What is required to accommodate future train services in the Doncaster area to maximise socio-economic benefits in the medium to long-term?

Doncaster Area Strategic Advice

February 2021
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Part A Executive Summary

What is required to accommodate future train services in the Doncaster area to maximise socio-economic benefits in the medium to long-term?

The Doncaster Area Strategic Advice provides a set of outputs to make sure that the railway in the Doncaster area is ready for the decades to come. The work considers the needs of the network holistically, with experts from across the rail industry working with Network Rail to provide inputs. The recommendations made here are evidence-based and impartial, produced using industry recognised analysis methodologies. Because of this, Doncaster Area Strategic Advice is a vehicle through which funders including the Department for Transport (DfT) and Transport for the North (TfN) can make informed investment decisions and understand the complex interdependencies between train service and infrastructure proposals.

This strategic advice is rooted in forming a holistic plan for the railway in the Doncaster area. It analyses the impacts of and synergies between plans for Northern Powerhouse Rail (NPR) and HS2 Phase 2b, tying in regional aspirations such as a heavy rail link to Doncaster Sheffield Airport (DSA) and proposals for new local services seeking to boost connectivity and offer more and new journeys to passengers.

This report is rooted in the role of the network in supporting the economy and society across the entire geography, including principal routes and the lines feeding them, whilst also having regard to the imperatives imposed by the climate emergency. Holistic planning is not just about track, station, and power supply capacity, but also seeks to make links to the performance benefits that can be gained by using the network as efficiently as possible, as well as to wider industry strategies such as Traction Decarbonisation Network Strategy (TDNS). All these factors combine to support a safe, sustainable and high performing railway for the long term which puts passengers and freight end-users first.

The combined impact of the many factors listed above is a recommendation for transformational change and a levelling-up of the rail network in South and West Yorkshire for the coming decades, helping to rebalance and decarbonise the economy. Doncaster Area Strategic Advice highlights the benefits of investment in the network regardless of the delivery of major programmes such as NPR. It acknowledges the potential impact of the COVID-19 pandemic on the level of demand for rail services while advocating that further development is undertaken on a set of options that will lead to a resilient, integrated network. This report sets out the next steps to making this happen, recommending that the industry further develops these proposals in parallel to wider industry efforts to reconcile post-pandemic demand forecasts, through a lens that the strategic case is every bit as important as the economic case.

The list below shows the key network constraints found through Doncaster Area Strategic Advice, based on the technical analysis undertaken. Indicative options with assessments of their deliverability and order of magnitude cost ranges have been identified and developed as a potential way of addressing these constraints, with the ultimate recommendation being that the outputs of this report are progressed through to Strategic Outline Business Case (SOBC) to further assess and understand the capacity and economic impacts of potential solutions.

The key constraints found in this study are:

- Line and junction capacity within the northern and southern throats of Doncaster station
- Platform capacity at Doncaster station
- Line and junction capacity between Hare Park and South Kirkby, including platform capacity at Fitzwilliam
- Line and junction capacity south of Doncaster on the East Coast Main Line (ECML)
- Platform lengths across the study area

Photo: Tony Watson
A.1 Frequently Asked Questions

A.1.1 How does this study integrate with the planned delivery of High Speed 2 and Northern Powerhouse Rail?

NPR and HS2 each have their own outputs, objectives and evidence-base. This report highlights the potential roles both respective programmes can play in meeting demand in the Doncaster area. NPR responds to these needs by providing an uplift in the frequency of services offered today, while HS2 can play a key role in abstracting wider East Coast Main Line (ECML) demand for through journeys, freeing up space on the conventional network for other uses. The recommendations throughout this report are therefore based on support for the programmes, with recommendations given on potential opportunities to maximise benefits. In addition, the conclusions of the Integrated Rail Plan for the Midlands and North (IRP) are expected imminently, and consideration has been given to the railway’s future in scenarios where NPR and HS2 are not constructed as planned as a result of delay or change to scope. Scenario planning is an important part of any strategy, so should not be misinterpreted as a suggestion that Network Rail does not support either programme.

A.1.2 Does this study take account of aspirations for a rail connection to Doncaster Sheffield Airport?

During consultation with stakeholders the study was remitted to consider the impact that a potential heavy rail connection to DSA may have on the wider railway in the area. As with NPR and HS2 Phase 2b, scenarios were modelled both with and without delivery of the scheme to give a spectrum of outcomes. Network Rail worked with the promoters of the scheme to fully understand their plans and how the airport could be served by heavy rail.

A.1.3 How does this work differ from previously published Network Rail strategic advice, such as the East Coast Main Line Route Study?

Doncaster Area Strategic Advice assesses the entire study area railway geography, including trade-offs between different routes. It therefore builds on the published East Coast Route Study not just through specific consideration of the impacts of HS2, NPR and DSA, but also through inclusion of the wider geography. The process also brings local stakeholders into the heart of the study, meaning that plans and aspirations can be more closely understood and reflected in more detail during the work.

A.1.4 This report doesn’t mention my organisation’s aspirations. Will Network Rail support our plans?

Strategic advice focuses its recommendations to paint a clear picture of what is required for the railway. This means that not all known aspirations are referenced. Network Rail welcomes discussions with interested parties on improvements to the railway, whether these are specifically recommended by this report or not. A proposal is of course more likely to be supported if it complements railway investment plans. Further, Network Rail welcomes working with interested parties to assess the relationship between rail and land-use planning more broadly, including how the railway can effectively support housing, employment and economic growth.

A.1.5 What are the impacts of COVID-19 on rail investment planning?

Demand forecasting for this work commenced prior to the COVID-19 pandemic. At the time of publication, the long-term impacts of COVID-19 on rail demand are still being fully analysed and understood. Scenario planning is an important part of rail strategy, and this study looked at a range of growth scenarios catering for low, medium and high growth outlooks, with a high degree of synergy between recommendations tied to each different scenario. This report makes the case for early development of options to be undertaken in parallel to wider industry efforts to reconcile demand forecasts, given the relatively small marginal cost of such activity weighted against the risks of standing still. Also identified are strong performance related drivers for investment based on the segregation of traffic flows, making some interventions appropriate even if growth is low. The rail industry continually reviews and updates strategic advice, and Network Rail will work with funders to make sure the rail network continues to support society and the economy in the long-term.
Part B Strategic Advice

Strategic Advice is produced using an industry process known as Continuous Modular Strategic Planning (CMSP), providing a rolling programme of recommendations and answering specific strategic questions defined by the rail industry. CMSP is the mechanism which provides funders with an impartial, evidenced-based strategy for the long-term future of the railway. In doing so, it puts the priorities of passengers and freight-users first by identifying opportunities for rail investment to stimulate economic growth as part of the wider transport system. As a collaborative approach to strategic planning, service specifiers, train operators and local and sub-national transport bodies work with Network Rail to develop these investment recommendations.

Making the best use of train, track and station capacity is a key challenge for the rail industry. It is important to understand how service patterns, journey times and train performance impact the capacity and capability of the rail network, and the CMSP process is led by Network Rail to balance these factors. Furthermore, in an environment in which land-use and transport powers are increasingly devolved to local and regional decision-makers, strategic advice recommendations are rooted in the whole-system impacts of planned major investments, including NPR and HS2. As such, organisations like TfN work closely with Network Rail throughout the CMSP process. All CMSP work is supported by a governance structure, including the working group, whose members contribute local knowledge and evidence throughout the process.

Figure 1: Some factors considered by this Strategic Advice
Part C Doncaster Strategic Context

C.1 Geographic Scope

Figure 2 (above) sets out the geographic scope for this study, which centres on the Doncaster area and its approaches. Heading away from Doncaster, the boundaries are (inclusive) Outwood, Joan Croft, Hatfield and Stainforth, Finningley, Ranskill, and Swinton, as depicted.

Doncaster is a key hub for the rail network and sees long-distance traffic from all corners of Britain mixing with local services in a constrained environment where capacity for trains is scarce, giving the potential for even the smallest of problems to have a wider effect across the country. Therefore, the way in which the railway around Doncaster operates is of significance to the wider system. It is incumbent on the industry to strike a note that allows for adequate capacity to support a good service meeting the needs of passengers and freight-users, without overfilling the railway to the point at which high performance becomes unsustainable. Over the coming years, multiple increases and changes to train services are proposed, with partners looking to boost connectivity and improve transport links across the region.

Planning for the network requires a clear understanding of any discrepancy between forecast demand and the capability and capacity of the railway to support a high-performing service. Strategic advice is about planning holistically for the future of the whole railway around Doncaster to facilitate forecast growth and to maximise the benefits of rail investment.

The strategic question answered by this report is therefore:

What is required to accommodate future train services in the Doncaster area to maximise socio-economic benefits in the medium to long-term?

It is important that the recommendations of this report are used by funders as investment plans for NPR and HS2 Phase 2b mature, in parallel with the conclusions of the IRP. In the case of NPR which directly serves Doncaster, there are synergies and whole industry cost savings to integrating plans at every stage of the development process. Likewise, although HS2 Phase 2b is not planned to directly serve Doncaster, construction will impact the scale of...
interventions required on the central and southern sections of the ECML. Planning in a joined-up manner for the long-term future of the network will provide a one-off opportunity to support the economy of the north. It should therefore be remembered that the desired outcome of investment recommendations made here is that rail provides socio-economic benefits for passengers, freight-users and the taxpayer across the region.

