powerhouse Rail transpennine route via the proposed Bradford tunnel is completely ineffective in facilitating transpennine links to cities outside the Northern Powerhouse region; these interregional links are of course considered by Transport for the North to be the responsibility of the HS2 scheme developed by HS2 Ltd.

Rather than attribute this to a specific failure of Northern Powerhouse Rail and Transport for the North, it would be more appropriate to cite this as an overall failure of national transport planning, to achieve the necessary integration between NPR and HS2 services. The massively superior connectivity performance offered by HSUK would seem to be the perfect illustration of the benefits of planning the UK's intercity rail network as a holistic and fully integrated system.

The overall performance of HSUK's and NPR's principal transpennine crossings, both inside and outside the immediate area of the Northern Powerhouse, is charted in Table E6.3 below. As with other connectivity comparisons, HSUK vastly outperforms HS2, offering 63 intercity connections via its Woodhead transpennine crossing, compared with 23 intercity connections via the NPR Bradford tunnel.

	Reference	Links via NPR Bradford Tunnel	Links via HSUK Woodhead Crossing
Links between Northern Powerhouse Cities	**Figure E5.3 Figure E5.4**	**23**	**39**
Links from Northern Powerhouse Cities to Adjacent Principal Cities	**Figure E6.1**	**0**	**24**
Total		**23**	**63**

Table E6.3 : Transpennine Links achieved by Bradford Tunnel & Woodhead Crossing

APPENDIX E7

Vision for Northern Powerhouse Railfreight (ref 7.1.7)

The High Speed UK scheme for enhanced transpennine freight links, routed primarily via a restored Woodhead corridor and augmented by a restored Skipton-Colne route (all as detailed in Section 7.1.7 and Figure 23), is part of a wider nationwide strategy for a transformation of UK railfreight.

This strategy is driven by the inability of the HS2 proposals to deliver the capacity and indeed the vision for step-change modal shift of national freight transport from road to rail. This modal shift is essential not only to address the crippling congestion on the existing road network, but also to bring about the dramatic reductions in transport CO_2 emissions necessary to meet the radical 80% reduction target of the 2008 Climate Change Act.

HS2 Ltd has made frequent claims that its new high speed lines will release significant extra capacity on the existing main line network for freight traffic, as intercity passenger flows transfer to the new high speed line. However this 'trickledown' strategy is compromised by:

- HS2's own lack of capacity, and its flawed routeing strategy. *This will leave key routes such as the West Coast Main Line and the Midland Main Line still congested.*
- The lack of any wider vision for a national freight strategy, with freight capacity issues addressed on a nationwide basis and a network of routes created on which freight is 'prime user'. *This requires transfer of express passenger traffic to other lines but slower-speed local/regional passenger traffic would be generally retained.*
- The lack of any vision for an upgraded freight network capable of accommodating larger 'continental' sized rail wagons and 'piggyback' HGV trailers on rail wagons.

The High Speed UK concept for a complementary national freight strategy[33] is illustrated in Figure E7.1. This shows the HSUK scheme for a lorry shuttle link via the restored Woodhead corridor between the M60 in Greater Manchester and the M1 in South Yorkshire. Figure E7.1 also shows the existing routes that must be upgraded to achieve a 'continental gauge' freight network extending to all the key conurbations that will be interlinked by HSUK's new high speed lines. These routes generally comprise either:

- underused existing freight lines; or
- abandoned routes; or
- main lines (such as the Midland Main Line from London to Leicester, and the East Coast Main Line from Newcastle to Edinburgh) that will be paralleled and superseded by HSUK's new high speed lines.

HSUK's establishment of a national continental gauge freight network capable of operating 'piggyback' services will be particularly valuable given its potential to transfer huge volumes of road freight to rail. This should dramatically reduce road congestion and assist in the achievement of step-change road to rail modal shift essential for CO_2 reductions in line with the 80% reduction target of the 2008 Climate Change Act.

[33] The HSUK national freight strategy is available on www.highspeeduk.co.uk.

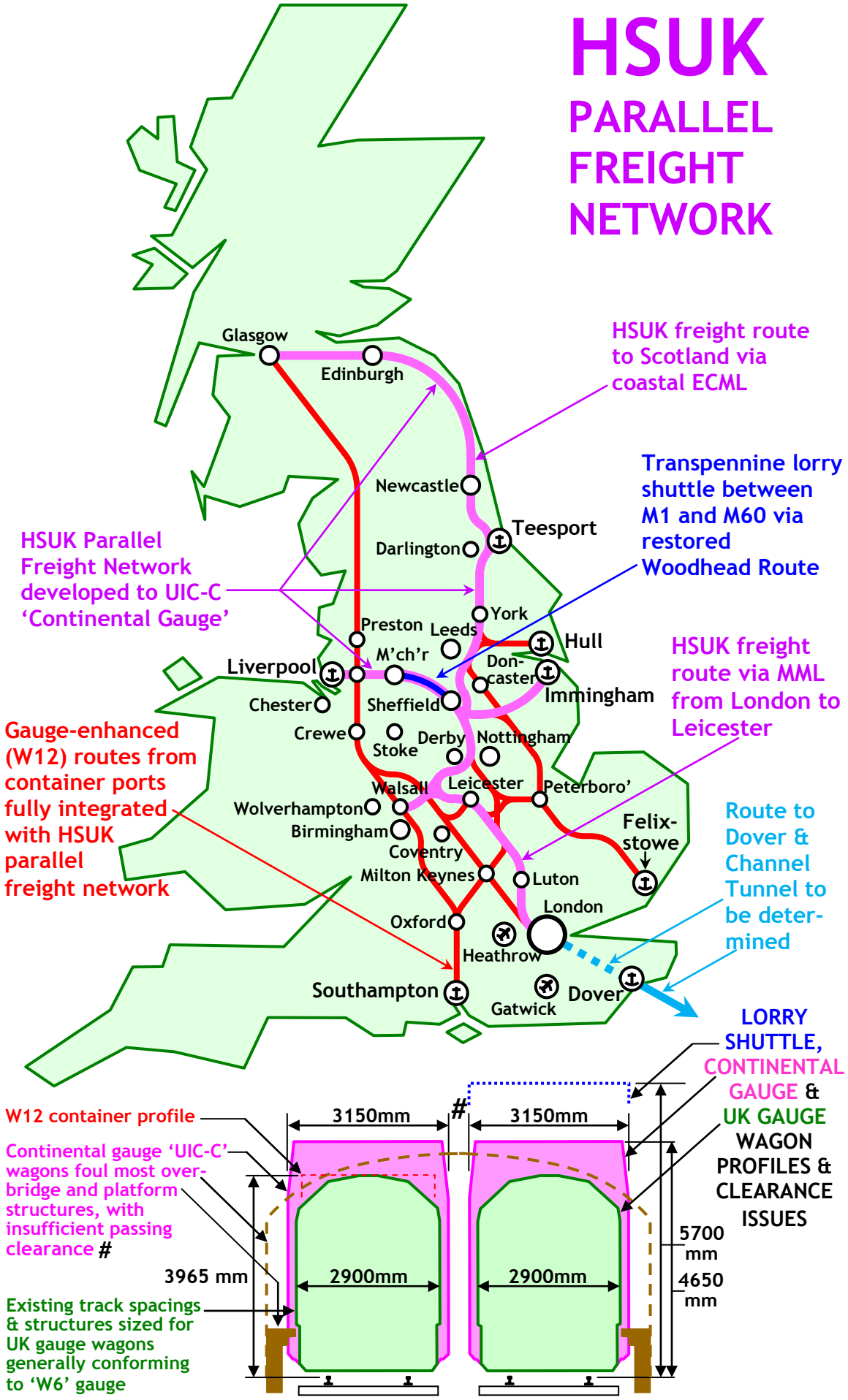


Table E7.1 : HSUK Parallel Freight Network

APPENDIX E8

Minimised Dependency on HS2 (ref 7.1.8)

