Agenda item 18

Report to: **Partnership Board –Transport for the South East**

Date of meeting: **21 July 2025**

By: **Chief Officer, Transport for the South East**

Title of report: **Analytical Framework**

Purpose of report: **To provide an update with the development on analytical framework**

RECOMMENDATION:

The members of the Partnership Board are recommended to comment on the progress with the development on analytical framework.

---

1. Introduction

1.1 This report provides an update on the development of an analytical framework to support business cases and the delivery of the schemes within the Strategic Investment Plan (SIP).

2. Background

2.1 The analytical framework route-map was initially approved at the Partnership Board meeting on 23 January 2023, followed by an endorsement of the refreshed route-map on 13 July 2024 to ensure its continued relevance and alignment with local challenges, while also ensuring value for money.

3. Data

3.1 We have been continuing our requirements gathering with our host authority's IT team for our data architecture build. The data architecture will consist of a virtual machine hosting a database to store modelling data produced by various TfSE workstreams. Various software tools required to produce, interrogate and visualise the data will also be available on the virtual machine creating a back office solution appropriate for the future direction of TfSE that will enable efficient sharing amongst our partners. Building of the system is due to start imminently.

3.2 The regional travel survey data collection has been completed, with almost 7,000 responses collected across the region. This provides a statistically robust sample for analysing evolving travel behaviour at the local transport authority level. The data is currently undergoing validation, and the final raw dataset and summary dashboards will be shared via the Centre of Excellence platform.

3.3 We have conducted a due diligence review of mobile network data options, which is a key source of information for understanding travel demand in the region and a critical input for building transport models. Once the data has been acquired, the raw dataset will be made available to all LTAs in our region to assist their modelling and strategic planning work.

3.4 We have conducted a due diligence review of network planning tools available, leading to our preferred choice of Podaris. The proposal negotiated with Podaris would give LTA stakeholders a discounted rate for access to the tool.

4. Analytical tools

4.1 The final report for the proof-of-concept study of the North Regional Transport Modelling System (NorTMS) has been received. The study evaluates the effectiveness of the NorTMS, comparing it against traditional methods, particularly elasticity-based approaches (e.g. MOIRA), across three key types of rail interventions.

4.2 The study concludes that NorTMS provides comparable and robust demand forecasts relative to traditional methods. Its comprehensive and flexible nature makes it particularly well-suited to transformative rail interventions or cases with minimal baseline demand. However, its value for TfSE depends on the scale of planned schemes, the potential cumulative benefits of evaluating multiple projects simultaneously, and the associated setup and maintenance costs.

4.3 Given that TfSE is not planning large-scale transformational projects akin to Northern Powerhouse Rail, a reasonable approach would be to build the components of NorTMS incrementally, in line with what has already been planned within TfSE's analytical framework. In the meantime, rail scheme assessments can continue to be supported using traditional methods until the full analytical framework has been developed. The full report is attached in Appendix 1, and will be shared with other STB's as part of the Common Analytical Framework to help inform their analytical plans.

4.4 We have commenced the Travel Market Synthesiser project, this project aims to develop an analytical tool to generate synthetic travel demand for a specified year, tailored to TfSE's area. It involves replicating Transport for the North's (TfN) Travel Market Synthesiser, enhancing it with local data and parameters, and validating the outputs against TfSE's observed data in line with Department for Transport guidance.

4.5 We are progressing with the development of the South East Highway Assignment Model (SEHAM) as planned, the initial stage is due to complete by the end of August.

5. Engagements

5.1 We contributed to the Department for Transport's study on overcoming barriers to AI adoption. The report highlights key obstacles, including data quality, infrastructure and workforce readiness, public trust, costs, and environmental concerns, while also recognising AI's potential to enhance safety, efficiency, and sustainability. A copy of their report is available at the following link **TRL | Bridging the gap: Overcoming the barriers to AI adoption in transport** Over the coming months, through our Centre of Excellence, TfSE will develop a targeted support programme to help local authorities build confidence in using AI for policy development, reporting, and data analysis. This initiative aims to boost day-to-day productivity and support the effective integration of AI into local government operations.

5.2 The fourth TfSE Modelling and Appraisal Forum was held on 2nd July 2025. As a number of LTAs are currently updating or considering update their strategic transport models, this session focussed on the experiences and lessons learned during these updates. A presentation was given by Jon Wheeler from East Sussex County Council, whose team has recently completed updates to their strategic transport model.

6. Financial Considerations

6.1 The work set out in this report is being funded from the DfT grant allocation awarded to TfSE for 2025/26.

7. Conclusions and recommendations

6.1 The Partnership Board is recommended to comment on the progress with the development on analytical framework.

RUPERT CLUBB
Chief Officer
Transport for the South East

Contact Officer: Joshua Jiao
Email: joshua.jiao@transportforthesoutheast.org.uk

Report
May 2025

NorTMS Rail Modelling Proof of Concept Study – Final Report

Transport for the South East (TfSE)
24544801

steer

Report
May 2025

NorTMS Rail Modelling Proof of Concept Study – Final Report

Prepared by:

Steer
67 Albion Street
Leeds LS1 5AA

+44 113 389 6400
www.steergroup.com

Prepared for:

Transport for the South East (TfSE)
County Hall,
St. Anne's Crescent
Lewes,
BN7 1UE

24544801

Contents

Figures

Tables

Executive Summary

Overview

Transport for the South East (TfSE) has produced a Strategic Investment Plan (SIP) which includes proposals to enhance the rail network in the South East of England. Conducting comprehensive demand, revenue, and benefit analyses is essential to make the case for investment in these proposals and to secure the required support and funding. While rail industry forecasting methods such as MOIRA are often suitable, some interventions require alternative approaches due to significantly large improvements in service, or the development of new markets where rail options currently do not exist.

In these cases, the traditional elasticity-based modelling approach, as outlined in the Passenger Demand Forecasting Handbook (PDFH), may be less effective due to the scale of rail journey time changes or minimal base rail demand. Alternative modelling methods, such as four-stage demand modelling tools, become more relevant.

Transport for the North (TfN) has developed the Northern Transport Modelling System (NorTMS), which includes the Northern Rail Modelling System (NoRMS) and the Northern Highway Assignment Model (NoHAM). NoRMS considers pan-northern rail passenger movements and longer-distance strategic passenger movements, while NoHAM focuses on highway travel. This suite could be applied to other Sub-National Transport Body (STB) areas with necessary adjustments to account for differences to northern England.

To determine the suitability of adopting a similar model to NorTMS, TfSE requested a study to compare this model against a traditional PDFH-based approach using case studies of similar schemes in the north of England to those which form part of the SIP. Steer collaborated with TfN and TfSE to analyse how demand forecasts derived from NorTMS compares to alternative methods. Analysis was undertaken for three types of interventions affecting heavy rail infrastructure:

- Infrastructure improvements aimed at reducing journey times.
- Service enhancements to increase frequency and punctuality.
- Projects designed to open up new markets or serve previously unserved areas.

The analysis demonstrated that NorTMS provides comparable demand forecasts to traditional methods for all interventions tested. The findings suggest that the NorTMS model offers a viable alternative to traditional demand forecasting methods. The flexibility and comprehensiveness of the NorTMS suite make it particularly well-suited for capturing the impacts of transformative and multimodal interventions, supporting TfSE’s strategic objectives effectively. However, this functionality needs to be considered alongside the cost of establishing and then maintaining a NorTMS suite of models for the South East.

1 Introduction

1.1 Transport for the South East's (TfSE) Strategic Investment Plan (SIP) sets out an ambitious programme of potential rail network enhancement schemes. To develop those schemes a range of demand, revenue and benefit analysis will need to be undertaken, both to refine the scheme definition and to make the case for funding by supporting a value for money assessment. For many interventions typical rail industry demand, revenue and benefit modelling approaches will be suitable.

1.2 However, there are other interventions, as well as the full programme of interventions taken together, that have the potential to materially improve the service offer or serve markets where there is no current rail option. In such cases the typical elasticity approach to modelling set out in the Passenger Demand Forecasting Handbook (PDFH) becomes less robust, either because of the magnitude of journey time change, or because there is a very low level of base rail demand against which to model.

1.3 While PDFH does set out approaches to forecast demand in these situations, it may be appropriate to make use of a different modelling approach, such as four-stage demand modelling tools.

1.4 Transport for the North (TfN) has developed the Northern Transport Modelling System (NorTMS), which includes Northern Rail Modelling System (NoRMS) and Northern Highway Assignment Model (NoHAM). NoRMS focuses on modelling pan-northern rail passenger movements as well as more strategic modelling of longer distance passenger movements whilst NoHAM is a highway model.