A high-quality rail network likewise encourages modal shift, reducing road congestion, carbon emissions and improving air quality. The working group agreed that there are multiple factors critical to providing recommendations for the 2030s and beyond including, but not limited to:

C.1.1 Capacity and Journey Time
In addition to understanding forecast demand between major destinations, strategic advice provides a sense-check that local forecast demand is factored into plans. The train services analysed have been assessed to make sure that sufficient passenger carrying capacity is provided on each identified corridor. In some scenarios, this includes testing the frequency conditional outputs of the TfN Long Term Rail Strategy (two trains per hour in each direction between locations). Where opportunities to reduce journey times are present, these are also explored.

C.1.2 Stations, Connectivity and Effective Interchange
Stations are of critical importance not only to railway operations, but also passenger experience and the economy. A well planned, efficiently functioning station helps to make the most efficient use of railway capacity, reduces the potential for station related delays, and offers passengers the opportunity to make their journeys and connections as quickly and easily as possible. Doncaster is particularly critical in this regard, acting as an interchange node connecting passengers from six directions. Strategic advice looks not just at service frequency and journey times for passengers, but also how the station operates and whether there is likely to be any crowding issues in scenarios tested.

C.1.3 Performance and Reliability
Because of its nature as a key hub surrounded by diverging routes, Doncaster has an abundance of train services that require the same portion of track. A key part of this work therefore is to consider how service groups and flows can be best managed to minimise the impact they have on one another. Simply providing adequate capacity is not enough on its own, and consideration must be given to opportunities to boost performance and reliability.

C.1.4 Safety
Safety is at the heart of everything the rail industry does. Providing strategic advice is no different and a key consideration is making safety recommendations where appropriate. As part of the analysis, the effect of increased train services on level crossings and stations is assessed, and a safety baseline (a review of safety in the area, looking at trends and themes) is produced to identify and act on any areas of concern.

C.2 Existing Train Services

C.2.1 Passenger
The study area is served by a wide range of passenger services including those run by open access operators. Long-distance high-speed trains provide direct links with major UK cities including London, Leeds, York, Newcastle and Edinburgh. Doncaster also acts as a hub for regional, cross country and local services, running to intermediate stations on their way to Leeds, Manchester, Hull, Cleethorpes, Lincoln, Sheffield and beyond.

The principal route at Doncaster is the East Coast Main Line. To the north, long-distance high-speed trains serve destinations such as York, Darlington, Newcastle, Berwick-upon-Tweed and Edinburgh, with some continuing to destinations including Dundee, Aberdeen and Inverness. Several miles north of Doncaster, some services branch off towards Selby or Pontefract. To the south, a range of long-distance operators, including open access, provide direct services to London.

Heading north west, a mix of long-distance high-speed and local services serve Leeds. To the east, trains make their way to the coast, linking the likes of Hull, Grimsby and Cleethorpes, while on the Great Northern / Great Eastern Railway stations to Lincoln are served, with plans for these services to become more frequent and continue on to Peterborough. Finally, a key route from Doncaster heads south west to Sheffield, with local trains serving intermediate stations, regional services heading to Manchester and cross-country services continuing to the Midlands and beyond.

C.2.2 Freight
Doncaster is one of the principal freight hubs on the national network, with significant yard and cargo handling facilities lying to the south of the station. Rail freight is responsive to market trends, and although flows are less uniform compared with passenger trains, the area supports a wide range of regular services. Amongst others, this includes regular container traffic; Doncaster hosts
two intermodal terminals with flows to and from Teesport, Wakefield, Leeds and the southern ports, with demand growing in recent years. Due to the significant yard facilities, Doncaster is also a hub for network trains, carrying materials and equipment needed for engineering works across the network, such as ballast. Amongst others, there are also trains carrying biomass, steel and aggregates and a mail train from Low Fell near Newcastle which runs to Willesden in North London.

C.3 Future Train Services

C.3.1 Planned service changes – the Doncaster Area Strategic Advice train service baseline

The railway network will see a significant improvement over the coming years, particularly as a result of the East Coast Upgrade\(^1\) comprising major investment at locations such as King’s Cross and Werrington, near Peterborough. As the industry works to complete the programme, the following new services were modelled based on changes planned to be implemented subject to detailed timetabling assessment:

- Extension of the existing London – York service to Newcastle, which will run hourly (currently runs every two hours)
- Five new trains per day between London and Edinburgh, which are not planned to stop within the study area
- A train every two hours between Middlesbrough and London
- Altered calling patterns on some services
- The existing Sheffield and Hull to Doncaster terminating services are joined into one through service
- The existing services from Lincoln and beyond to Doncaster increase from five trains per day to an hourly service from Peterborough via Lincoln

C.3.2 Northern Powerhouse Rail and Transport for the North plans

NPR plans to provide transformational changes to journeys across the north of England. TfN are developing the programme, which will make it easier to move between the north’s towns and cities through new and significantly upgraded railway lines. Within the study area, emerging plans are being developed in parallel with Doncaster Area Strategic Advice, based on speeding up journeys to and from cities across the wider region, such as Hull and Sheffield. The industry’s agreed train service plans for NPR are factored into the relevant scenarios of this strategic advice. It is important to recognise that Doncaster Area Strategic Advice does not present an alternative to NPR, instead providing a complementary suite of recommendations to make sure that benefits are maximised and that investment plans are consistent with forecast demand on all routes.

C.3.3 High Speed Two Phase 2b

HS2 Phase 2b is planned to form a ‘Y’ shape, splitting into an eastern and western leg, and both are pertinent to this study. The western leg is planned to connect to high speed lines at Crewe and continue towards Manchester, with services joining the West Coast Main Line (WCML) further north to destinations across the North West and Scotland. Meanwhile, the eastern leg is planned to connect in the West Midlands and allow trains to run through to Sheffield, Leeds and Newcastle.

Although the high-speed line is not planned to pass through the Doncaster area, it is significant in the context of wider abstraction of demand. It can be reasonably expected that, upon planned completion of HS2 Phase 2b, many passengers travelling from origins in Scotland and North East England will choose quicker options running via HS2, lessening the demand on existing long-distance high-speed services. This report sets out recommendations that are consistent with various HS2 Phase 2b outcomes, making them durable in the face of changes to the wider rail context and the Integrated Rail Plan for the Midlands and North (IRP).

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1  The East Coast Upgrade is a £1.2 billion investment in the ECML, facilitating more services and faster journeys.  
https://eastcoastupgrade.co.uk/
C.3.4 Doncaster Sheffield Airport

Doncaster Sheffield Airport owners, Peel Group, alongside Sheffield City Region and Doncaster Borough Council, have developed proposals for a new national rail connection to the airport site. As depicted below, DSA is situated at the apex of the ECML and the northern end of the Lincoln line, with connections to both being feasible because of their proximity to the airport. Known as GatewayEast, the scheme seeks to introduce just over four miles of new track connecting with the ECML at Bawtry, passing through a new station at the airport and joining the Lincoln lines at Finningley, giving the potential for a mix of through and terminating services from either direction.

During early stakeholder working groups, examining the effect that the scheme could have on the railway around Doncaster was identified as an output of this study. A Strategic Outline Business Case (SOBC) for the proposal was submitted by local stakeholders in early 2020. Following their review, the Department for Transport (DfT) informed the proposers in summer 2020 that the scheme will not be considered for inclusion within the Rail Network Enhancements Pipeline at this time. This outcome was noted but does not change the analysis undertaken or strategic advice provided within this report, which focusses on scenario planning so that the railway is ready for either eventuality.
Train service scenarios were produced in order to understand the levels of capacity required to facilitate expected train services through to 2050. These scenarios, referred to as Indicative Train Service Specifications (ITSSs), were agreed with the working group and include, as appropriate:

- Current passenger services
- Freight services, with industry forecasts used to predict uplifts
- Planned future passenger services
- NPR services, including a sensitivity to account for the possibility of tram train operating on the Sheffield to Doncaster corridor
- Services diverted or added to serve Doncaster Sheffield Airport
- Removal of selected services to account for abstraction of demand in HS2 Phase 2b scenarios

This gives the scenario matrix shown in Table 1 below.

### D.1 Economic Analysis

#### D.1.1 COVID-19 Pandemic

This study began towards the end of 2019, in the early stages of the COVID-19 outbreak in Wuhan, China. Economic Analysis was completed during February and March 2020, and while the United Kingdom was beginning to experience its first cases, life continued largely as before. It was not until the analysis was nearing completion towards the middle of March, that the nation went into lockdown and the face of short-term rail demand was changed beyond recognition.

To predict future demand, analysts use a variety of tools including data from past ticket sales and patronage. It is therefore important to understand that the analysis conducted as part of this study was done so in the context of pre-pandemic expectations. While the industry is still coming to terms with what the COVID-19 pandemic will mean for medium and long-term demand, it is important to caveat our analysis accordingly. This study aims to cater for several growth scenarios, and it is therefore suggested that as development of options continues, the economic analysis set out here is refreshed and updated to reflect the latest understanding on the effect of the pandemic on medium to long-term rail demand. The rail industry continually updates and refreshes its strategic advice and will continue to do so in this case as understanding matures.