The primary contention of this report is that Transport for the North's design of a rail network to efficiently link the primary centres of the Northern Powerhouse has been fatally compromised by its predication upon the established HS2 proposals. These proposals have been developed to exclusively north-south priorities; this is utterly clear from the briefest examination (see Figure E8.2) of the full range of routes in Yorkshire that were considered by HS2 Ltd.

With HS2's routes in Yorkshire and Greater Manchester taken as a given, Northern Powerhouse Rail's transpennine routes have been retrofitted onto HS2; there appears never to have been any meaningful effort to design, without prejudice or preconception, a holistic and integrated network that might meet the basic requirements of the 'HS3 Specification' first put forward by 'One North' on 2014.

Figure E8.1 below illustrates the 2 primary dysfunctionalities that predication upon HS2 has introduced into the design of Northern Powerhouse Rail:

- A north-south HS2 route in Yorkshire, located to the east of Barnsley and Wakefield, and (as demonstrated in Figure E8.2) designed with no thought for transpennine connectivity. This places HS2 too far to the east for efficient integration with the single new transpennine route specified by 'One North' (see Section 3.3). Instead, NPR will require 2 separate transpennine routes, each with a tunnel >30km long, to comply with the HS3 journey time specification.
- A circuitous route from Liverpool to Manchester, following the HS2 Manchester Spur via Manchester Airport, that is incapable of offering the 20 minute journey time specified for this route (see Appendix E1.3).