1.5 TfN is able to make the NorTMS modelling suite available for other Sub-National Transport Bodies, although further development to cover different geographies outside the north of England would be required.

1.6 To inform the decision on whether to adopt a similar model to NorTMS, Transport for the South East (TfSE) has set out a scope of work to test the NorTMS model against a typical PDFH-based modelling for a set of case studies based on comparable 'twin' schemes in the north of England.

1.7 Steer has worked with TfN and TfSE to undertake a comparison of how demand forecasts derived from NorTMS compare to alternative approaches for three different types of intervention affecting heavy rail infrastructure. This note describes the findings of this comparison.

2 Identifying Case Studies

2.1 To identify suitable interventions to model in NorTMS we have reviewed the TfSE SIP to identify proposed interventions for which comparable interventions in the North can be found. The initial sift included:

- Route upgrades – including a mixture of reduced journey times and increased frequency.
- Additional station capacity provision to support additional services.
- Relocated stations or improved walking route between near-by stations – to allow better interchange between different lines.
- New stations.
- New chords to allow new direct services.
- Reopened lines.

2.2 There are some interventions which are out of scope of this work. These include those where NorTMS is not the right tool to model the benefits, including freight interventions, safety-focussed schemes, station quality and schemes delivering performance benefits or rail decarbonisation. We have not proposed to test interventions in the South East that are primarily focused on London commuting, as there are no comparable markets in the North.

2.3 Possible twin schemes considered included:

- **Route upgrades**: previously delivered schemes enhancing the Liverpool – Manchester route via St Helens, and the Bolton corridor. Planned route upgrades such as the TransPennine Route Upgrade and Hope Valley upgrade.
- **Additional station capacity**: Platform 0 at Leeds or Platform 5 at Bolton. Planned schemes could include elements of the above route upgrades; Huddersfield station or Dore Station.
- **Relocated stations or improved walking routes**: The most recent scheme of this kind was Liverpool South Parkway, which opened in 2006. Conceptual schemes could be modelled at locations including Wigan, Warrington, Wakefield
- **New stations**: recent new stations openings include Warrington West (2019), Low Moor (2017), Kirkstall Forge (2016) and Apperley Bridge (2015). A new station at major city centre station is being planned at Bradford and NorTMS analysis will be available for this.
- **New chords**: Halton Curve opened in 2019 and the Todmorden Curve opened in 2015.
- **Reopened lines**: TfN has recently developed forecasts for the Skipton-Colne reopening which included NorTMS modelling. The Northumberland Line opened in December 2024.

2.4 The proposed twin schemes were revised following discussion with TfN. It was then proposed the above list should be grouped into three potential scenarios to model which are:

- A Route Upgrade
- A New Station
- A New Line/Line Reopening

Route Upgrade

2.5 The chosen route to model for this case study is the Preston to Leeds corridor. The TfSE SIP includes proposals to improve line speed and service frequency on a number of routes including on the Brighton Main Line, Arun Valley, North Kent, Chatham Main and East and West Coastways, The TfSE Transport Strategy highlights the need to improve cross-regional services, such as Brighton - Southampton and Ashford - Gatwick- Reading as a key policy to improve connectivity in the region. In comparison Preston-Leeds has similar characteristics to those routes in terms of geography, distance, service frequency, average speed, and population of towns and cities on the corridor.

2.6 Preston to Leeds is a similar distance to Brighton to Southampton and has a similar average speed. Both have 1 train per hour (tph) end to end but up to 5 or 6 tph on intermediate route sections. Selected statistics shown below for comparison.

Figure 2.1: Comparison of key metrics between "twinned" route corridors

Preston - Leeds

Route	Distance (Miles)	Journey time (mins)	Average speed (mph)	Frequency (tph)
Preston - Leeds	60	103	35	1
Man Vic - Bradford	40	58	41	3

Station	Entries/exits 2019 (m)
Leeds	19
Bradford	3
Halifax	2
Burnley	1
Blackburn	1
Preston	5

Brighton - Southampton

Route	Distance (Miles)	Journey time (mins)	Average speed (mph)	Frequency (tph)
Brighton - Southampton	62	109	34	1
Brighton - Littlehampton	20	55	22	2
Brighton - Portsmouth	45	82	33	1
Portsmouth - Southampton	25	45	33	2

Station	Entries/exits 2019 (m)
Brighton	17
Littlehampton	0.9
Barnham	0.9
Havant	2.2
Portsmouth S	2
Portsmouth H	2
Southampton	6.3

Ashford - Reading

Route	Distance (Miles)	Journey time (mins)	Average speed (mph)	Frequency (tph)
Ashford - Tonbridge	26	35	45	1
Tonbridge - Redhill	20	31	39	1
Gatwick - Reading	53	85	37	2

Station	Entries/exits 2019 (m)
Ashford	4
Tonbridge	4.4
Redhill	3.6
Gatwick	21
Guildford	6.9
Reading	16.7

2.7 The Route Upgrade consists of an increase in service frequency and a reduction in journey time. This is a conceptual scenario that is agnostic of infrastructure capacity. In this case the focus of the analysis is on uplifting an established existing base rail demand. For this purpose an elasticity approach to modelling as set out in PDFH is appropriate.

2.8 The impacts of such changes in frequency and journey time have been quantified as passenger generalised journey time (GJT) changes. This is a measure of passengers' perceived station to station journey time which includes an in-vehicle time, a frequency penalty and, where necessary an interchange penalty.

2.9 The demand resultant from the change in GJT (in terms of user time savings), has been forecast using MOIRA, the industry standard rail demand and revenue forecasting tool. This uses an elasticity based approach to calculate the uplift in demand based on the change in GJT.

New Station

2.10 TfSE SIP includes consideration to create a number of new stations including a new station north east of Horsham, new stations east and west of Guildford, Canterbury Interchange and Strood Interchange.

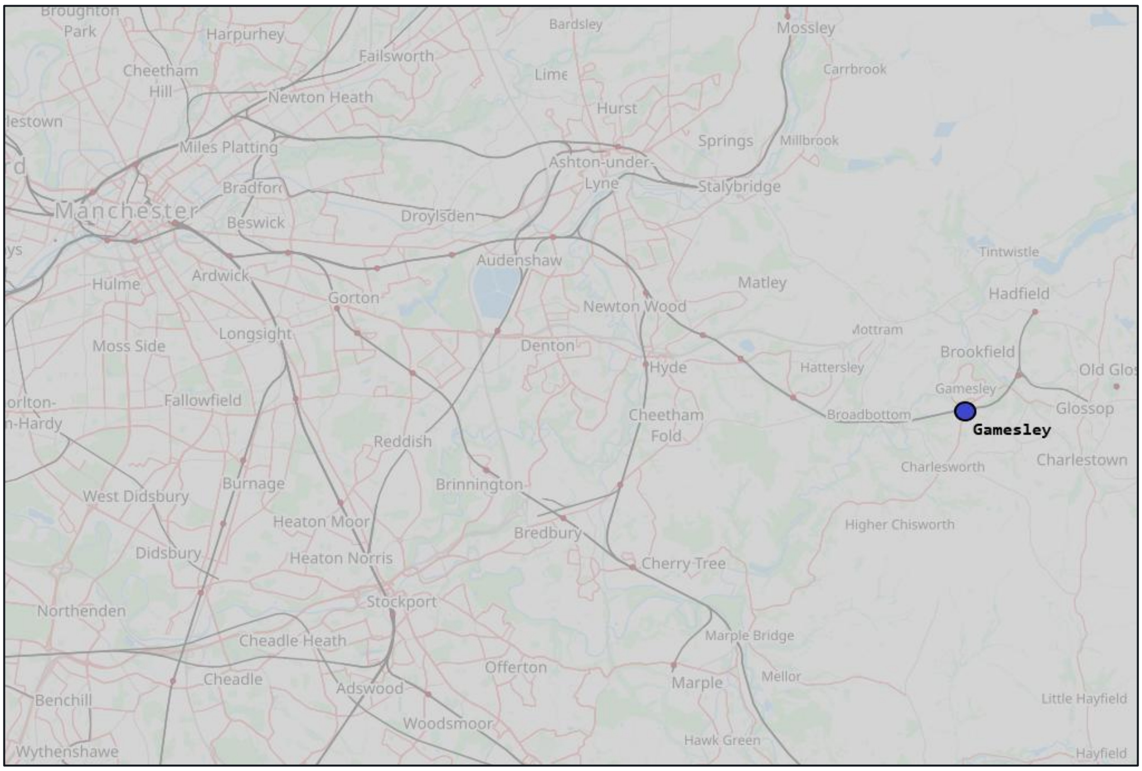
2.11 TfN has already coded a set of proposed new stations into the NorTMS network. These have no services stopping in any time period but have services passing through which can be amended to stop. The initial sifting process produced a list of four potential comparator new stations:

- Cottam Parkway
- Dinting
- Gamesley
- Skelmersdale

2.12 Steer has previously produced a business case for Gamesley and therefore this was chosen as a suitable case study. Gamesley is located just one mile outside the Greater Manchester boundary in Derbyshire, but has poor transport links to the city.