#### D.1.2 Passenger demand

Each of the scenarios listed was tested against one or more of the following growth forecasts:

- Demand forecasts endorsed by the Department for Transport. This uses Passenger Demand Forecasting Handbook 6 (PDFH6) and predicts demand using the DfT endorsed and provided model called EDGE
- Network Rail System Operator forecasts. This approach applies a demand overlay to the DfT forecast, representing the demand gap between the actual holistic growth and what would be predicted using PDFH Handbook 6. This is also known as the back-cast gap growth model
- Transport for the North (TfN) forecasts. This is a high growth forecast specified by TfN, which includes assumptions of higher growth in the number of jobs which is triggered by improved connectivity across the region

Two years (2033 and 2050) were selected for these growth forecasts to be tested against, giving an outlook on both the medium and long term. The DfT and System Operator growth forecasts are intended to model the impact of conditions determined by wider economic factors rather than induced through train service changes. These exogenous factors include population and employment growth. The TfN growth forecasts were constructed using population, employment and GDP data from the TfN Independent Economic Review. These forecasts assumed high-level improvements to the transport network across both road and rail and so may implicitly include some of the impacts from expected rail service improvements. It was therefore

| Table 1: ITSS scenarios |  |
|---|---|---|
| 1 – services agreed by the working group, no HS2 Phase 2b, NPR or DSA. 2033 and 2050 | 2 – services agreed by the working group, with some diverted or added to serve DSA. 2033 and 2050. | 3 – services agreed by the working group, plus NPR services. Some current services removed to account for HS2 abstraction. Some services diverted or added to serve DSA. Also includes a tram train sensitivity. 2050 only |
only appropriate for NPR scenarios to look at TfN growth models, because they include the NPR services needed to trigger the assumed high-level improvements to connectivity.

**D.1.3 Freight demand**

The freight market is highly responsive to market demands and flows vary daily. Despite this, in order to provide consistency, freight growth has been equally applied to each scenario in each respective year, based on industry agreed forecasts and inputs from the working group. Due to several factors, such as the decarbonisation agenda, expected uplifts in intermodal flows and reflective of Doncaster’s position as a key freight hub, it was appropriate to use high growth forecasts for this strategic question. Given these factors, rail freight is expected to be more robust to the challenges of the COVID-19 pandemic than passenger markets in the immediate term.

In the 2033 scenario, 4 paths per hour were tested in each direction through Doncaster, rising to 6 in 2050, supplementing peripheral flows that do not pass through the station area. A proportion of services in the ITSS were modelled accessing Doncaster iPort via a “run round” (in simple terms, the procedure whereby the locomotive detaches from the leading end, then re-attaches to the other end of the train so it can proceed back in the direction it came from) move at Hexthorpe, which was identified by the working group as a regular occurrence that uses up scarce track capacity.

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**D.2 Capacity – providing for the 2030s and beyond**

**D.2.1 Crowding Analysis**

Each scenario has been assessed against the demand forecasts to assess potential over or under-provision of standard seating capacity in the scenarios detailed. The purpose of this is to inform recommendations of the optimisation of services for the network.

Analysis tested the evening high-peak (1700-1759) as the time which would typically see highest demand across the day for tested services. The working group considered the appropriate time period to analyse, concluding that Doncaster’s position on the network means that many long-distance high-speed services have not reached the area in the morning peak, and so focusing on the evening peak instead would give a true worst case view of the capacity picture. Crowding outside the peak is still foreseeable however and should be mitigated where possible.

For the purposes of forecasting demand, services were split into market groups as depicted in Table 2. To quantify markets that may not have enough seating capacity, the standard measure used is the average vehicle gap (AVG). This is the number of additional vehicles required to meet the demand across all services in the market group, assuming that passengers rebalance themselves across services so that they are equally loaded.
The AVGs varied between infrastructure context and growth models. The analysis showed that across all scenarios, there is generally expected to be enough seating capacity in 2033, with only small pockets of standing forecast in Doncaster to Sheffield markets. However, in the Doncaster to Leeds stopping market, it should be noted that one service in 2019 (the 1721 Leeds to Doncaster), was found to possess a higher load factor than similar services on departure from Leeds. This is an instance of a service driven by peak demand, whereby the train leaves Leeds at the most popular time, with parallel services less full.

By 2050, larger AVGs begin to appear. In the Doncaster to Sheffield (limited or no stops) market, up to five extra cars are needed in the hour with TfN growth applied; even in lower growth scenarios, an AVG of four cars can be found. There is a similar picture in the stopping market, where up to three extra cars are needed, even in low growth scenarios.

The market which sees the widest scenario fluctuations is the ECML (shown in Figure 3), and again this is most prevalent in the southbound direction for the time period looked at. Vehicle gaps of up to 6 cars respectively are found in “no HS2” scenarios even under low growth models; this is alleviated completely when HS2 Phase 2b is provided however, where demand for services passing through Doncaster from the North East and Scotland is abstracted to the new, faster route.

<table>
<thead>
<tr>
<th>Market Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doncaster to Sheffield – Limited or no Stops</td>
<td>Services calling only at Meadowhall and the non-stopping Reading – Newcastle service</td>
</tr>
<tr>
<td>Doncaster to Sheffield - Stopping</td>
<td>Services calling at all stations</td>
</tr>
<tr>
<td>Doncaster to the coast</td>
<td>Services east of Doncaster towards Humberside and North Lincolnshire</td>
</tr>
<tr>
<td>Doncaster to Leeds - Stopping</td>
<td>Services calling at all stations via Wakefield Westgate</td>
</tr>
<tr>
<td>Doncaster to Leeds – Limited Stoops</td>
<td>Long distance services calling only at Wakefield Westgate</td>
</tr>
<tr>
<td>ECML Services</td>
<td>All ECML services between York and Peterborough</td>
</tr>
</tbody>
</table>

Table 2: Market Groups
D.2.2 Indicative Train Service Specifications (ITSS)

The AVGs were used to draw up a set of ITSSs\(^2\), ensuring that enough additional seats to eliminate standing were provided in scenarios where a shortfall was predicted. Largely, this was achieved through service lengthening, although where greater AVGs existed it was necessary to add an additional service. In NPR scenarios, specific configuration states were tested based on the conditional outputs of that programme alongside a reduction in ECML services given the predicted abstraction of demand to HS2.

As can be seen in Part F, many of the interventions proposed as a result of modelling these ITSSs are common across all scenarios, regardless of whether additional services were added to make up a shortfall in seats. This is important, in the context of the COVID-19 pandemic and the effect on forecast demand, because it demonstrates that there are a series of “no-regrets” interventions that initial development can begin on with confidence. Doncaster station and its approaches are constrained today, with many trains competing for the same portion of track as they cross each other’s path; therefore, it is not a surprise that even the most modest growth assumptions drive a need for interventions.

D.3 Connectivity – connecting places and people

D.3.1 Rail Mode Share

As part of this study, the mode share of rail has been examined by looking at data from the 2011 census; although this was some time ago now, it was the most recent data available at the time the work was carried out. Unsurprisingly, rail enjoys its highest mode share relative to other corridors in the areas where direct rail connections into Doncaster are provided, such as from Kirk Sandall, Thorne, Adwick and the Lower Don Valley.

Despite this, rail mode share in the Doncaster area is comparatively low in the context of other major towns and cities across the north, with many inhabitants preferring to travel by road. Interestingly, these same areas that attract a higher density of rail users, broadly also see a high dependency on car usage and therefore it implies that through provision of increased rail connectivity, some demand for rail services could be extracted from the road network (including commuter markets out of Doncaster, to neighbouring cities such as Sheffield and Leeds), assisting with the wider decarbonisation agenda. Figures 4 and 5 show this in the form of mode share heat maps.

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\(^2\) An Indicative Train Service Specification details the train services expected to run at a high level. It takes account of rolling stock, train length, calling pattern and frequency, but does not specify a timetable.
D.3.2 Generalised Journey Time

The most used measure of connectivity in the rail industry is generalised journey time (GJT). This brings together the three facets of connectivity (journey time, frequency and interchange) into one single measure. The disbenefits of low service frequency and the need to interchange between services are converted into a journey time penalty which is added to the station to station journey time to give the overall GJT. These penalties are based upon research of passenger preferences. The measure is calculated over the whole day for each origin, destination and ticket type, taking an average of the journey times at different times of day weighted by a profile of passenger journeys.

This gives greater weight to the speed and frequency of journey opportunities at peak times when more people traditionally wish to travel. Longer distance flows tend to have greater GTJs, so comparing them without reference to the distances involved is not advisable. It is important to further note that these figures are indicative. Smaller changes in GTJ are more responsive to precise train timing assumptions, and therefore they should be viewed as high-level until later in the timetable development process. Current GTJs for selected destination locations can be seen in Figure 6.