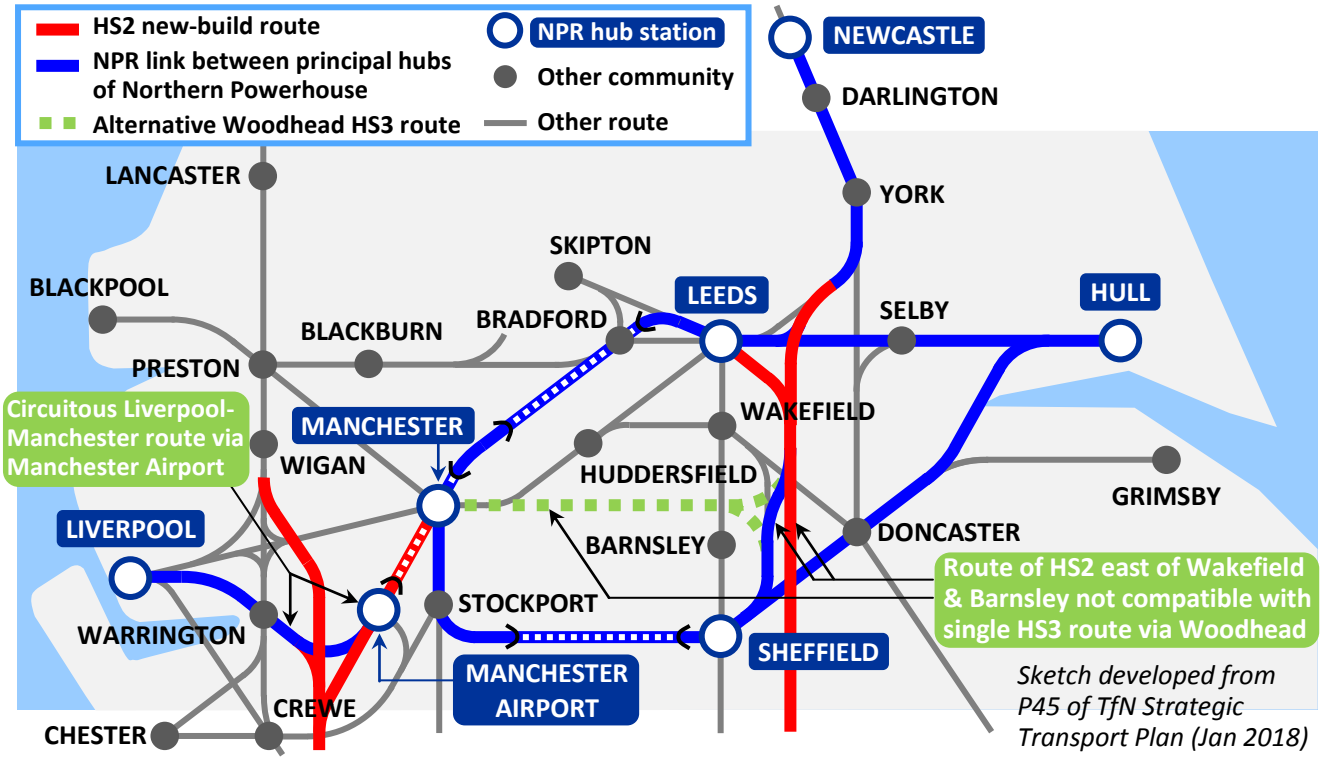


Figure E8.1 : Relationship of HS2, NPR & Single HS3 Transpennine High Speed Line

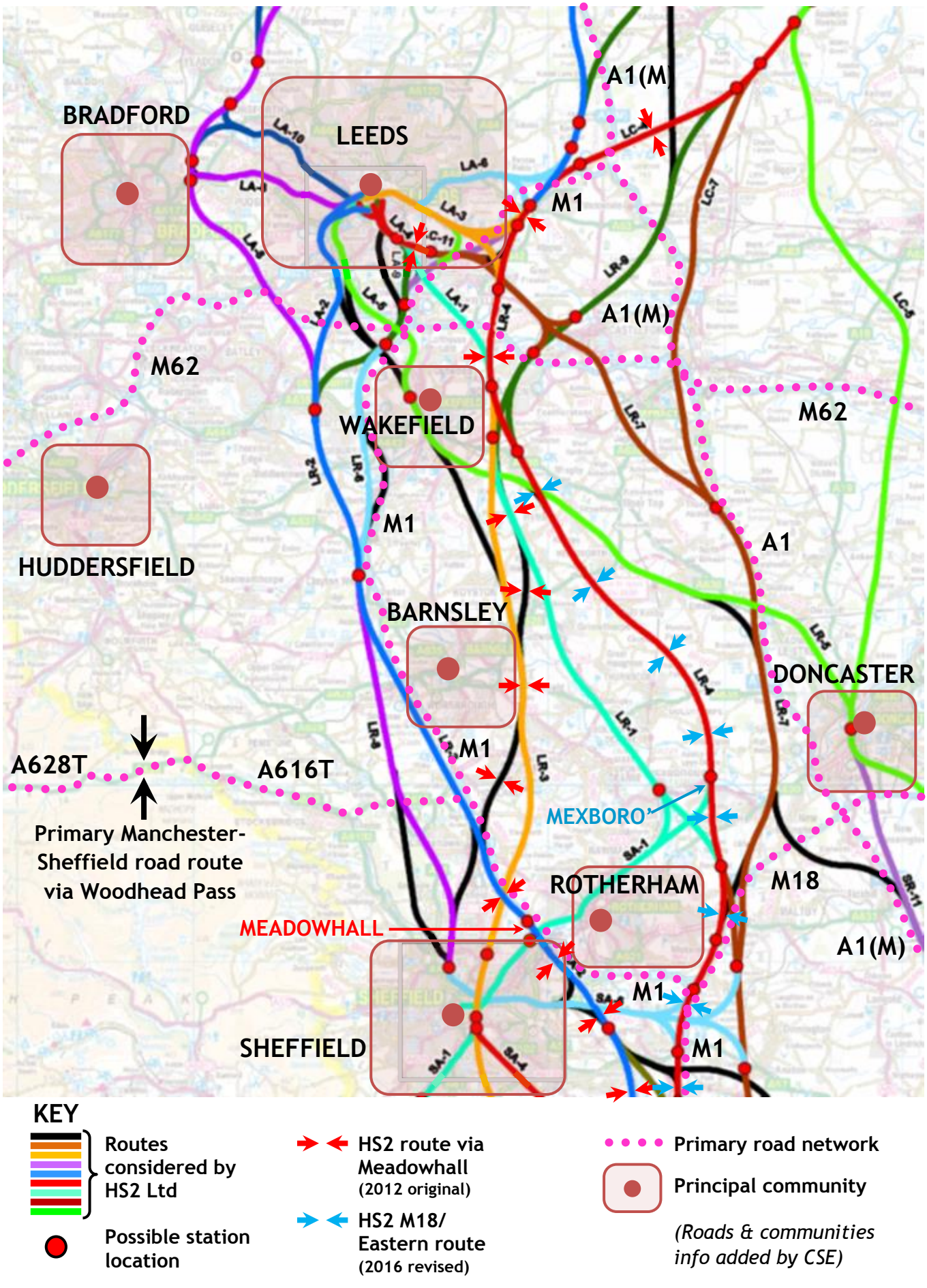
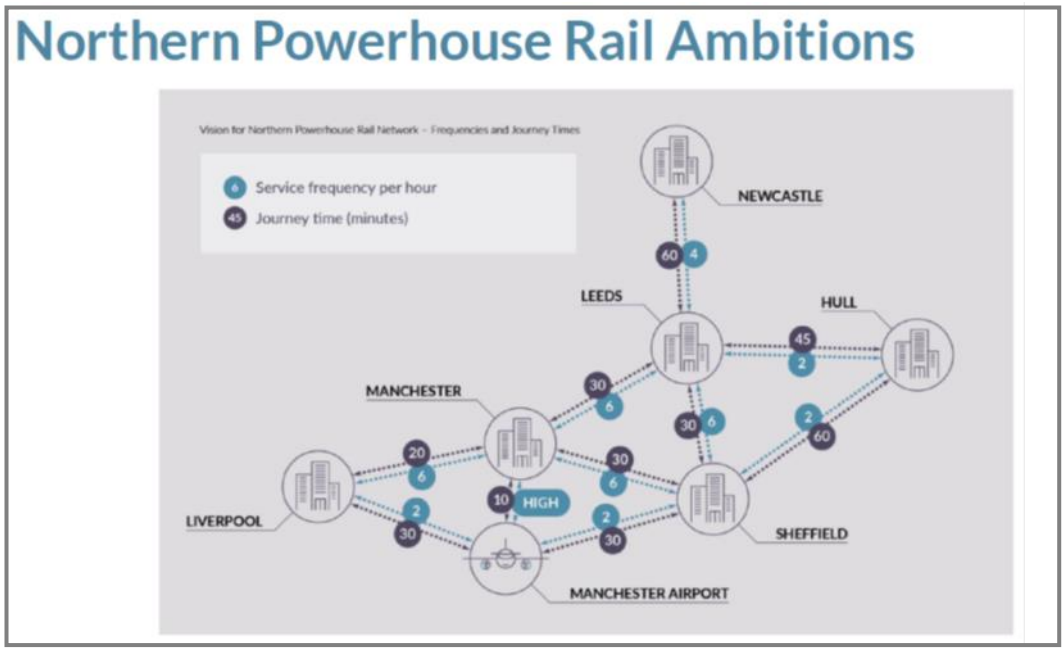


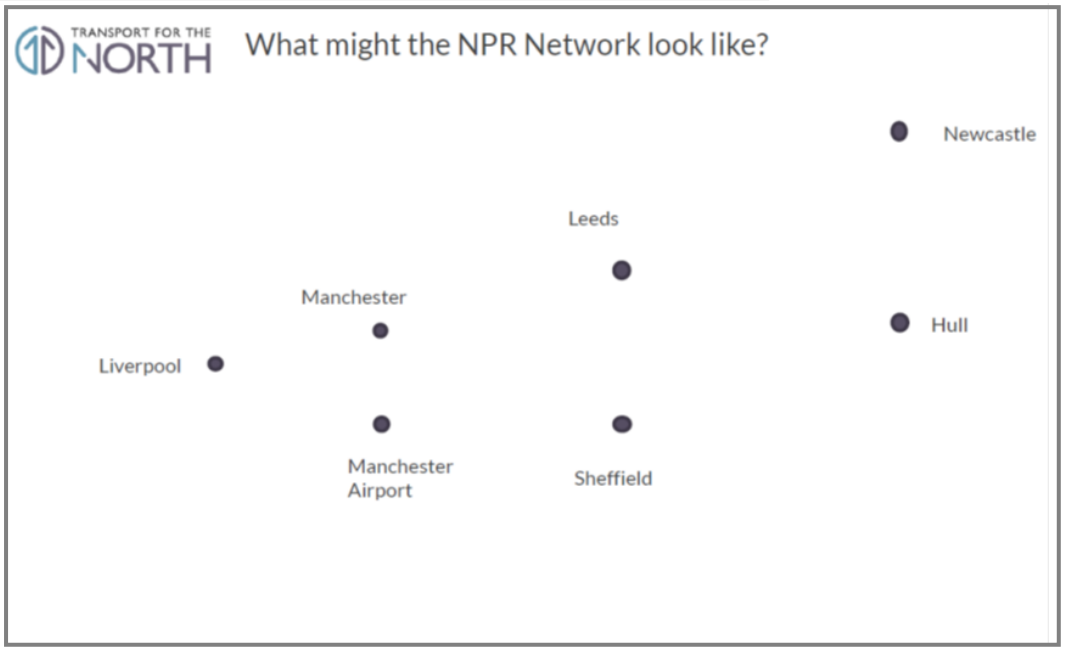
Figure E8.2 : HS2 Route Options in South and West Yorkshire considered by HS2 Ltd