2.13 The community at Gamesley is situated in the Derbyshire borough of High Peak, adjacent to the border with Greater Manchester. It is a short distance (circa. two miles) from the towns of Glossop and Hadfield, however the Peak District National Park then separates the community from Derbyshire's principal economic centres in the centre and east of the county. Derby, for example, is 50 miles away and around 90 minutes travelling time by car. The community is therefore reliant on the Greater Manchester city region for much of its employment, higher education, healthcare and other opportunities.

Figure 2.2: Proposed Gamesley station location



2.14 The rail corridor provides a half-hourly off-peak service to and from Manchester Piccadilly station, rising to a 20-minute frequency at peak times. This study assumes all services passing the proposed location will be amended to call at Gamesley.

2.15 In comparison with proposals for new stations in the TfSE SIP the size of the catchment is likely to be larger for those than for Gamesley and the frequency of service greater. However the modelling approaches would be similar.

New Line/Line Reopening

2.16 TfSE has identified potential line re-openings in the SIP including the Waterside Line (Fawley), Uckfield – Lewes and establishing a rail link to Heathrow from the region.

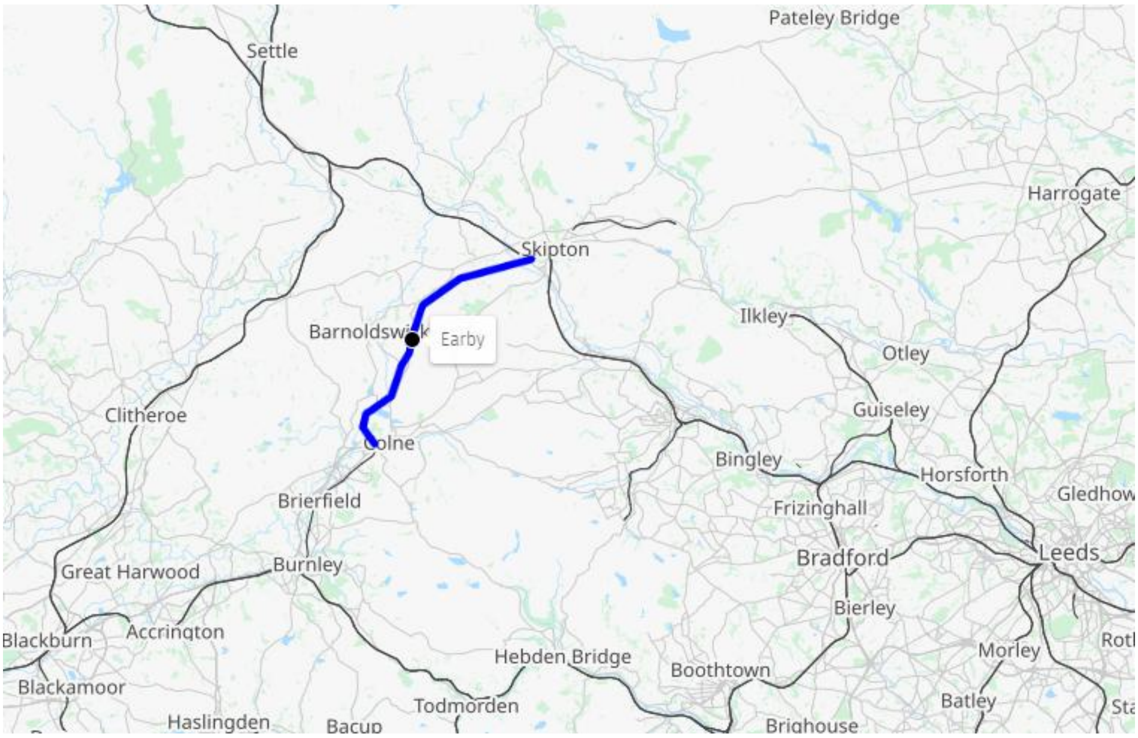
2.17 The NorTMS model network already included proposed line reopenings at Skipton- Colne and the Northumberland Line. The Northumberland Line is an example of a reopening of a branch line with seven stations, whereas Skipton Colne is a link between two existing railways with a single station.

2.18 Steer has previously supported the business case for Skipton – Colne and it was deemed most appropriate with similarities to Uckfield - Lewes.

2.19 By connecting the Aire Valley Line at Skipton with the Blackburn and Colne Line at Colne, reopening the line would provide a further trans- Pennine railway that has the potential to be used by passenger and freight services. A railway between Skipton and Colne was opened in October 1848 as part of the Leeds and Bradford Railway. By April 1849 it was part of a through route from Leeds to Liverpool. There were stations at Elslack, Thornton-in-Craven, Earby and Foulridge. A branch from Earby to Barnoldswick was opened in 1871. The Barnoldswick Branch closed to traffic in September 1965 and the route between Skipton and Colne closed to traffic in February 1970. In February 2018, the

Secretary of State for Transport announced that a feasibility study would be undertaken to look at the case for reinstating a railway line between Skipton in North Yorkshire and Colne in Lancashire.

Figure 2.3: Map of proposed Skipton – Colne line



2.20 The option assessed here is the reinstatement of a twin track railway between Skipton and Colne with a new station at Earby, doubling of the current single line section between Colne and Gannow Junction to permit a two trains per hour passenger service.

3 Introduction to NorTMS

3.1 Transport for the North (TfN) commissioned development of NorTMS to model large-scale rail improvements across the North of England. NorTMS is part of TfN's Analytical Framework which aims to provide consistency between modelling approaches used across studies covered by TfN.

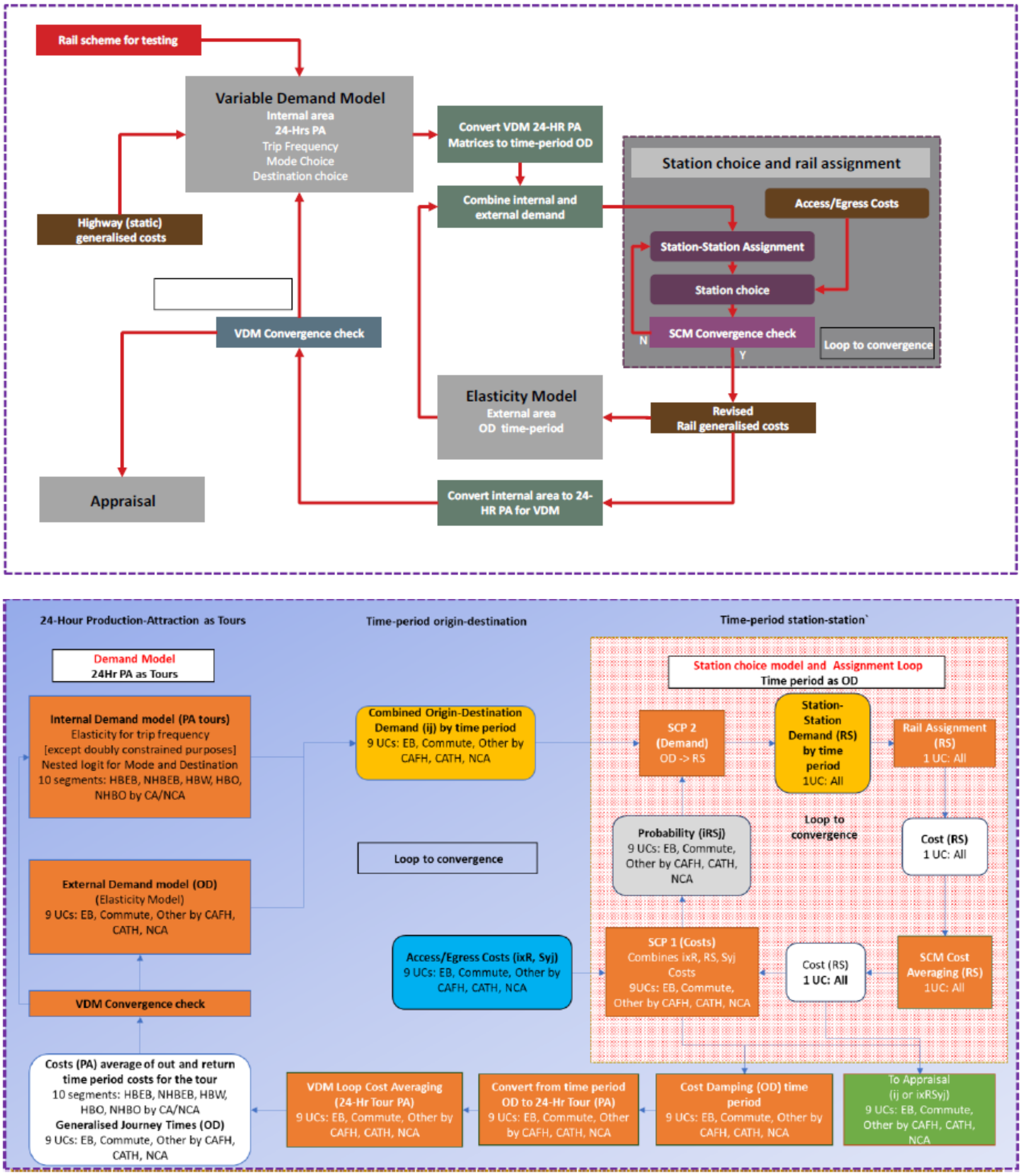
3.2 Primarily NorTMS was developed to support the business case for Northern Powerhouse Rail (NPR). NPR aims to improve journey frequency and reduce journey times between key cities in the north including Liverpool, Manchester, Bradford, Leeds, Sheffield, Hull, York and Newcastle. The NPR scheme is a combination of route upgrades and new high speed rail line sections.