Figures 6 and 7: Selected Current GTJs and changes with Scenario 1

Planned service changes on the ECML have been factored into ITSSs, and as a result we can observe changes to GTJs when comparing the current values with those calculated for scenario 1, as seen in Figure 7. The greatest improvements can be seen in journeys to and from Middlesbrough, due to the planned introduction of a bi-hourly service to the capital stopping at Doncaster, and more incremental improvements can be seen for other towns and cities along the route.

Figure 8 develops the GJT changes further, showing what the expected difference in values would be in the case of HS2 and NPR being provided. Again, generally there is a reduction in values that can be attributed to the provision of both quicker direct services via high-speed lines and upgraded existing infrastructure. Also noteworthy is some longer GTJs between destination pairs, but these are limited in number and none exceed 10 minutes (given their sensitivity to precise timing assumptions, anything under 10 minutes is considered neutral at this stage of development). Given HS2 Phase 2b is not planned to directly serve Doncaster, the town does not see an improvement in GJT to destinations on the ECML, however it is likely to see improvements on an east-west axis through NPR service provision.

Figure 8 (below) Changes in GJT, Scenario 1 to 3
D.3.3 Connectivity to the Five Towns

The area known as the “The Five Towns”, lying close to Wakefield comprising Pontefract, Knottingley, Featherstone, Castleford and Normanton was identified with stakeholders as an area of perceived poor connectivity. There are currently no direct rail connections to Doncaster from these towns, other than from Pontefract which sees a handful of Open Access operator services each day connecting Bradford with London. As shown in Figure 9, the GJT from the Five Towns are consistently poor when paired with Doncaster, particularly given that the distance between the towns is relatively short.

In line with the remit, ITSSs were created which provided additional services from Doncaster to the Five Towns area via the Askern branch (the line from Shaftholme Junction, north of Doncaster, to Pontefract Monkhill). In 2033 scenarios, one service per hour was tested, increasing to two trains per hour in 2050. Given this assumed level of service, the GJT calculations were rerun, to see what effect the services had on the values. As can be seen in Figures 10 and 11, GJTs came down significantly between most destination pairs with the introduction of an hourly service (1TPH). Further improvements in GJTs with two trains per hour (2TPH) could still be found but were more modest in nature. It should be noted when viewing this data that proxy destinations and calling patterns were assumed, and as such the GJTs could likely be rebalanced to suit funder requirements if other calling patterns and GJT values were desired.

D.3.4 The Value of Time - Five Towns

The value of time is the opportunity cost of the time that the passenger spends travelling and is a measure that helps to understand the economic value of prospective improvements to train services. The figure generated is the overall value that the improved connectivity provides to passengers in monetary terms. In respect of the Five Towns, the value of time breakdown by ticket type is displayed in Table 3. As can be seen, a notable value of time saving can be offered to passengers through provision of one train per hour, with further savings available through a doubling of this service although the figures do suggest diminishing returns in this respect.

Table 3: Value of Time, Five Towns

<table>
<thead>
<tr>
<th>Ticket Type</th>
<th>1TPH Value of Time (£ per annum, 2010 prices)</th>
<th>2TPH Value of Time (£ per annum, 2010 prices)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>185,596</td>
<td>333,967</td>
</tr>
<tr>
<td>Reduced</td>
<td>96,652</td>
<td>164,771</td>
</tr>
<tr>
<td>Season</td>
<td>122,785</td>
<td>212,520</td>
</tr>
<tr>
<td>Total</td>
<td>404,833</td>
<td>710,738</td>
</tr>
</tbody>
</table>
Part E  The Needs of the Future Railway

E.1.1 National Rail Passenger Survey
The Spring 2020 National Rail Passengers Survey (NRPS) was the last one carried out before the effects of the COVID-19 pandemic changed travel patterns, having to stop the fieldwork as the stay-at-home orders were declared in Britain. The results, however, were largely consistent with expectations and provide the most up to date view on rail user satisfaction. The key factors for satisfaction are punctuality/reliability (37%), followed by the train cleanliness (14%) and frequency (11%). On the other hand, the biggest sources of dissatisfaction are responses to delays by the Train Operating Companies (TOC) (49%), crowding (11%) and reliability (10%).

This suggests that to provide an attractive service for passengers, the industry must offer them faster journeys, that operate at higher frequencies and run in a consistently punctual manner. These offerings are entwined with the capacity available on the infrastructure (stations, junctions, etc.), and so the link between capacity and passenger satisfaction is profound. In terms of dissatisfaction, problems with the train company’s response to delays were by far the most common complaint with 49% of respondents singling it out as a key issue. Other sources of complaint are generally tied to punctuality issues, which underscores the link between passenger satisfaction and capacity once again; to run a punctual railway, sufficient capacity must be provided to maintain a resilient timetable.

Passengers are more satisfied with the service they receive on trains that start in Doncaster than on those ending there (81% vs 62%), suggesting that delays or other issues on the approaches to the station could be affecting their experience. When analysing only passenger journeys that start or end in Doncaster (rather than the train service itself), the trend reverses (69% vs 80%), suggesting that changing trains in Doncaster has a detrimental effect on overall passenger satisfaction, serving as a reminder of the importance of effective interchange.

E.1.2 A safe railway
Operation of a safe railway is key to Network Rail. Industry incident data going back three years was analysed to create a baseline understanding of the current factors impacting railway safety and steer recommendations accordingly. The most common safety incidents involved trespass, vandalism, station accidents (i.e. slips, trips and falls) and level crossing misuse. Trespass and vandalism were most frequently recorded on the Doncaster to Outwood and Swinton portions of line respectively. There can be a range of motivations for this behaviour, and Network Rail will continue to review fencing, signage and security at known locations while working with local schools and communities to communicate the dangers of such activity.

As would be expected, station slips, trips and falls centered on Doncaster station. Effective pedestrian flow in stations can help to minimise the risk of such accidents, and section E.1.4 looks in more detail at how passengers move through the station and highlights areas of short-lived congestion. This is of significance at Doncaster where high numbers of passengers are known to interchange.

Level crossing misuse, where members of the public use level crossings contrary to the rules of the highway or specific crossing, is an issue encountered across the network. Specifically, there was a prevalence of lorries misusing Moat Hills Level Crossing and issues with motorists weaving around the barriers at Moss Level Crossing. There were sadly also a number of fatalities across the study area (in all cases later ruled to have been a deliberate act of self-harm), generally occurring at stations such as Doncaster, Swinton and Fitzwilliam. Network Rail will continue to work with station operators to provide appropriate safeguards, such as signage, fencing or new technologies. At Fitzwilliam, the recommendations set out in Section F will assist to provide a further degree of separation between the public and passing high-speed trains.

E.1.3 Doncaster Carr Hitachi Depot
Lying just to the south of Doncaster station, Doncaster Carr Depot is the site at which Hitachi maintains the class 80X fleet of trains on behalf of London North Eastern Railway, TransPennine Express and Hull Trains. Alongside general maintenance operations, the site also includes facilities for stabling, refueling, tanking and wheel re-profiling. The working group considered the potential impact that traffic to and from the site might have on operations in the Doncaster area. Because the peak hour selected was 1700-1759, a time at which traffic is typically not coming off or onto the depot, and other traffic is at its most dense, a path was not modelled in the ITSSs, which is appropriate for this high-level stage of analysis. It is recommended that as the options and interventions presented in this report mature, detailed modelling is undertaken to
further understand the impact traffic to and from the Hitachi site has on the proposed works.

**E.1.4 Station pedestrian capacity**

It is key that stations have capacity for not only the required increase in train services, but also the increased volumes of people using the railway and station facilities. To that end, the impacts of forecast passenger numbers have been assessed for Doncaster, with a modelling exercise undertaken to understand passenger behaviour as they move throughout the station. The aim of this modelling is to understand if there are any areas of concern at the station under each ITSS, with the focus on safe passenger circulation and movement. At this stage of modelling, analysis is of a high-level and does not give exact indications of the issues but identifies potential problems and allows focus to be drawn to any risks later in the development lifecycle.

The model used the demand forecasts provided by the economic analysis team to assess the numbers of passengers boarding and leaving services at Doncaster, matching this with the platform plan produced as part of the capacity analysis work. Doncaster is a key interchange station and using 2018/19 Office of Rail and Road (ORR) statistics it was assumed that 44% of passengers were changing services, with interchange between each platform based on a logical movement matrix.

Under each ITSS modelled, isolated areas of higher densities were seen but these were short lived and therefore modelled station operations were found to be acceptable. The modelling was then extended to look at what the impact could be on station pedestrian capacity if new platforms were provided to the west of the existing station, as proposed in Section F. Indicative designs were used for this modelling, and no significant issues were identified under any of the ITSSs, although transit time from the eastern to the western side of the station should be minimised. Some passenger congestion was also noted around the centre of the new platforms, where the platform width could be restricted by the presence of the stairs. Appropriate recommendations have been made in Section F.

**Figure 12: Scenario 3D 2050 with new western platform – station pedestrian capacity**
E.1.5 Power supply

Making sure the rail network has enough capacity to support services extends beyond provision of track and platforms. The ECML provides capability for electric trains, and the power supply is currently being upgraded. The scale of change required to support the uplift in services recommended by this study though will require further investment. The precise power supply requirements for the 2030s and beyond cannot be known this early in the process, primarily because power-draw is dependent on the arrival times of trains within the section of railway supported by a given feeder station. Whilst capacity analysis for this study is based on train service specifications, these are not yet mature enough to provide anything beyond a high-level requirement for power supply assumptions.