(Extract from FOI18-1944 response by HS2 Ltd, dated 21 February 2018)



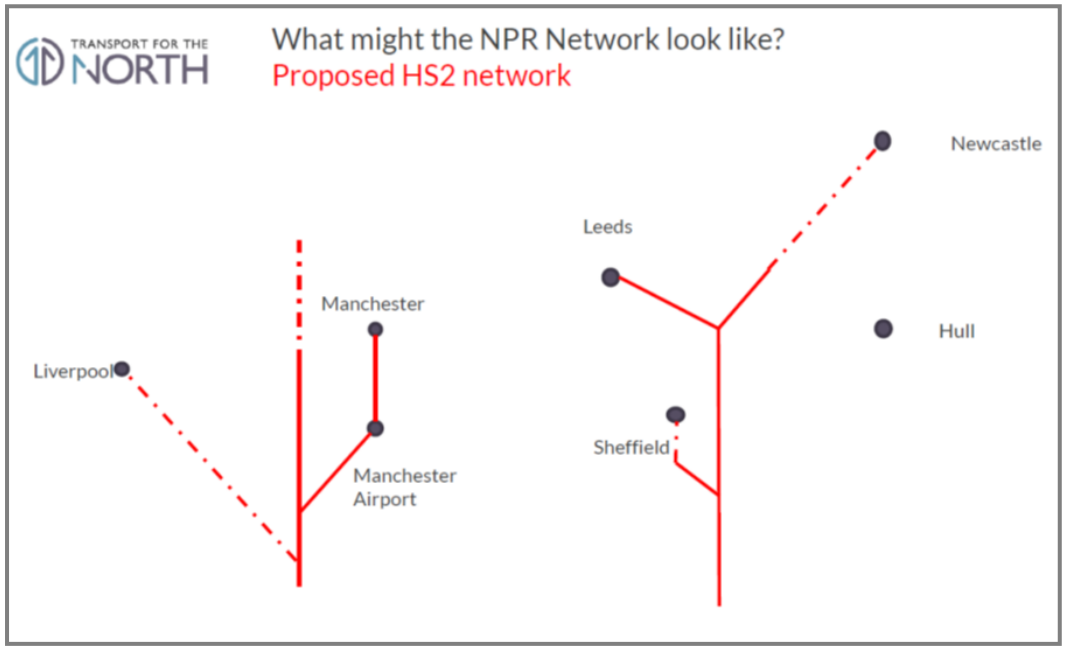
Slide 10/19

'HS3 Specification' for intercity journey times and service frequency – as per Figure 6 of this report



Slide 11/19

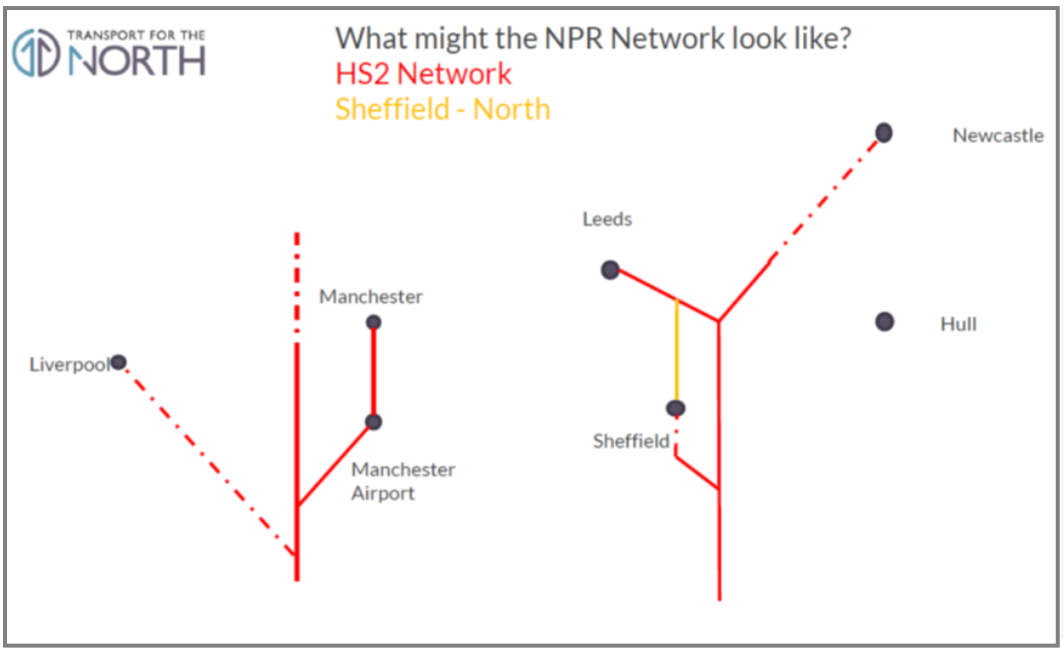
'Clean Sheet of Paper' showing cities and airport to be linked by the 'NPR Network'



Slide 12/19

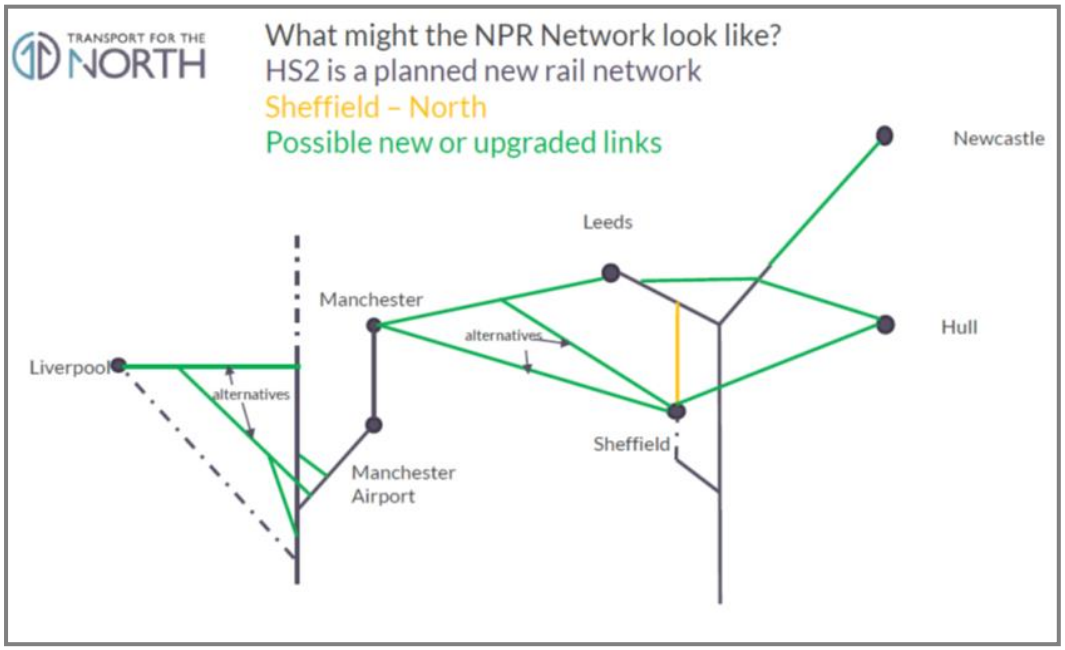
Proposals for HS2 'Y', with routes to North-West and to Yorkshire, taken as the basis of the 'NPR Network'