3.3 The Passenger Demand Forecasting Handbook (PDFH) recommends that an elasticity based approach to forecasting demand as provided by the industry standard MOIRA modelling software is less appropriate where the change in generalised journey time (GJT) is greater than circa 30%, and in particular where there is not a significant base demand to build from.

3.4 In the case of NPR, due to the amount of new infrastructure proposed, it was decided a multi-modal form of model following the guidance in TAG would be more appropriate than solely an elasticity-based approach. The High Speed 2 (HS2) project has adopted the PLANET modelling suite as its core demand forecasting software. PLANET was trialled on the NPR scheme, but was observed to be more focussed on North-South movements and was not giving what were considered to be plausible results for east-west intercity trips in the north.

3.5 NorTMS has been developed as a multi-modal variable demand model which also takes account of the interaction with highway competition. It has been developed using Cube transport modelling software. It consists of a nested set of applications, the relationship between each application is shown in detail in the figure below:

Figure 3.1: NorTMS Model Map



3.6 NorTMS primarily has two models working together:

- **Internal**: Demand forecasts for trips entirely within the internal study area are made using the Variable Demand Model (VDM), a four-stage model (generation, mode choice, destination choice and assignment), which runs at 24-hour Producer-Attractor level. The Variable Demand Model (VDM) subgroup processes the destination choice, modal choice, and trip frequency as well as the external elasticity to generate new demand. This demand is then assigned and new costs produced. This process is run iteratively until the convergence criterion is met.
- **External:** Demand forecasts for trips with one or both trip-ends outside the internal area are made using an elasticity model that runs in Origin - Destination form by time period. This uses PDFH GJT elasticities.

3.7 Demand forecasts from the two approaches are combined for the station choice model that includes rail assignment. The station choice and rail assignment run at OD level by time period.

3.8 The station choice model is a key element of the model and forecasts the usage at new stations and the level of abstraction from other stations using a catchment model using the distance and mode of access/egress. The station choice model represents the decision as to the most appropriate stations to travel between on the rail network for each journey given rail travel and access/egress costs. This functionality allows a rail route choice response to significant service changes and new stations.

3.9 NorTMS model includes modelling of crowding. Each rail service has a rolling stock formation allocated and the model applies a penalty to the in vehicle journey time to reflect passenger perception of crowding. Crowding curves are derived from PDFH. The crowding model iterates to a convergence allowing passengers to re-route to avoid or reduce crowding penalties.

4 Alternative Methodologies

4.1 This section provides a summary of the alternative approaches to NorTMS for the three agreed Case Studies:

- A Route Upgrade
- A New Station
- A New Line/Line Reopening

4.2 In each case we are comparing the calculation of changes in demand, and the drivers of that change (for example generalised cost or generalised journey time). The assessment does not consider infrastructure cost, operating cost or revenue.

4.3 The approaches used are consistent with:

- Passenger Demand Forecasting Handbook and Transport Appraisal Guidance (TAG)
- DfT guidance on demand forecasting for rail schemes

Route Upgrade

4.4 The Route Upgrade in this case is assumed to consist of an increase in service frequency and a reduction in journey time. This is a conceptual scenario that is agnostic of infrastructure capacity. In this case the focus of the analysis is on uplifting an established existing base rail demand. For this purpose, an elasticity approach to modelling as set out in PDFH is deemed appropriate.

4.5 The impact of such changes in frequency and journey time have been quantified as passenger generalised journey time (GJT) changes. This is a measure of passengers' perceived station to station journey time which includes an in-vehicle time, a frequency penalty and, where necessary an interchange penalty.

4.6 The demand resultant from the change in GJT (in terms of user time savings) has been forecast using MOIRA, the industry standard rail demand and revenue forecasting tool.

New Station

4.7 For a new station the typical elasticity approach to modelling set out in PDFH is not directly applicable because there is no or minimal base rail demand against which to model demand changes. In this case, a "catchment model" approach has been used. .

4.8 This type of model is often used in relation to new station demand forecasting and uses estimates of the number of people living within a particular station catchment area. The catchment model allocates hex cells to rail stations based on the shortest overall journey time to a selected destination. The baseline rail station demand is then allocated to each hex in the Do Minimum scenario. The allocation to each hex is based on population and a weighted access time from the hex to the station.

4.9 The model is re-run with the new station included. Each hex is re-allocated to take into account the revised access times and rail GJTs from the new station. This estimates the existing demand that will be abstracted from currents stations to the new station.

4.10 Demand uplift is then calculated based on the difference between the GJT and access time change between the Do Minimum and Do Something scenarios for each Hex.

4.11 Stopping existing rail services at new stations creates an increase in journey time for existing rail users. In order to calculate this disbenefit, MOIRA has been used to calculate the impact in terms of change in GJT to existing users and subsequent impact on demand.

Re-opening/New Line

4.12 A reopened or new line can have two specific impacts in terms of connectivity benefits. It will serve new rail users, for whom no rail mode currently exists and in some cases, the line may also connect to the existing network at each end. In this case there may also be benefits to established rail markets from quicker journey times. Different tools are applicable in each case, summarised as follows:

- Where there are benefits to existing established flows MOIRA has been used.
- For new and significantly improved rail flows, catchment analysis and a direct demand gravity model has been applied;

4.13 The theory behind the MOIRA elasticity approach is summarised previously. However, PDFH 6.0 suggests using alternatives to MOIRA where there are large GJT changes which it states are "traditionally taken to be more than ~30%".

4.14 A Gravity Model is a suitable approach to forecasting new flows. A gravity model estimates passenger demand between localities based upon the respective localities' characteristics such as GVA, as well as the characteristics of the rail and road journeys made between the pair of localities. The methodology undertaken for Skipton-Colne is detailed further below.

Sample Methodology

4.15 The benefits appraisal analysis is calculated using the projected levels of passenger demand, driven by a combination of exogenous and endogenous factors. This section details the modelled user benefits, and the underlying passenger demand.

4.16 The following key benefits are quantified:

- Passenger generalised journey time (GJT) savings. This is a measure of passengers perceived journey time which comprises:
  - → In-vehicle time,
  - → A frequency penalty,
  - → Changes in station access time, and,
  - → Where relevant, an interchange penalty;
- The change in passenger miles and journeys for the consequential impacts on highway users; and
- Additional revenue to franchised operators as a result of the additional demand.

4.17 In the Scenario described below two models are used to develop the GJT benefits for passengers, one for existing flows, and one for new flows.