As an indication, Table 4 provides a high-level assessment of additional power demand requirements across the geography over and above the train service baseline (which is expected to be delivered on completion of the planned Power Supply Upgrade). All figures below relate to the relevant 2050 ITSS with the highest volume of electric services, as a result of industry decarbonisation and electrification plans recommending electrification around the wider Doncaster area. A sensitivity excluding freight and local passenger service groups is also shown for reference. More comprehensive power modelling of the existing power supplies should be considered where additional electrification is being proposed that will allow service groups through the area to be operated using electric traction. Indicative power modelling undertaken as part of Traction Decarbonisation Network Strategy (TDNS) has suggested a greater increase in tractive power may be required than that outlined here to support electric freight services.

E.1.6 Level crossings

It is important that holistic railway planning looks not just at the capacity and capability of the track, platforms and junctions but also considers wider system risk. A key area of risk for the railway occurs at level crossings, where there is interaction between members of the public and the operational railway. Network Rail is committed to eliminating this risk, undertaking a rolling programme of closures, which has seen the removal of over 1,250 level crossings nationwide since 2009. Where it has not been possible to close level crossings, Network Rail has taken steps to minimise risk, such as through improved traffic signals, installation of additional barriers or through use of new technology. Considering how future traffic levels might impact level crossings is an important component of informing the ongoing programme of reducing and eliminating level crossing risk.

Analysis was conducted to understand what affect future train service levels would be likely to have on level crossings in the study area. ALCRM (All Level Crossing Risk Model, an industry tool used to assess level crossing risk) data was cross referenced with the ITSSs and expected growth in vehicular traffic to give an understanding of what impact expected train service densities could have. Strategic advice is about high-level problem identification, allowing railway planners and safety managers to focus interventions appropriately. It is not intended to give a definitive risk outcome for the level crossings assessed.

Alongside the findings of the safety baseline which detailed the extent to which crossing misuse is prevalent in the Doncaster area, it was found that on many crossings, barrier downtime would be in

<table>
<thead>
<tr>
<th>Table 4: Indicative additional power requirements post-2021</th>
</tr>
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<tbody>
<tr>
<td><strong>Section</strong></td>
</tr>
<tr>
<td>Doncaster South to Ranskill (towards Retford)</td>
</tr>
<tr>
<td>Doncaster Station Area</td>
</tr>
<tr>
<td>Doncaster North to Joan Croft (towards York)</td>
</tr>
<tr>
<td>Doncaster North to Outwood (towards Leeds)</td>
</tr>
</tbody>
</table>
excess of the ORR recommended maximum of 45 minutes in the hour. Running more services over level crossings would also be expected to increase the general risk factors at the crossing, if appropriate mitigations were not made. It is recommended that as the interventions set out in this report mature, focus is given to the impact of higher levels of rail traffic, with level crossings progressed for closure or enhanced mitigation measures where needed while remaining cognisant of the need to maintain access and manage road traffic congestion.

E.1.7 Doncaster Sheffield Airport

The capacity analysis considered the effect of a heavy rail link to DSA, with existing calling patterns altered to serve the airport and some long-distance services having their station call at Doncaster switched to DSA in the appropriate ITSSs. Generally, it was found that although this did abstract some platform capacity utilisation away from platforms and onto the quieter fast lines, it was not enough in any scenario to prevent the requirement for more platform capacity to be made available. South of Doncaster, more capacity was consumed because some services which had previously terminated at Doncaster were extended, putting a greater demand on tracks and junctions; however, in common with the findings at Doncaster station this was a relatively small uplift on other scenarios and would not be likely to trigger any additional interventions that wouldn’t otherwise be necessary.
Part F  The Needs of the Future Railway

F.1  Approach to Recommendations
Capacity and connectivity analysis for Doncaster Area Strategic Advice shows that across all scenarios, there is commonality between constraints. For those familiar with the railway around Doncaster, this will come as no surprise; today’s railway already contends with challenges in accommodating existing services, many of which cross paths. It is important however to provide an impartial assessment of the capacity and capability of the infrastructure to deliver a high-performing railway fit for the future. As Section G highlights, the ultimate delivery of these recommendations is subject to a detailed understanding of affordability and value for money. It sets out that although the COVID-19 pandemic is likely to cause uncertainty for investment decisions, there is a strong case for funding early development of interventions to run in parallel with industry efforts to reconcile its expectations on long-term demand. This is fueled not just by Doncaster and the capacity pressure it faces today, but also by the conditional outputs of major programmes such as NPR, alongside the promotion of a high-performing, resilient railway.

F.1.1  Capacity analysis
Capacity analysis has been undertaken, using a capacity utilisation methodology for the whole study area in order to identify constrained locations and guide the identification of potential interventions. Calculations of capacity were undertaken based on the baseline infrastructure and Train Planning Rules. The scenarios tested are listed in Part D, with an additional sensitivity analysis to account for the potential introduction of tram train services between Sheffield and Doncaster. Potential interventions were suggested as a part of the analysis and re-tested alongside suggestions from the early development team and wider working group, to observe the effects on capacity utilisation.

The capacity utilisation methodology gives a percentage utilisation of the line, junction and platform for the individual area in isolation. This gives a high-level view of capacity constraints; however different or additional areas could be found to be more constrained when assessing the wider network or accounting for the timing of services.

F.1.2  Development and cost ranges
In parallel with the capacity analysis, early-stage development has been independently undertaken for the interventions identified. Some additional interventions were developed over and above those recommended here. These options are not recommended to be progressed for a variety of reasons including technical feasibility, conflicts with committed developments and the identification of more effective interventions. Order of magnitude cost ranges were produced and validated by Network Rail for all developed options, though, as with any early-stage development work, these cost ranges should be considered indicative and subject to more detailed costing as recommendations are progressed.

The costs have been categorised utilising a low, medium, high and very high approach using the following ranges:

<table>
<thead>
<tr>
<th>Cost Category</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Up to £5m</td>
</tr>
<tr>
<td>Medium</td>
<td>£5m-£50m</td>
</tr>
<tr>
<td>High</td>
<td>£50m-£250m</td>
</tr>
<tr>
<td>Very high</td>
<td>&gt;£250m</td>
</tr>
</tbody>
</table>

The analysis for Doncaster Area Strategic Advice has found that various options should be progressed to support not just uplifts in services and the delivery of major programmes, but also to deliver a high performing resilient network, with core flows segregated from one another where possible. The recommendations here therefore focus on the similarity of tested scenarios, such that progression of these recommendations is supported across scenarios to deliver a railway fit for the 2030s and beyond.

F.2  Doncaster station and approaches
Multiple interventions are recommended for progression at Doncaster station and on the approaches to it, with all scenarios tested requiring a consistent set of interventions. This means that Doncaster Area Strategic Advice can recommend with confidence options which funders may wish to progress, with the knowledge that investments will be fit for whatever the future holds.
**F.2.1 Two additional through platforms at Doncaster station**

**Indicative Cost Range - High**

In all scenarios tested, at least one platform was assessed to be over capacity, although which platform specifically varied. In DSA scenarios, where selected services in the ITSS called at the airport rather than Doncaster, a relatively small proportion of platform consumption was abstracted, but not enough to alter the need for additional capacity.

The capacity analysis undertaken found the need for only one additional through platform, and there is room for this to be constructed to the west of the existing station. However, under the scenarios tested, tram train services (modelled as part of NPR scenarios) were assumed to use platform 5, which would not be long enough to accommodate more than a single tram train unit. Given that some bespoke alterations are likely to be required to platform heights and facilities, it is not advisable to rely on only one short platform for these services, which would preclude platform sharing or the strengthening of services where required. It is therefore recommended that the additional platform is an island, with a second platform face also made operational, given the relatively small expected marginal cost of using both faces, the likely cost efficiencies to delivering these simultaneously and the potential for heavy rail to use this in the meantime, reducing pressure on the rest of the station and increasing resilience. Any use of the second platform face by heavy rail should not preclude the use of it by tram train in the future, unless tram train plans are discarded.

Initial development has suggested the platforms are located to the west of the existing goods lines, although there may also be options to build them closer to the existing station footprint and replicate the goods lines further west with a rise in costs accordingly. It is also notable that existing stabling facilities in this area will need to be replicated elsewhere. Cognisant of the station capacity analysis carried out on this option and the number of slips, trips and falls at Doncaster picked up in the safety baseline, it is recommended that to access the new platforms, an extension of the existing subway is made, rather than installation of a bridge. This will remove the additional transit time and risk imported by making passengers change grade from subterranean level. More detailed modelling should be undertaken as plans mature.

**F.2.2 New track to improve capacity at South Yorkshire Junction**

**Indicative Cost Range – Medium**

The area just south of Doncaster around South Yorkshire Junction was also found to be heavily constrained across all scenarios, where services to and from Sheffield must share track with traffic travelling on the ECML south of the station. Here it is recommended that a new chord is built, connecting the Sheffield lines to the western part of the station independently of the existing West Slow lines. This would offer the potential for excellent synergy with the construction of new western platforms and allow traffic from Sheffield to access the station without infringing on the station footprint and southern throat as it exists today. This intervention provides sufficient capacity in the medium term, but in the long-term will need to be supplemented by signalling alterations as set out in F.4.1.