Figure E8.3 : Slides from Transport for the North Presentation, 21 February 2017 (1)



Slide 13/19

Northern link from Sheffield (upgrade of existing route) also assumed as part of HS2 package



Slide 14/19

Other Northern Powerhouse Rail routes then retrofitted onto HS2 to form the 'NPR Network'

Slide 15/19

General design considerations for the 'NPR Network'

Figure E8.4 : Slides from Transport for the North Presentation, 21 February 2017 (2)

Figure E8.2 illustrates the full range of route options within Yorkshire, that were considered by HS2 Ltd in their development of proposals for Phase 2b of HS2. This proves beyond doubt that HS2's routes within Yorkshire were developed only to deliver north-south connectivity, with no thought whatsoever for future east-west transpennine links. Even routes passing to the west of Barnsley and Wakefield (shown lilac, blue and turquoise), which could make a useful connection to a transpennine route via the Woodhead corridor, appear to be designed to exclusively north-south priorities.

The process by which TfN's Northern Powerhouse Rail proposals have developed from the established HS2 scheme is confirmed in Figures E8.3 ad E8.4. These show slides from a presentation given by Transport for the North to an Institution of Civil Engineers meeting in Leeds on 21 February 2017. These slides confirm a) that TfN was still working to the HS3 Specification in 2017 and b) that the fundamental design philosophy of Northern Powerhouse Rail is founded upon the established HS2 proposals.

The folly of basing the design of Northern Powerhouse Rail upon the deeply flawed HS2 scheme is exposed by every aspect of High Speed UK's comprehensively superior performance, that has been documented in this report.

It must particularly be emphasised that the core HSUK design for a national network of high speed intercity railways was first published[34] in 2008, predating the HS3/Northern Powerhouse Rail concept by several years. The HSUK design required no modification or development to meet the HS3 specification for intercity journey times established in 2014 by 'One North'; it was necessary only to develop the scheme to allow through services to Manchester Airport (see Appendix E1.5/E1.6), and to amend the location of Sheffield's HSUK station from Meadowhall to Sheffield Victoria (see Appendix E3.2).

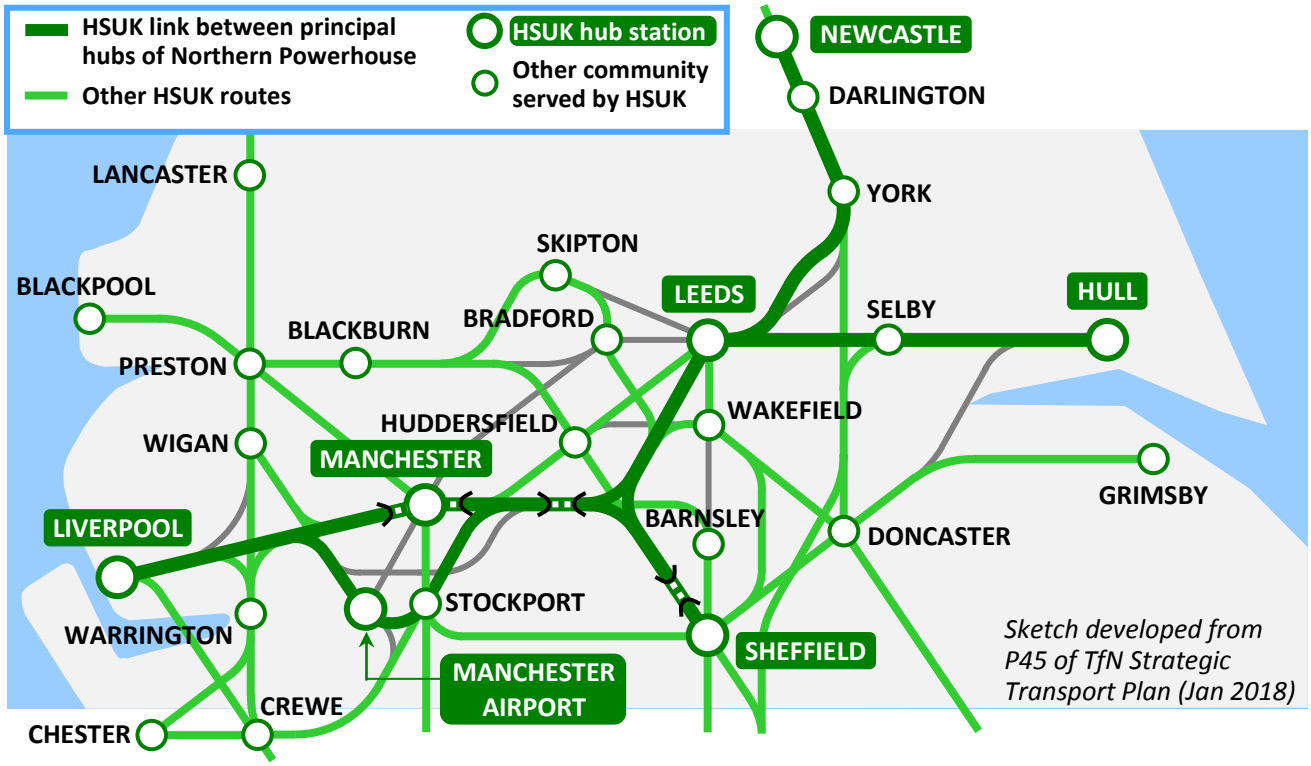


Figure E8.5 : HSUK Transpennine Routes fully integrated with National Network

[34] The High Speed UK concept was first introduced in 2008, under the name of 'High Speed North'. The article by Colin Elliff, entitled *High Speed Rail – Where are the Engineers?*, was published in the Journal of the Permanent Way Institution in October 2008.

The consequence, in terms of construction cost alone, of the misguided development of HS2 and Northern Powerhouse Rail with no overall coordinating masterplan, has already been identified in Section 7.3. The huge £7 billion discrepancy between the costs of HS2 and Northern Powerhouse Rail, and of HSUK, to achieve the journey time targets and wider transport aims of the Northern Powerhouse, can simplistically be attributed to:

- the need for two new heavily-engineered transpennine routes, rather than one; and
- the flawed and fragmented process by which HS2 and Northern Powerhouse Rail have developed.