Inputs to the Model

4.18 Key inputs to the model were:

- GVA data for 2015, sourced from ONS
- BRES data for 2016 sourced from NOMIS
- Rail generalised journey times for the do minimum and test scenarios, from MOIRA;
- Car journey times (from drivetime software); and
- Value of time parameters from TAG.

4.19 These explanatory variables were regressed against historical journey and revenue data (2017/18) for each in-scope rail flow, and a gravity model produced.

Specification and Calibration of the Model

4.20 The specification of our direct demand model in its basic form is as follows:

4.21 $$\ln(Demand) = \ln\left(\alpha GVA_{Origin} + \beta BRES_{Destination} + \gamma GJT_{Rail} + \delta JT_{Road}\right) + \varepsilon_1 XMC_{Origin} + \varepsilon_2 XMC_{Destination} + \varepsilon_3 LDS_{Origin} + \varepsilon_4 LDS_{Destination} + \varepsilon_5 XLP_{Origin} + \varepsilon_6 XLP_{Destination} + C$$

4.22 Where:

- GVA_{Origin} is the annual Gross Value Added of the area around the origin station;
- $BRES_{Destination}$ is a measure of employment in the area around the destination station;
- GJT_{Rail} is the generalised journey time between the origin and destination via rail;
- JT_{Road} is the drive time between the origin and destination;
- XMC_{Origin} to $XLP_{Destination}$ are binary flags for the origin/destination stations being Manchester (XMC), Leeds (LDS) or Liverpool (XLP); and
- C is a constant.

4.23 The areas around the stations are defined using a layer of hexagonal cells of side length 1333 m. The following rules were used to assign these hex cells to stations:

- Hex cells are assigned to the station for which the sum of the drive time, and the minimum of the rail GJTs to key O_Ds. Including rail GJTs in this allows passengers to ‘prefer’ stations with regular, fast connections to the wider network.
- Passengers are assumed not to travel more than 7 km at the origin end, and 3.5 km at the destination end.

4.24 The model derived was statistically sound, with all explanatory variables significant at the $p<0.01$ level, and an R-squared statistic of 0.491, indicating that around half of the observed variation in demand was captured by the explanatory variables used.

4.25 The table below shows the values of the coefficients used in the modelling.

Table 4.1: Gravity model coefficients

Coefficient	Value
Α	0.19
Β	0.21
Γ	-3.75
Δ	0.70
ε_1	2.53

ε_2	3.69
ε_3	1.87
ε_4	2.73
ε_5	1.76
ε_6	3.02
C	15.00

Existing Flows Model

4.50 The Existing flows model uses MOIRA to determine benefits for the flows that will experience changes in GJT less than 30% as a result of the new service.

5 Comparison of Models

5.1 In order to compare 'like with like' it is necessary to understand the difference in base data between the models.

Definitions

Base

5.2 In this note the **Base** refers to actual timetable or demand data used to build the future year timetables.

- The Base demand is the actual number of rail journeys made in a particular year.
- The Base timetable is a published timetable which operated at a particular time.

Do Minimum

5.3 A Do Minimum is a future year projection of rail demand and a timetable assumption that assumes committed changes are made, for instance due to the completion of on-going enhancements to the network.

Do Something

5.4 The amended rail service offer enabled by the specific infrastructure enhancement being modelled is referred to as the Do Something scenario.

Reference Case

5.5 The **Reference Case** refers to the modelled position that the Scenario is compared against. In the case of the alternative modelling approaches, the Reference Case is always the same as the Base position. This applies to demand and timetable assumptions.

5.6 In the case of the NorTMS modelling the Reference Case is a future year "Do Minimum" position, with a different level of demand and a different timetable compared to the Base.

5.7 The NorTMS Do Minimum includes a change to the timetable and underlying demand year to represent a future position with known timetable amendments and a forecast change in demand.

Assumptions

Timetables

NorTMS

5.8 The NorTMS model has a Reference Case that has been used to compare all scenarios against. This represents a future position, in this case the 2028 Do Minimum. This has been built from the December 2021 public timetable as a Base, but with amendments to services to represent future committed schemes, including:

- Manchester Recovery Task Force December 2022 service changes.
- Thorpe Park new station.
- PFM Hybrid Minimum timetable for East Coast Mainline long distance services.
- Additional 1 tph Sheffield-Wakefield Westgate-Leeds semi-fast service.
- PFM Hybrid Minimum timetable for long distance services including restoration of 2 tph CrossCountry via Sheffield.
- Magna Templeborough (Rotherham) new tram-train stop.

Alternative Modelling

5.9 The Reference Case timetable for the alternative modelling approaches is different depending on the case study, however in each case the Reference Case timetable is the same as a Base, that is there is not a separate Do Minimum.

5.10 The Reference Case timetables are:

- **Case Study 1**: Preston – Leeds Route Upgrade uses the June 2024 Base Timetable.
- **Case Study 2**: Gamesley New Station uses the December 2019 Base Timetable.
- **Case Study 3**: Skipton-Colne uses the May 2018 Base timetable.

5.11 There are differences therefore in the rail service offer used in the Reference Case timetables for each Case Study, however the with respect to the findings of this work, the differences should not be significant in the geographical areas covered by the three case studies.

Table 5.1: Timetables used as the Reference Case

CS	Case Study	Scheme Name	NorTMS	Alternative Model
1	Route Upgrade	Preston – Leeds	2028 DM	June 2024 Base
2	New Station	Gamesley	2028 DM	December 2019 Base
3	Route Reopening	Skipton - Colne	2028 DM	May 2018 Base

Demand

NorTMS

5.12 The NorTMS model is built upon base rail demand from 2017/18 with exogenous growth to rail journeys applied using DfT's Rail demand forecasting tool EDGE (Exogenous Demand Growth Estimator) to create a 2028 Reference Case/Do Minimum. This is the same model parameters used for all case studies.

5.13 The exogenous growth observed in the NorTMS model shows an average increase to rail journeys of 30% between 2017/18 and 2027/28.

5.14 In addition to this the Do Minimum timetable adds another 10% of growth in journeys on average compared to the Base. In total when considering endogenous and exogenous growth the NorTMS 2028 Do Minimum shows an average increase to rail journeys of 40% between 2017/18 and 2027/28.

Alternative Modelling

5.15 Base demand year for alternative modelling is different depending on the Case Study. In each case there is no separate Do Minimum or Reference Case, the demand is taken directly from the Base.

- **Case Study 1**: the Preston – Leeds Route Upgrade uses a Base year of *2023/24* for the demand.
- **Case Study 2**: the Gamesley New Station uses a Base year of *2018/19*, and
- **Case Study 3**: the Skipton-Colne route reopening uses a Base year of *2017/18* for the Do Minimum/Reference Case.

Table 5.2: Demand used as the Reference Case

CS	Case Study	Scheme Name	NorTMS	Alternative Model
1	Route Upgrade	Preston – Leeds	2028 DM forecast	2023/24 actual
2	New Station	Gamesley	2028 DM forecast	2018/19 actual
3	Route Reopening	Skipton - Colne	2028 DM forecast	2017/18 actual

5.16 The model results are therefore not directly comparable between NorTMS and the alternative modelling methodology without adjustment.

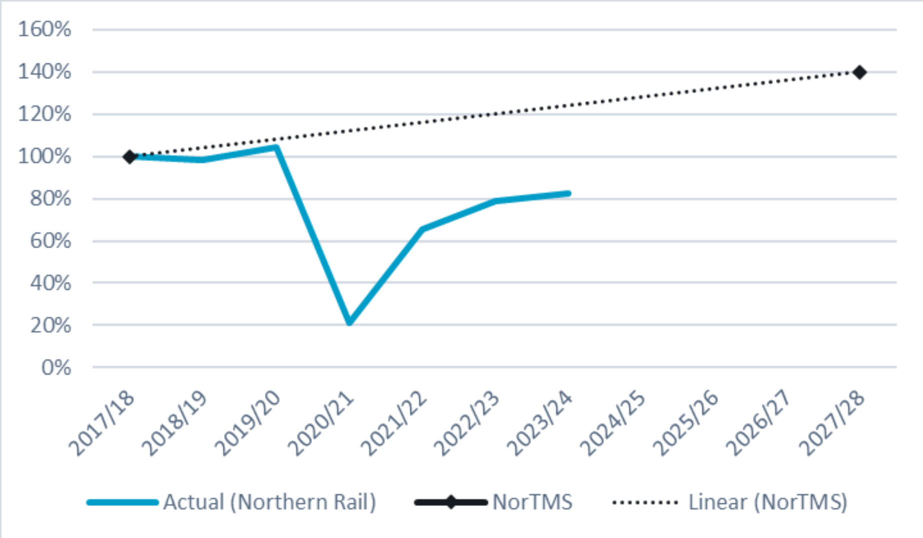
Growth

5.17 For the purposes of this project the impact of exogenous and endogenous growth has been removed from the NorTMS modelling in order to improve the comparison with the Alternative approaches.