**F.2.3 Marshgate – Doncaster North Flyover or New track on the western side of Marshgate Junction**

**Indicative Cost Range – High (flyover) or Medium (new track)**

Marshgate was found to be the most consistently constrained part of the entire study area. In every ITSS tested, including HS2 Phase 2b scenarios featuring a lower quantum of long-distance high-speed traffic, the lines heading off towards Leeds saw capacity utilisation values of over 80% and the central lines of over 100% respectively.

Two solutions have been drawn up to tackle this, because of the variations between ITSSs affecting their appropriateness. The first option is construction of a new chord to the west of the existing Leeds Slow line, connecting to the avoiding lines that pass over the ECML. This would allow all traffic from the west side of Doncaster station heading to and from Kirk Sandall to cross Marshgate junction without conflicting with ECML traffic. This offers excellent synergy with the proposed extra track at South Yorkshire Junction and western platforms, giving a joined-up strategy for segregation of flows through the Doncaster area. However, it is more of an appropriate solution in scenarios with a high quantum of through services from Sheffield towards Kirk Sandall, and less effective for ITSSs that have these split into two services that start or terminate at Doncaster, removing the need to cross the full layout.

As an alternative to Doncaster North Flyover, an option has also been developed for an additional line from the western platforms through Marshgate Junction running on the western side of the alignment, however instead of connecting to the avoiding lines it continues to join the Leeds lines. This solution is more appropriate for ITSSs with a low quantum of east-west crossing moves, where an intervention at Marshgate is still required but would
be better focused by simply providing an additional running line.

There is a difference in the order of magnitude costs associated with these options, with the flyover expected to be more expensive. It is recommended that both options are investigated in detail to deliver the greatest possible value for money in terms of delivering specified funder outcomes, with further detailed analysis undertaken later in the development lifecycle as the understanding of the quantum of crossing moves that need to be accommodated matures.

Figure 13: Recommended interventions for Doncaster Station with North Flyover option

Figure 14: Recommended interventions for Doncaster Station with additional Marshgate running line option
F.3 South Kirkby – Hare Park

The relatively short stretch of railway between South Kirkby Junction and Hare Park Junction was consistently found to be constrained, particularly in the long-term. This stretch of two track railway, which also plays host to Fitzwilliam station, sees long-distance high-speed services to and from Leeds mixing with local stopping services and freight movements. These factors combine to put both junctions under pressure from regular crossing moves at grade, with the shortage of capacity between the junctions made more acute by local trains serving Fitzwilliam.

F.3.1 Hare Park Junction Options

Indicative Cost Range – Low (Line Speed Improvement) and High (Grade Separation)

In the medium-term, analysis has shown that Hare Park Junction is forecast to be over capacity by 2033, broadly because it has a low turnout speed of 20mph for trains heading to and from Crofton. Development has been undertaken to raise this turnout speed to 55mph, which is expected to be sufficient in the medium-term only. In the long-term, analysis has shown that by 2050 the junction is expected to require full grade separation regardless of whether HS2 Phase 2b and NPR are delivered, and as such this is the option that is most likely to accommodate train services and offer performance benefits. However, it is recommended that a line speed increase is progressed immediately, given the low order of magnitude costs involved and the potential capacity and performance benefits that could be offered to the railway of today. Grade separation should be developed as a long-term solution, in parallel with maturing understanding of NPR, HS2 Phase 2b and freight outcomes.

F.3.2 South Kirkby Junction Grade Separation

Indicative Cost Range – Medium / High

In the medium-term South Kirkby Junction, with its higher turnout speed in comparison to Hare Park, is expected to adequately cope with demand. However, by 2050 it is forecast to be over capacity with growth in freight traffic being the main driver of higher capacity utilisation.

This location is ideal for potential grade separation as there is an existing railway bridge that carries the Moorthorpe to Ferrybridge Junction line over the top of the Doncaster to Leeds line, which would allow segregation of flows to be achieved through construction of a single chord linking the Up Doncaster to the Down Pontefract. This would mean that traffic flows from the Leeds direction could cross the Down Doncaster line and head to Moorthorpe without conflicting with other services. Although it is acknowledged that this intervention is not strictly required until the 2050’s, funders may find merit in bringing it forward for early delivery to unlock performance benefits sooner.

F.3.3 South Kirkby to Hare Park Four Tracking

Indicative Cost Range – Very High

Line capacity between South Kirkby and Hare Park is constrained in all scenarios, although it is predicted to meet demand in the medium-term albeit with little resilience. Headways\(^4\) are four minutes in this area, and it is not thought practical to reduce them on existing signalling because of the junctions lying at relative proximity to one another, alongside the mix of traffic using the line including freight and stopping services. By 2050, all scenarios are over capacity including those without HS2 Phase 2b and NPR. Building on the outputs of the 2018 route study, it is recommended that this key constraint is tackled with four tracking from South Kirkby to Hare Park, which at Fitzwilliam would include moving station calls onto new slow lines, to segregate stopping and non-stopping traffic. In the indicative diagram below, the platforms have not been re-located due to the embankment making this difficult to achieve, but the fast lines could be fenced off. It is suggested that as development matures, the phasing of the full scope of interventions on this section is finalised, with an assessment also carried out on whether digital signalling could offer a partial solution by reducing headways.

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\(^4\) Headways are the time apart that trains must be planned to run at their optimal speed without catching other services up.
F.4 ECML South towards Retford
The railway South of Doncaster sees several competing demands, as ECML traffic mixes with freight trains accessing and egressing yards, alongside services to and from the Lincoln lines. Capacity analysis has demonstrated the line between Doncaster and Retford to be over capacity in all scenarios, except where HS2 Phase 2b is provided, where enough demand is abstracted to thin the train service specification to acceptable levels. The presence of a Doncaster Sheffield Airport rail link does drive additional pressures on this section of line; however, these are marginal and can be addressed by the cross-scenario recommendations set out below.

F.4.1 Headway Reductions and Routing Changes
Indicative Cost Range – Subject to further development
Cognisant of the potential for HS2 Phase 2b to abstract demand from the ECML, it is not recommended that physical infrastructure interventions are made on this section. Further analysis was conducted to understand the marginal gains that could be achieved through routing changes and headway reductions. Both steps provide some of the capacity uplift required for non-HS2 scenarios, but do not comprehensively address the issues unless they are combined. Therefore, there are two core recommendations for this corridor:

- ECML headways south of Doncaster to be reduced from 4 to 3 minutes. There is an existing initiative already being considered by Network Rail Eastern Region for headways between Peterborough and Newcastle to be reduced to 3 minutes for non-stopping services which is expected to take effect in 2021/22. It is recommended that further headway gains should be explored through digital signalling, in line with the Network Rail’s Digital Railway Long Term Deployment Plan (LTDP).

- Freight trains should be generally routed via the Lincoln lines, rather than on the ECML. This has the additional benefit of making use of investments already being made, such as at Werrington, near Peterborough. It is noted that there will be some exceptions to this, such as in the case of express logistics or overnight traffic. Links should be made to wider decarbonisation and electrification strategy to ensure that freight services are able to utilise this routing with electric traction, if appropriate. The industry must also remain cognisant of journey times for freight operators, identifying opportunities to mitigate the effects of diversionary routing where feasible.

Analysis has shown that these interventions are expected to be sufficient to meet demand in all tested scenarios. If HS2 Phase 2b is constructed as planned, these “no regrets” interventions, already under progression by the industry because they offer benefits to today’s railway, would still deliver performance, resilience and flexibility benefits and assist with an efficient use of released capacity. Therefore, they are recommended under all scenarios.

F.5 Swinton Area
The Swinton area is of strategic importance given its position straddling a key junction on the Sheffield to Doncaster route, where services can branch off towards Moorthorpe. A few miles to the east sits Mexborough Junction, where services from the Sheffield direction can rejoin the main line having diverged at Aldwarke Junction and avoided Swinton via the Roundwood Chord.

F.5.1 Medium Term – Flexibility Improvements
Indicative Cost Range – Low
Analysis of this section has shown that the area copes well in the medium term, however due to a disproportionate spread of services through the station, platform 1 is expected to be at capacity by 2033. This is because all trains arriving on the down main from Sheffield use this platform, with trains arriving on the up main from Doncaster and Moorthorpe respectively spread between platforms 2 and 3. It is therefore recommended that some changes to switches and crossings are made alongside signalling alterations, to allow platform 2 to become bi-directional. This will allow two trains following each other from the Sheffield direction to use alternate platforms, with trains for Moorthorpe using platform 1 and trains for Doncaster generally using platform 2. Added flexibility is often sought after by operational staff and it is recommended that further detailed modelling be undertaken in later development to understand the wider benefits.