However, it is instructive to examine in greater detail how the £7 billion cost differential has arisen. Figures E8.7 and E8.8 on the following page identify 4 different 'functional' elements of the HS2/NPR and HSUK schemes, as follows:

1. North-south routes from London to Sheffield and Leeds (red).
2. Connections from north-south route to East Coast Main Line (purple).
3. Transpennine routes connecting Sheffield, Leeds, Bradford and Manchester (blue).
4. Onward routes to Manchester Airport and Liverpool (green).

These cost elements are summarised in Table E8.6 below.

Cost Element		HS2/NPR	HSUK	Difference
1	North-south routes from London to Sheffield and Leeds	£6.7bn	£8.0bn	- £1.3bn
2	Connections from north-south route to East Coast Main Line	£1.8bn	£2.0bn	- £0.2bn
3	Transpennine routes linking Sheffield, Leeds, Bradford and Manchester	£13.7bn	£5.7bn	+ £8.0bn
4	Onward routes to Manchester Airport and Liverpool	£3.7bn	£3.0bn	+ £0.7bn
Total		**£25.8bn**	**£18.6bn**	**+ £7.2bn**

Table E8.6 : Comparative Costs of High Speed Routes in Northern Powerhouse Region

These cost comparisons tell the full story of the failure of the planning process underlying both HS2 and Northern Powerhouse Rail.

- HS2 Ltd selected the cheapest and fastest north-south route in Yorkshire, with no consideration of transpennine connectivity. This route naturally passed through flatter land to the east of Wakefield and Barnsley, and it also had the effect of placing Sheffield on a loop. More expensive routes via central Sheffield, and passing to the west of Barnsley and Wakefield, were rejected.
- With HS2's north-south route located so far to the east, Transport for the North cannot now fulfil the original requirements of the 2014 'One North' initiative, for a single east-west 'HS3' route, fully integrated with the north-south HS2. Instead, it becomes necessary to develop two separate and hugely-expensive new transpennine routes, to meet the HS3 journey time specification.
- The saving of just over £1 billion on north-south routes has led to the wasting of over £8 billion on east-west routes.

The failures of the fragmented and uncoordinated HS2 and Northern Powerhouse Rail are proven by the vastly superior performance of the holistically designed High Speed UK.