5.18 Prior to the COVID-19 pandemic, actual rail demand had seen year on year growth each year since the economic recession around 2008. Future growth forecasts continued this trend. However, the pandemic saw rail demand in 2020/21 fall to around 22% of 2017/18 levels. Since then, rail demand has grown back towards but in the North of England still short of the levels seen prior to the pandemic. Further growth is forecast.

5.19 The chart below (Figure 5.1) shows the NorTMS forecast used to create the 2028 Do Minimum as a percentage change compared to the 2017/18 Base demand. Alongside this is the actual observed demand for the Northern Rail TOC from the ORR as a percentage change compared to the 2017/18 base.

Figure 5.1: NorTMS modelled growth in rail demand since 2017/18 compared to actual.



5.20 The chart shows that the Base demand levels used in the alternative modelling will be lower than the NorTMS model. In reality growth will differ by geography, sector and journey purpose however for the purposes of providing a high level estimate a single average growth figure has been used. The following reductions are applied to compare the Alternative modelling with the NorTMS results.

Table 5.3: Factors applied to NorTMS results for comparison

CS	Case Study	Scheme Name	Base Demand (Alternative)	Estimated factor required to NorTMS results
1	Route Upgrade	Preston – Leeds	2023/24 actual	-41%
2	New Station	Gamesley	2018/19 actual	-30%
3	Route Reopening	Skipton - Colne	2017/18 actual	-29%

Differences in Approach

5.21 There are some further key differences between the MOIRA and NorTMS approaches including:

- NorTMS uses a headway approach to rail service analysis, focussed on the average interval between services, whereas MOIRA uses the exact timings of the train service at each station.
- The NorTMS model includes modelling of crowding, the alternative approach using MOIRA does not. A newer iteration of MOIRA, MOIRA2, does include crowding as an option however it has not been used for this study.

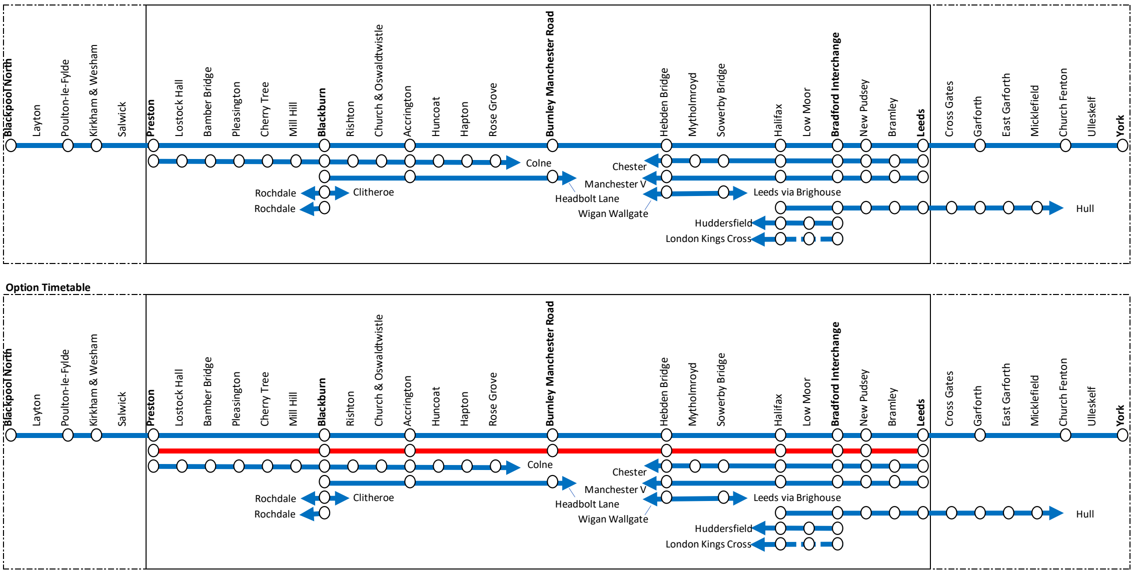
- Different wait times and interchange penalties are used. NorTMS applies an interchange penalty of 5 minutes at all stations, with boarding penalties of 15 minutes giving a total penalty of 20 minutes, whereas MOIRA uses varied interchange penalties based on the size of the station.
- The modelling of fares not included in NorTMS or the alternative modelling approaches. The impact of fare change is included in NorTMS forecast demand as it is included in the EDGE forecast. The farebox impact of demand changes are also included in appraisal. There is not however an ability to test the impact of fare/fare policy change.

6 Route Upgrade

Scenario Specification

6.1 The proposal is to model infrastructure upgrades which allow an increase from 1 tph to 2 tph between Preston and Leeds in both directions. It is assumed that line speed upgrades will allow a circa 10% reduction in journey time between Preston and Leeds. Line speed upgrades take effect for the faster services, local services assumed not to benefit.

Figure 6.1: Service specification



Results Comparison

Test 1 – Journey Time Reduction

6.2 Test 1 reduced journey times in existing services on the Leeds – Preston corridor by 10% but did not increase the frequency of services.

NorTMS

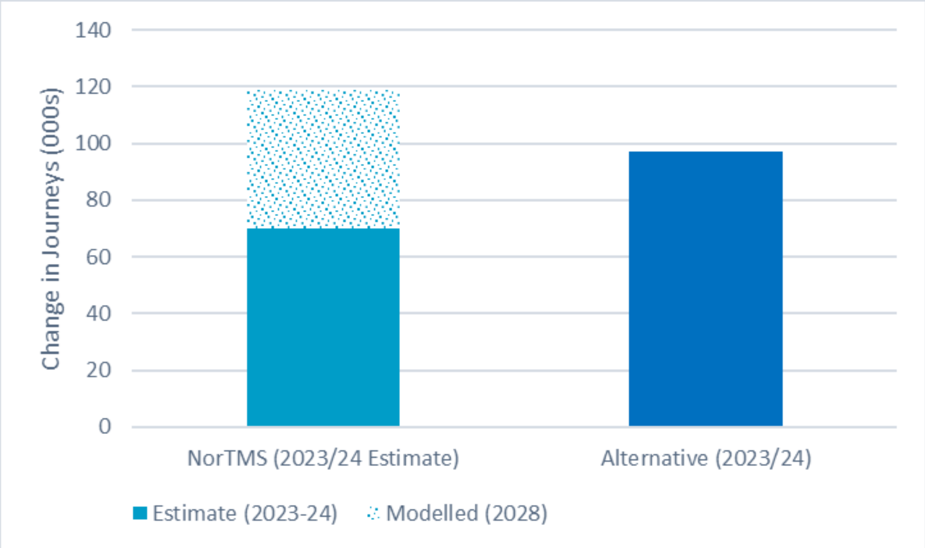
The NoRMS/NorTMS model produced an increase in journeys of **119,000** per annum in 2028. Removing growth would produce an estimate of **70,000** journeys in 2023/24.

Alternative Method

The MOIRA approach produced an increase in demand between Base and Do Something option of approximately **97,000** additional journeys per annum in 2023/24.

6.3 The overall change in demand is shown in the chart below.

Figure 6.2: Change in demand between DS and Reference Case for Test 1



6.4 The range of results for the journey time reduction test appears to be a similar order of magnitude between both modelling approaches. There is, however, a difference in the make up of those results which is analysed further for Test 2 below.

Test 2 – Adding New Services

6.5 In addition to reducing journey times on existing services, Test 2 increased the frequency between Leeds and Preston from 1 tph to 2 tph by adding an hourly Leeds – Preston service in both directions.