Figure 16: Swinton Medium Term – Indicative Diagram
F.5.2 Long-Term
The long-term solutions for Swinton are more uncertain and tied into NPR plans. It is clear from the capacity analysis conducted for this study, that to cater for the level of growth predicted by 2050, an additional platform will be required; this is the case irrespective of whether services between Sheffield and Doncaster are provided by heavy rail or tram train options. In the ITSS modelled for tram train, three trains an hour were scheduled to terminate at Swinton; as such, some preliminary development was undertaken for a new low-level platform lying to the east of platform 3. However, development was not expanded further because if the forecast uplift in services were to be provided by heavy rail, then this may not be the optimal location for a new platform.

If 2050 services are to be provided by heavy rail, analysis has shown that Swinton North Junction is expected to be over capacity; however, if the services are provided by tram train (with three services an hour going via the Roundwood Chord), then it is expected to cope. Conversely, analysing the tram train ITSS has shown that services running via the Roundwood Chord would cause Mexborough Junction to be at capacity and in need of an intervention. Plans for tram train to serve Doncaster are uncommitted, therefore they may be subject to change as plans and understandings mature. Different ITSSs will drive different combinations of interventions and will need to be cognisant of the service requirements between Sheffield and Leeds via Moorthorpe.

On all other corridors looked at during this study, there is good synergy between scenarios and recommendations have been made with a high degree of confidence despite potential uncertainty, however this is not the case here. Therefore, the strategic advice for Swinton is that the medium-term recommendations around platform flexibility are brought forward for further development, with the NPR programme continuing to develop long term options cognisant of maturing plans and thinking for both the Sheffield to Doncaster and Sheffield to Leeds via Moorthorpe corridors.

F.6 Doncaster to Shaftholme ECML
The ECML north of Marshgate Junction was also found to be constrained in all scenarios, including where HS2 Phase 2b is provided. This is attributable to the additional services that were modelled to serve the Five Towns via the Askern line, which were assumed to run via the ECML to Shaftholme Junction, the most logical route; withdrawing these services from the ITSSs brings capacity on this section back to an acceptable level. Initial development options considered three and four-tracking the ECML between Marshgate and Shaftholme to support one and two trains per hour respectively to the Five Towns, however due to the very high order of magnitude costs involved alternative routing options were considered supported by smaller scale interventions. This approach was taken with a view to offering a potential means for local stakeholder aspirations to be supported in a more affordable manner, although it is important to bear in mind that no assessment was made of what might be required to support these services beyond the geographical limits of the study area.

F.6.1 Barnby Dun Chord
Indicative Cost Range – Medium
As an alternative to the very high order of magnitude cost options of three and four tracking north of Doncaster, it was assessed if local services running via the Askern line could be re-routed. Running these services via Adwick (using a proposed new west to north chord at Shaftholme Junction) was considered, analysed and later discounted because of the additional pressure placed on the Leeds lines at Marshgate.

Should proposals for these services proceed towards implementation, the recommended option is for the proposed Askern local services to make use of the recent investment at Doncaster North Chord, passing over the top of the ECML at Joan Croft in an easterly direction, before doubling back towards Doncaster in the Stainforth Junction area, requiring construction of a new chord at Barnby Dun. This alternative routing was remodeled, and because it uses the Hull lines at Marshgate, which have more available capacity than the other lines at this location, capacity utilisation remained within acceptable limits. Using this side of the alignment at Marshgate would also open the option to use platform 0, a relatively recent investment at Doncaster which is likely to be used less once the Sheffield and Hull services link to form one through service. A simple layout has been depicted in figure 17, although if funders desire services to call at Kirk Sandall, additional crossovers would be required with order of magnitude costs rising accordingly. Barnby Dun Chord would also offer an alternative route in and out of Doncaster for existing services, adding network resilience.

It is recommended that funders wishing to pursue proposals to introduce additional services to the Five Towns via Askern take cognisance of this analysis as their plans mature.
F.6.2 Shaftholme Junction

*Indicative Cost Range – Low (ECML Route Only)*

An opportunity for a line speed improvement has been identified at Shaftholme Junction, which would allow trains travelling on the line towards York to pass through the area at 125mph rather than being restricted to 100mph as they are today. This has been assessed as attracting a low order of magnitude cost, and further development should be a priority to release capacity, performance and journey time benefits to today’s railway.

Through investigation with freight operating companies, it came to light that the planning margins used for diverging traffic at Shaftholme Junction are prohibitively high. This is likely as a result of a low turnout speed of only 20mph, which is compounded by an “approach release” arrangement (this means when trains approach the junction, the protecting signal will not clear until the train is close to it, which is a safety measure which seeks to ensure trains have reduced their speed appropriately for the diverging route). Increasing the line speed for this diverging route is not included in the indicative cost range set out above, however it is recommended that funders may want to explore this further. Increasing both the through and diverging line speed at this location with associated signalling changes would likely have a positive impact on performance and capacity, not just limited to freight, and it is worth further understanding the quantified costs and benefits of such a scheme.

F.7 Freight-Specific Recommendation

Recommendations throughout Part F have been presented geographically, with the holistic approach to Doncaster Area Strategic Advice making no distinction between supporting freight and passenger services on a mixed-use railway. This section, however, presents a specific freight recommendation which is supported by the interventions referenced throughout.

F.7.1 St Catherine’s Chord

*Indicative Cost Range – Medium*

Currently, freight trains serving Doncaster iPort using the Lincoln lines are unable to access the site directly because there is no direct connection across the ECML in the Flyover Junction area. Instead, trains must go to Hexthorpe Junction where there are facilities to “run round” (in simple terms, the procedure whereby the locomotive detaches from the leading end, then re-attaches to the other end of the train and so it can proceed back in the direction it came from). There are two key drawbacks to this move; firstly, it is a time-consuming activity which adds journey time to services, and secondly it uses up scarce capacity in the congested area south of Doncaster.

There is currently a small scheme in its early stages which seeks to replicate the run round facilities at Hexthorpe Junction closer to iPort, through construction of a short chord at Low Ellers Curve; although services would still have to run round, they could do so much closer to their destination at Doncaster Up Decoy, saving some journey time and easing the capacity demand south of Doncaster. In the longer term, with container traffic destined for iPort expected to see strong and sustained growth, it would be desirable to eliminate the need for a run round move entirely and funders may wish to consider options for a direct connection. A way of achieving this would be through provision of St Catherine’s Chord, which would see the re-instatement of a former rail connection linking St Catherine’s Junction with Black Carr Junction. The chord, of approximately 300 metres in length, would allow any train arriving from the South, be that ECML or more notably given freight routing recommendations the GN/GE, direct access to iPort without requiring a time-consuming run round move. The time saved could be used for longer terminal time, facilitating longer trains and a more efficient use of capacity.
F.8 Platform Extensions

F.8.1 Area-wide Platform Extensions

Indicative Cost Range – Individually Low

Platform lengths were found to be too short for some services throughout the study area, particularly when testing NPR scenarios which included 6 car trains on routes that currently only see 3 car variants. Development has been undertaken to this effect; however, it will be a decision for funders whether to pursue this further or utilise functionality such as Selective Door Opening (SDO) to deliver longer services.

<table>
<thead>
<tr>
<th>Station</th>
<th>Platform</th>
<th>Shortage for longest Train in ITSSs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hatfield and Stainforth</td>
<td>Both</td>
<td>39m on P1, 43m on P2</td>
</tr>
<tr>
<td>Outwood</td>
<td>Both</td>
<td>57m on both platforms</td>
</tr>
<tr>
<td>Sandall and Agbrigg</td>
<td>Both</td>
<td>57m on both platforms</td>
</tr>
<tr>
<td>Fitzwilliam</td>
<td>Both</td>
<td>57m on both platforms</td>
</tr>
<tr>
<td>South Elmsall</td>
<td>Both</td>
<td>59m on both platforms</td>
</tr>
<tr>
<td>Adwick</td>
<td>Both</td>
<td>46m on both platforms</td>
</tr>
<tr>
<td>Bentley</td>
<td>Both</td>
<td>46m on both platforms</td>
</tr>
<tr>
<td>Swinton</td>
<td>All</td>
<td>58m on all platforms</td>
</tr>
</tbody>
</table>

Photo: Alex Ayre
### F.9 Summary of Recommendations

The tables and diagram below set out a summary of the recommendations made in this report:

**Table 7: Summary of Options Required to Deliver Tested ITSSs**

<table>
<thead>
<tr>
<th>Scope</th>
<th>Constraint</th>
<th>Intervention option</th>
<th>Benefit</th>
<th>Cost</th>
<th>2033</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doncaster</td>
<td>Limited platform capacity</td>
<td>New island platform</td>
<td>Provides additional platform capacity and performance resilience by segregating flows.</td>
<td>High</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Doncaster</td>
<td>High capacity utilisation at South Yorkshire Jn.</td>
<td>New track from Hexthorpe Junction to the new western platforms</td>
<td>Provides capacity and performance benefits at South Yorkshire Jn. by segregating flows.</td>
<td>Med</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Doncaster</td>
<td>High capacity utilisation at Marshgate Jn.</td>
<td>New track at Marshgate forming grade separated access to the Hull lines via the avoiding line OR… New track at Marshgate to the Leeds lines</td>
<td>Provides capacity and performance benefits at Marshgate Jn. by segregating east / west flows from north / south flows</td>
<td>High</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Doncaster</td>
<td>High capacity utilisation at Marshgate Jn.</td>
<td>New track at Marshgate forming grade separated access to the Hull lines via the avoiding line OR… New track at Marshgate to the Leeds lines</td>
<td>Provides capacity and performance benefits at Marshgate by segregating Leeds flows.</td>
<td>Med</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>South Kirkby to Hare Park</td>
<td>High capacity utilisation at Hare Park Jn.</td>
<td>Line speed increase from 20mph to 55mph for trains heading to and from Crofton Grade separation</td>
<td>Provides capacity and performance benefits by reducing the time it takes trains to cross the junction Provides capacity and performance benefits by segregating flows</td>
<td>Low</td>
<td>✓</td>
<td>x</td>
</tr>
<tr>
<td>South Kirkby to Hare Park</td>
<td>High capacity utilisation at South Kirkby Jn</td>
<td>Grade separation</td>
<td>Provides capacity and performance benefits by segregating flows</td>
<td>Med / High</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td>South Kirkby to Hare Park</td>
<td>High capacity utilisation between South Kirkby and Hare Park</td>
<td>Increase the number of tracks from two to four, moving the platforms at Fitzwilliam to the slow lines</td>
<td>Provides capacity and performance benefits by moving station calls off fast lines and segregating flows</td>
<td>V. High</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td>Doncaster South</td>
<td>High capacity utilisation between Doncaster and Retford</td>
<td>Headway reductions south of Doncaster station Freight trains to be routed via the Lincoln lines where possible and practical</td>
<td>Provides capacity and performance benefits by allowing trains to run closer together Releases capacity on ECML between Doncaster and Peterborough</td>
<td>N/A</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Swinton</td>
<td>High capacity utilisation at Swinton and adjacent junctions</td>
<td>Re-modelling to be undertaken to provide additional flexibility Long-term options to be developed in accordance with NPR programme</td>
<td>Helps to spread services through the station more evenly Development work accurately reflects funder specifications</td>
<td>Low</td>
<td>✓</td>
<td>x</td>
</tr>
<tr>
<td>Platform Extensions</td>
<td>Numerous platforms across the study area are too short for the modelled services</td>
<td>Platform extensions OR… Selective door opening</td>
<td>Provides platforms that are physically long enough for proposed services Provides a means of safely working with short platforms</td>
<td>Low</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Service Lengthening</td>
<td>Some services are not expected to have enough passenger carrying capacity to meet demand</td>
<td>Service lengthening, subject to revised demand forecasts once the medium to long-term effects of the COVID-19 pandemic become clearer</td>
<td>Provides enough seating to eliminate standing</td>
<td>N/A</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Power Supply</td>
<td>Existing power supply does not have enough capability to support future electric services</td>
<td>Deliver further upgrades on power supply capability in the Doncaster Area</td>
<td>Provides suitable traction power supply for forecast levels of electric services</td>
<td>N/A</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Level Crossings</td>
<td>Increased train service levels will put more pressure on level crossings, adding risk</td>
<td>Assess level crossing risk levels in parallel with other interventions through closures or upgrades</td>
<td>Helps to minimise and eliminate level crossing risk</td>
<td>N/A</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
### Table 8: Summary of Additional Options to deliver wider Aspirations

<table>
<thead>
<tr>
<th>Scope</th>
<th>Constraint</th>
<th>Intervention option</th>
<th>Benefit</th>
<th>OOM Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doncaster North</td>
<td>Unable to accommodate proposed Askern local services on two track ECML section between Doncaster and Shaftholme</td>
<td>A new chord at Barnby Dun so these services can run into Doncaster through Kirk Sandall, avoiding the ECML</td>
<td>Filters proposed services via a route with a lower capacity demand from other services.</td>
<td>Med</td>
</tr>
<tr>
<td>Doncaster North</td>
<td>Low line speeds in the Shaftholme Jn. area</td>
<td>Line speed increase from 100mph to 125mph on the down main line to York</td>
<td>Journey time, capacity and performance benefits</td>
<td>Low</td>
</tr>
<tr>
<td>Doncaster North</td>
<td></td>
<td>Raise line speed for trains diverging towards and coming from Askern</td>
<td>Journey time, capacity and performance benefits</td>
<td>N/A</td>
</tr>
<tr>
<td>Doncaster South</td>
<td>Freight trains cannot directly access iPort from the ECML South or Lincoln lines without “running round”</td>
<td>New track to be provided at St. Catherine’s Junction to allow direct access to iPort from the south</td>
<td>Reduces journey time, giving longer terminal time and potentially longer trains. Reduced capacity consumption.</td>
<td>Med</td>
</tr>
</tbody>
</table>

### Figure 19: Geographic map of headline infrastructure recommendations
Part G  Next Steps

G.1 Staging of Recommendations
Recommendations given in this document are subject to the caveats provided in Part F. It should be remembered that the interventions are not by default required to be delivered immediately; but, there is a strong case for early development of interventions in the Doncaster area on the grounds of easing the constraints encountered today, while laying the foundations for the planned delivery of NPR on a resilient and high-performing railway. A case for investment has been identified with or without HS2 Phase 2b, NPR and DSA, ensuring the area is ready for any eventuality. It is important that detailed analysis of the deliverability of not only infrastructure proposals, but also their planned outcomes, continues as plans mature, with work including a strategy of phasing. With that in mind, there are two business cases which can be recommended for progression towards further development due to not only the commonality of the problems they seek to solve across all scenarios but also the weight of evidence behind the need for the industry to act in these areas:

- Doncaster station and its approaches are constrained in all tested scenarios, with common solutions recommended to address this based on the segregation of core traffic flows. Given the train performance benefits of such a strategy, development should be a priority, with a potential SOBC seeking to understand how the interventions could be phased to unlock key benefits early

- The stretch of railway between South Kirkby and Hare Park is a key constraint, with a mix of stopping, express and freight traffic competing for capacity on a two-track railway bringing performance risk. It is recommended that work begins on an SOBC, with a view to realising early performance benefits. Because the most critical capacity need is more long-term, some elements could be phased for early delivery based on detailed performance modelling

Bringing forward these recommendations would have significant benefits to the railway and economy over the coming years, and they are resistant to fluctuations in demand because they address the congestion issues that exist today, assuming only marginal uplifts in train services in the future. They are also required to help facilitate the conditional outputs of major programmes such as NPR, with the benefits not only being measured in terms of capacity, but also crucially train performance, a key driver of passenger satisfaction according to the National Rail Passenger Survey.

Given the mounting weight of evidence that the industry needs to act at Doncaster and in the South Kirkby to Hare Park area, it is suggested work on SOBCs should begin as soon as practical despite the uncertainty caused by the pandemic. Since 2018, the ECML Route Study, this strategic advice and other industry work have all identified common constraints on this geography. Development of solutions must therefore be a priority, given the relatively small marginal cost of funding an SOBC weighted against the economic risks of inaction.

The following next steps are also recommended, with Network Rail available to work with interested parties where appropriate:

- Accommodating local services to the Five Towns via Askern is unlikely to be possible on the ECML north of Doncaster. An alternative solution for these services to run via a new chord at Barnby Dun is recommended should funders wish to progress with these services

- NPR should continue to develop long-term options in the Swinton area as plans mature

- Funders should work with the freight community to develop proposals such as St Catherine’s Chord

Photo: Alex Ayre
### G.2 Rail Network Enhancements Pipeline Process

Doncaster Area Strategic Advice has identified potential enhancements to deliver forecast rail growth for the longer-term. The options presented are recommended for funders to consider for development and ultimately delivery. Development should be mindful of the emerging work being undertaken on the decarbonisation and electrification workstreams. Where appropriate, schemes should look for synergies with identified future renewals to minimise disruption and improve value for money.

Network Rail is open for business and welcomes working with funders and interested parties to progress these recommendations. Given the opportunities identified to support and maximise the benefits of NPR, this will involve working closely with TfN.

If central government funding is sought, the development of the schemes should align to the Rail Network Enhancements Pipeline (RNEP) process, established to create a rolling programme of enhancements. The decision points for investment in the railway are supported by the government’s Five Case Model for business cases ensuring value for money throughout the lifecycle. Figure 20 illustrates the stages of the RNEP process and identifies where the key decisions for enhancement schemes take place.

The first stage of the process, a Decision to Initiate, is the establishment of the case for intervention and agreement to produce a Strategic Outline Business Case (SOBC). This would form the next stage in progressing recommendations, entering the potential interventions into the pipeline. Should the next stage, a ‘Decision to Develop’ be agreed, further development through the pipeline and business case cycle would be undertaken. Only when a ‘Decision to Deliver’ has been agreed would the enhancement be considered committed.

The recommendations from this study have been produced collaboratively with industry stakeholders to deliver a collective view on what is required to deliver future train services to support socio-economic benefits for the 2030s and beyond. Network Rail will continue to work with funders to refine credible options that meet the needs of passengers and freight users; that drive social and economic benefits; and that fit with the long-term needs of a reliable railway system.

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**Figure 20: Illustration of the Rail Network Enhancements Pipeline process**

- **Stage 1**: Determine
- **Stage 2**: Develop
- **Stage 3**: Design
- **Stage 4**: Deliver
- **Stage 5**: Deploy