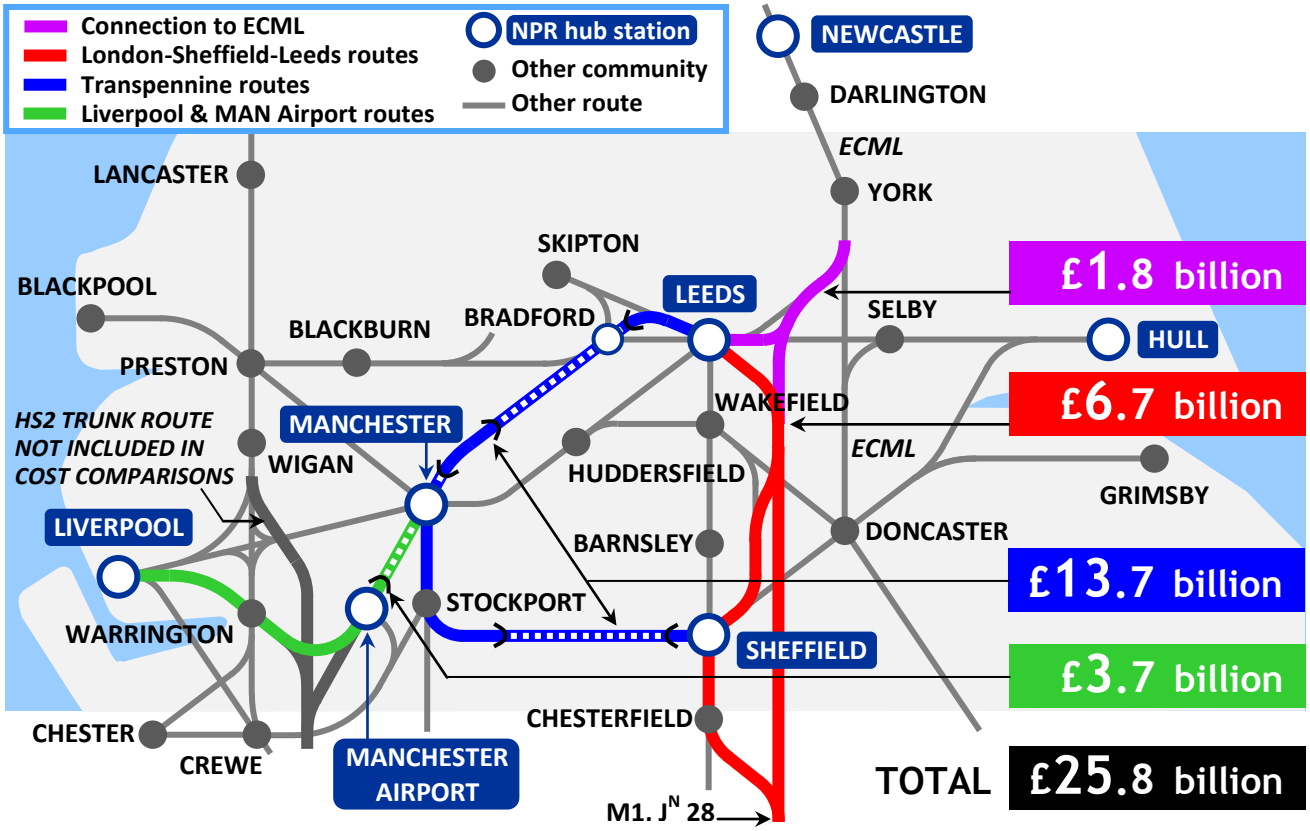


Figure E8.7 : Costings of HS2 and NPR Routes in Northern Powerhouse Region

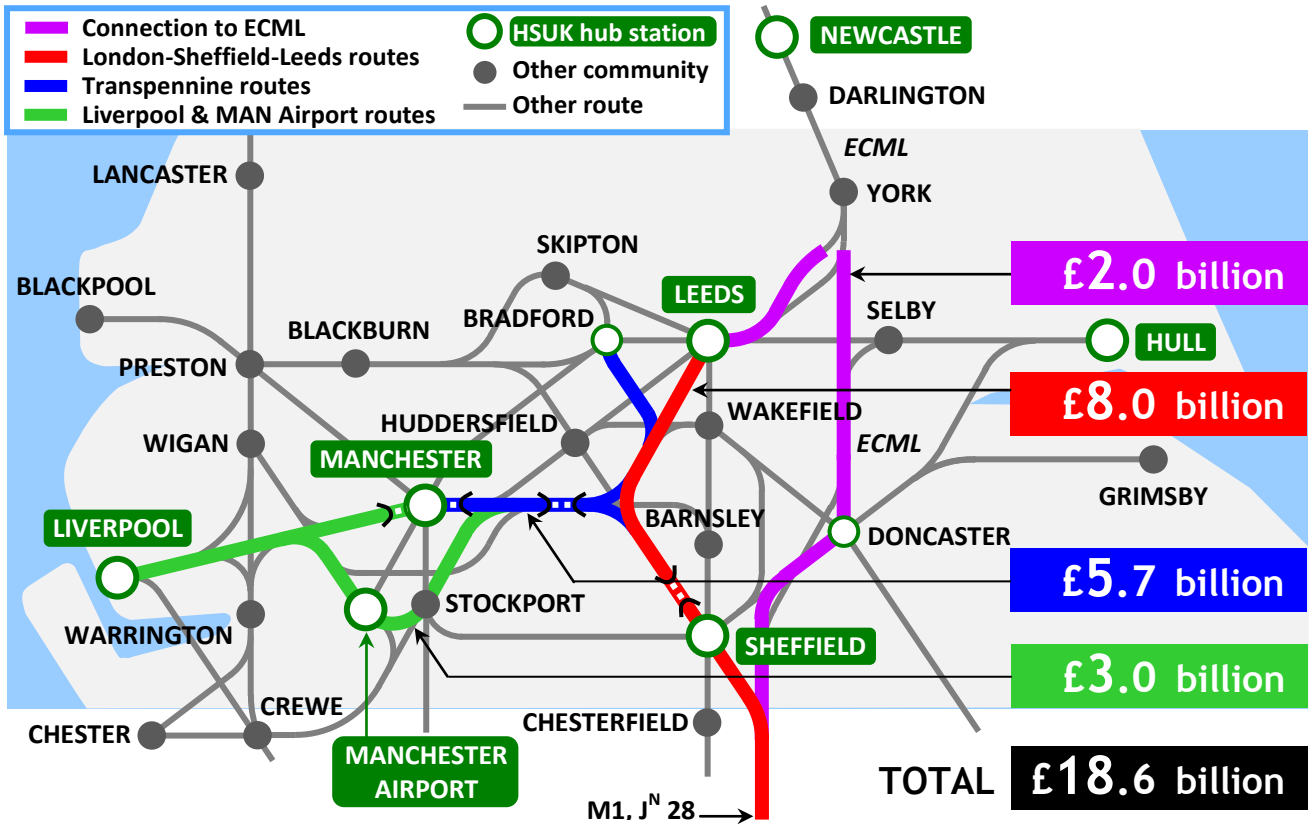


Figure E8.8 : Costings of HSUK Routes in Northern Powerhouse Region

APPENDIX E9

A Complete Vision for Northern Powerhouse Rail (ref 7.1.9)

The readers of this report should consider the 'Emerging Vision' for the Northern Powerhouse Rail network set out in Figure E9.1, and the 'Established Vision' for High Speed UK's passenger and freight networks across the Northern Powerhouse region as set out in Figures E9.2 and E9.3. It is for the readers to decide which scheme represents the best and most complete transport future for the Northern Powerhouse.