NorTMS

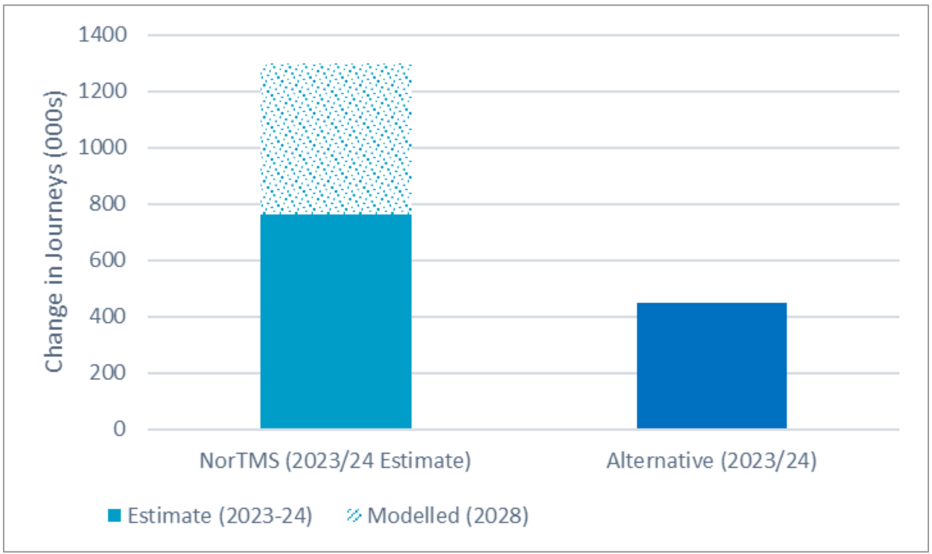
The NorMS/NorTMS model produced an increase in journeys of **1.3m per annum**. Removing growth would produce an estimate of **765,000** journeys in 2023/24.

Alternative Method

The MOIRA approach produced an increase in demand between Base and Do Something option of approximately **450,000** additional journeys per annum in 2023/24.

6.6 The range of results for the journey time reduction and service frequency improvement combined test shows a larger disparity show between methods compared to Test 1 (Journey Time Reduction). The overall estimated change in demand is shown Figure 6.3.

Figure 6.3: Change in demand between DS and Reference Case for Test 2



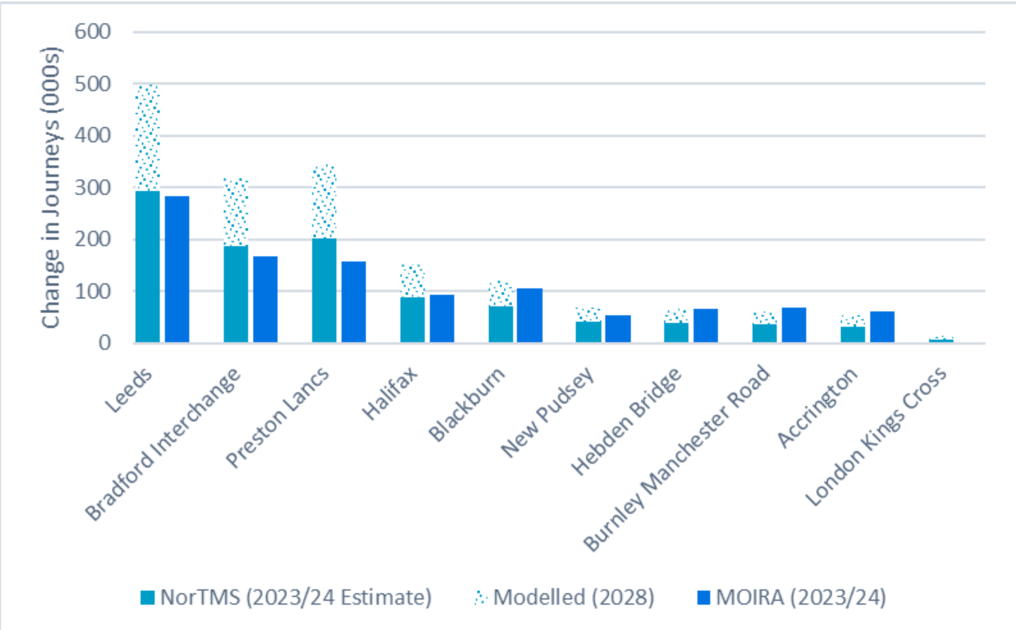
6.7 Further analysis of the results has been undertaken to establish where the large differences in demand present themselves.

Comparison by location

6.8 NorTMS results have been provided by TfN as list of changes to boarders and alighters at individual stations. In contrast the default output from MOIRA is the change in passengers by station to station flow. In order to compare the change in journeys at individual stations the number of flows starting/ending at each station plus the number of interchanges in MOIRA has been calculated in order to estimate total change in use of each station. This allows a comparison to be made with the NorTMS output.

6.9 A comparison by location is included in Figure 6.4. This shows the 10 stations with the largest increase from the NorTMS modelling (with adjustments made to reduce the growth in the NorTMS results).

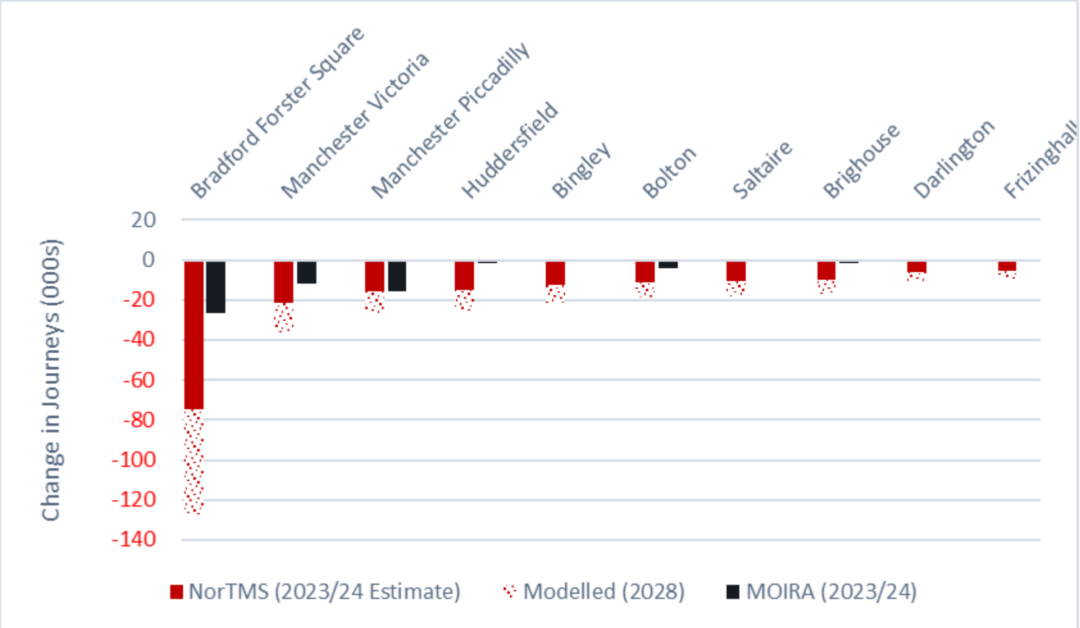
Figure 6.4: Change in demand between DS and Reference Case (Top 10 increases in NorTMS)



6.10 The chart shows similar levels of increase across both models for the stations shown in the chart. The top three, which are the three largest stations on the route, show slightly higher forecasts in NorTMS than MOIRA. In contrast the smaller 'medium sized' stations of Blackburn, Hebden Bridge and Accrington are slightly higher in the MOIRA run than the NorTMS estimates (when factored to remove growth).

6.11 The top 10 largest reductions in use at stations from the NorTMS results are shown in Figure 6.5, along with the comparable reductions shown in MOIRA.

Figure 6.5: Change in demand between DS and Reference Case (Largest decreases in NorTMS)



6.12 The reductions modelled are greater in the NorTMS modelling with close to 75,000 passengers per annum no longer travelling to/from Bradford Forster Square compared to less than 30,000 shown in MOIRA. This will mostly be the abstraction of passengers from Bradford Forster Square to Bradford Interchange due to the improvement in service offer, particularly to/from Leeds.

6.13 Travelling to/from and interchanging at Manchester stations (Victoria, Piccadilly and Oxford Road) is also affected. This is considered to be a result of a change in interchange location for flows between Yorkshire and stations north of Preston. The largest reduction in the MOIRA model is at Manchester Oxford Road with a loss of 37,000 uses per annum. Analysing the MOIRA results further, it is possible to see that the reductions in the use of stations in Manchester is mostly related to interchanging flows. Flows starting and ending at the stations are largely unaffected.