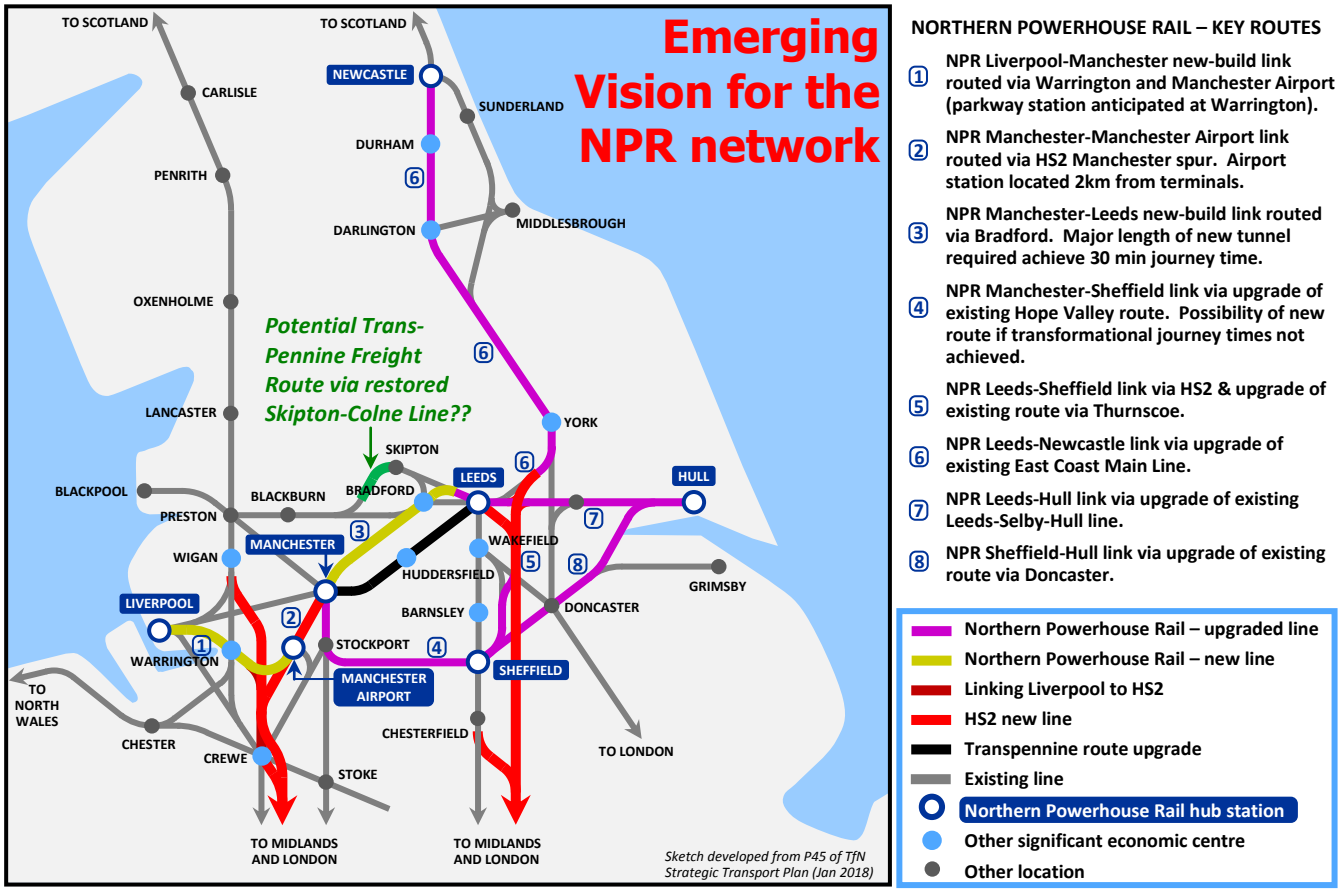


Figure E9.1 : 'Emerging Vision' for TfN Northern Powerhouse Rail Proposals

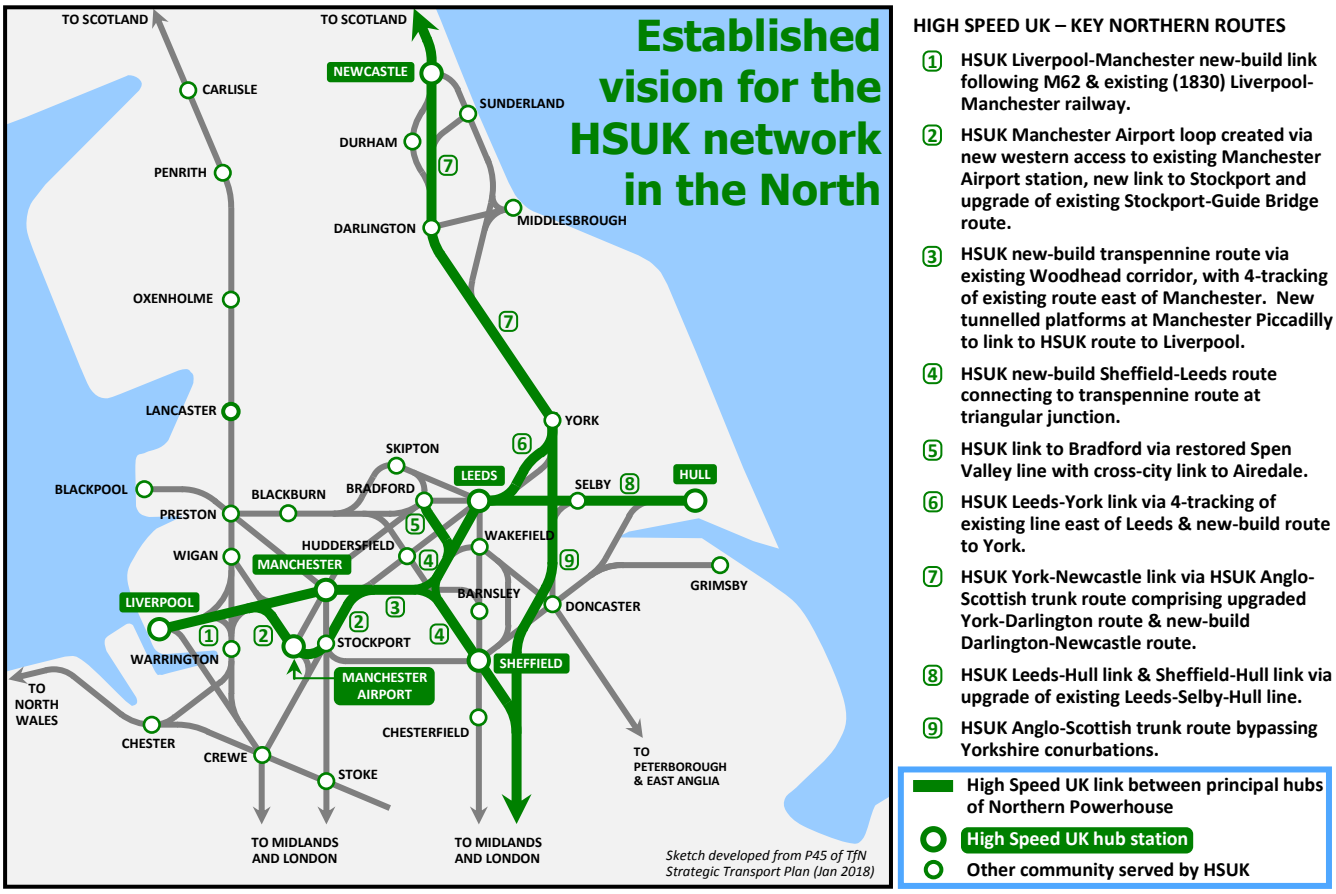


Figure E9.2 : 'Established Vision' for HSUK links between principal Northern Powerhouse cities

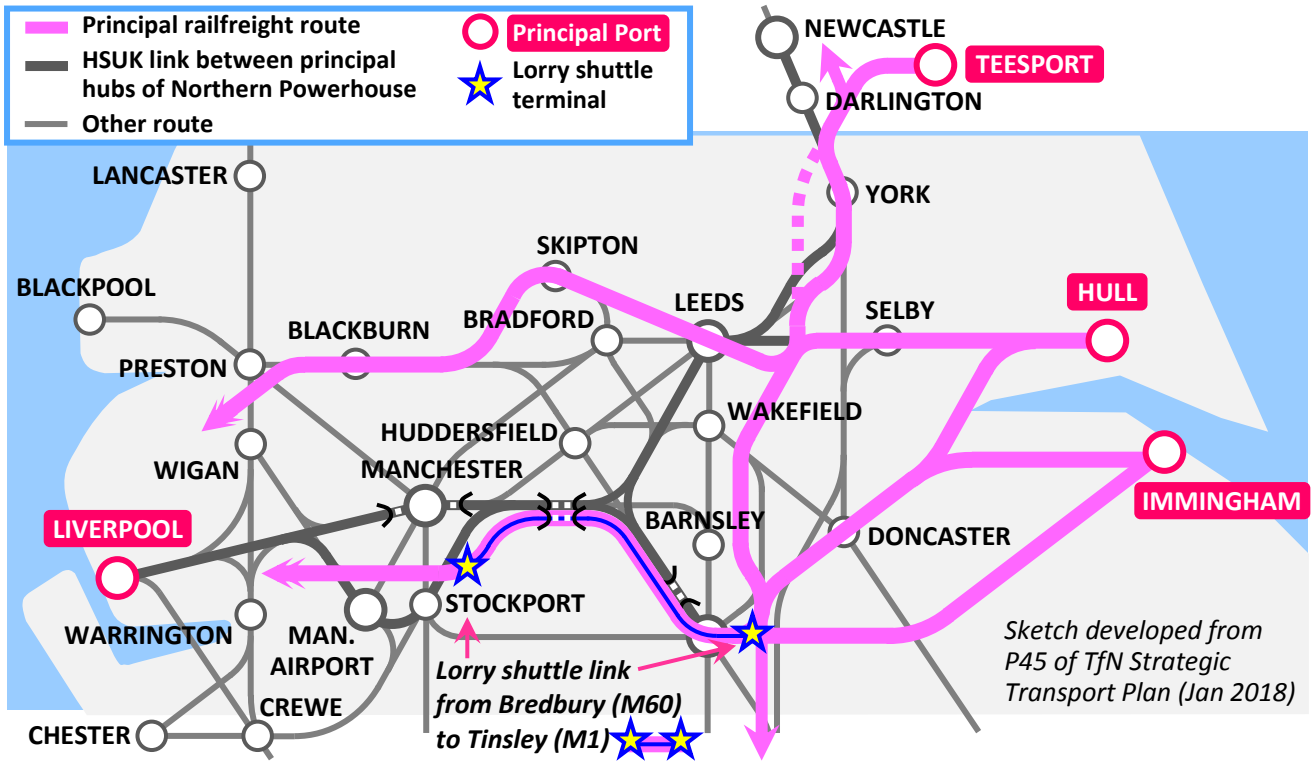


Figure E9.3 : Scheme Plan for HSUK freight routes in Northern Powerhouse region