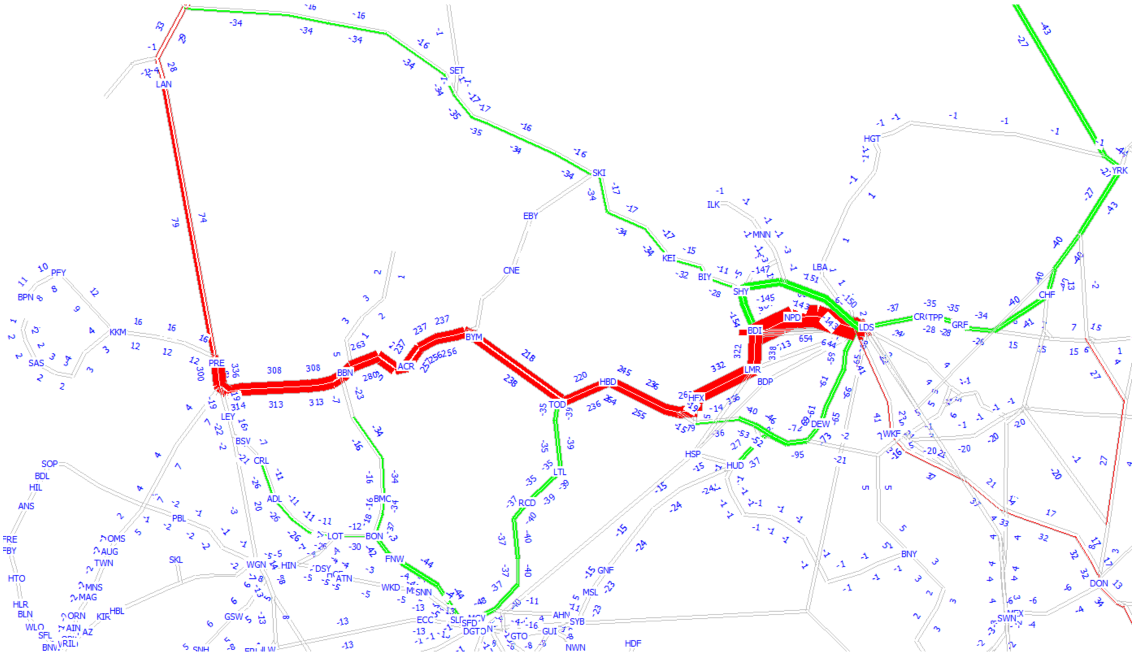
Table 6.1: Change in use of Manchester BR stations in MOIRA model run

	Starting/Ending	Interchanging	Total Impact
Manchester Piccadilly	0	-15,838	-15,838
Manchester Victoria	5,241	-16,824	-11,583
Manchester Oxford Road	-4,799	-32,281	-37,080

6.14 Other locations showing reductions in usage in NorTMS include Huddersfield, Bingley, Bolton and Brighouse where passengers will be using other routes. Again, the impact is less pronounced in the MOIRA model.

6.15 The NorTMS results provided by TfN also included plots of change in journeys along route sections. This shows the effect of abstraction of demand from other routes. This effect is shown geographically below where green denotes a reduction in demand between the reference case and the red shows an increase.

Figure 6.6: Change in demand between DS and Reference Case in NorTMS Inter-peak period (green = reduction, red = increase).

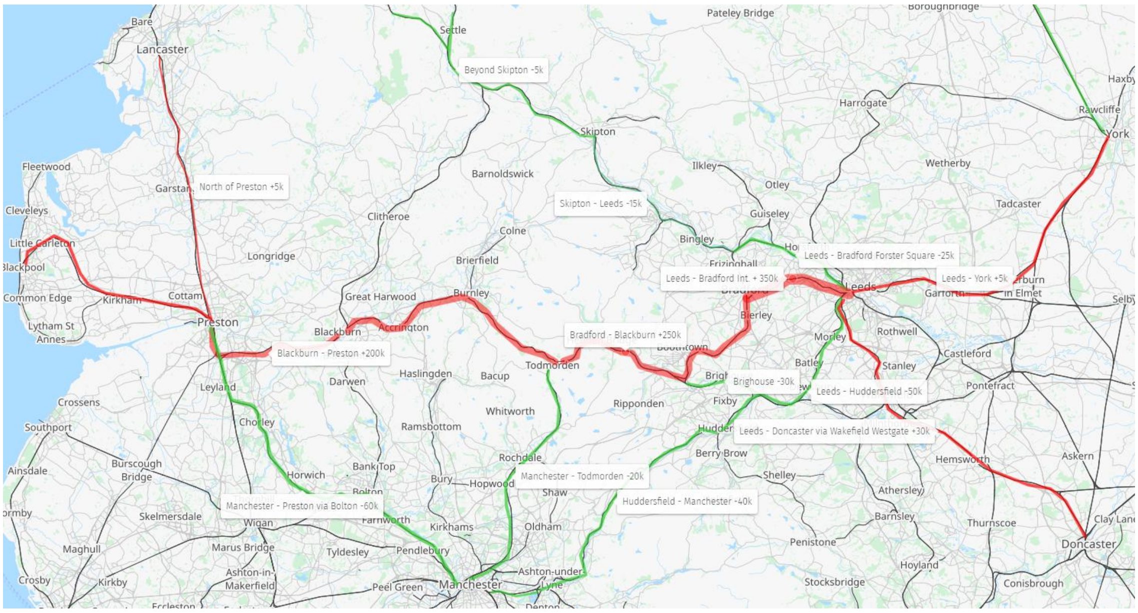


Source: TfN

6.16 Whilst Leeds to Preston is shown to increase in demand, to some extent this is extracted from alternative routes including Leeds – Skipton - Lancaster.

6.17 The NorTMS output above has been replicated in Figure 6.7 using the MOIRA outputs showing the change in number of journeys by ‘arc’. The colour key of green showing reduction in journeys and red showing an increase in journeys has been replicated.

Figure 6.7: Change in demand between DS and Reference Case in MOIRA modelling (green = reduction, red = increase).



6.18 The pattern shown in the NorTMS modelling broadly matches the MOIRA results which show between 200,000 and 350,000 additional annual journeys along the Preston – Leeds corridor. Also observed is a reduction in journeys along the Transpennine route, including a reduction of 40,000-50,000 journeys along the route between Leeds and Manchester via Huddersfield and a reduction of 60,000 journeys along the route between Manchester and Preston via Bolton

6.19 Noticeable differences between the NorTMS map and the alternative approach is the Leeds – York corridor, where MOIRA shows an increase in journeys and NorTMS a decrease.

Summary

6.20 The results of the two rail modelling approaches to the Route Upgrade Case study show many similarities. Both models show a significant increase in demand on the Preston – Leeds corridor. Both models also show a level of abstraction from other route corridors, in particular abstraction of demand away from Bradford Forster Square and abstraction of demand from the North Transpennine route between Leeds and Manchester.

6.21 MOIRA results show between 200,000 and 350,000 additional annual journeys along the Preston–Leeds corridor. They also show reductions elsewhere: 40,000–50,000 journeys on the Leeds–Manchester route via Huddersfield and 60,000 on the Manchester–Preston route via Bolton.

6.22 The NorTMS model broadly aligns with this. These shows reductions in usage in locations such as Huddersfield, Bingley, Bolton, and Brighouse, with a notable abstraction effect where demand is diverted from alternative routes. For instance, Leeds to Preston shows an increase in demand, partially extracted from the Leeds–Skipton–Lancaster route.

6.23 However, there is a discrepancy in the Leeds–York corridor, where MOIRA shows increased journeys compared to a decrease in NorTMS.

6.24 The difference of close to 300,000 additional journeys in NorTMSNorTMS compared to MOIRA appears to be primarily driven by differences in demand at locations away from the core study area. NorTMS appears more sensitive to changes in demand on other route corridors. This is perhaps expected due to the functionality and the models ability to change the origin or destination of trips.

6.25 This test highlights the similarities in the rail demand forecasting models and their implications for use on Route Upgrade studies.

7 New Station

7.1 The case study chosen for the new station was Gamesley. The rail corridor offers a half-hourly off-peak service to Manchester Piccadilly, increasing to every 20 minutes during peak times. This study assumes all services will stop at Gamesley.

7.2 The Base Timetable used was the December 2019 timetable.

NorTMS

The NorTMS modelling suggests between **98,000** and **148,000*** journeys per annum would be made from a new Gamesley station. However, the overall impact on the rail network would be an overall reduction in journeys of approximately **-17,000** journeys per annum in 2028.

Removing growth to estimate a comparable figure to the Alternative modelling would give an estimate of between **69,000** and **104,000** journeys per annum at Gamesley, and a net position of **-12,000** journeys per annum in 2018/19.

7.3 * The NorTMS forecast included a larger difference between boardings and alighting's for this test than the other tests, therefore forecasts for the proposed new station at Gamesley are shown as a range.

Alternative Method

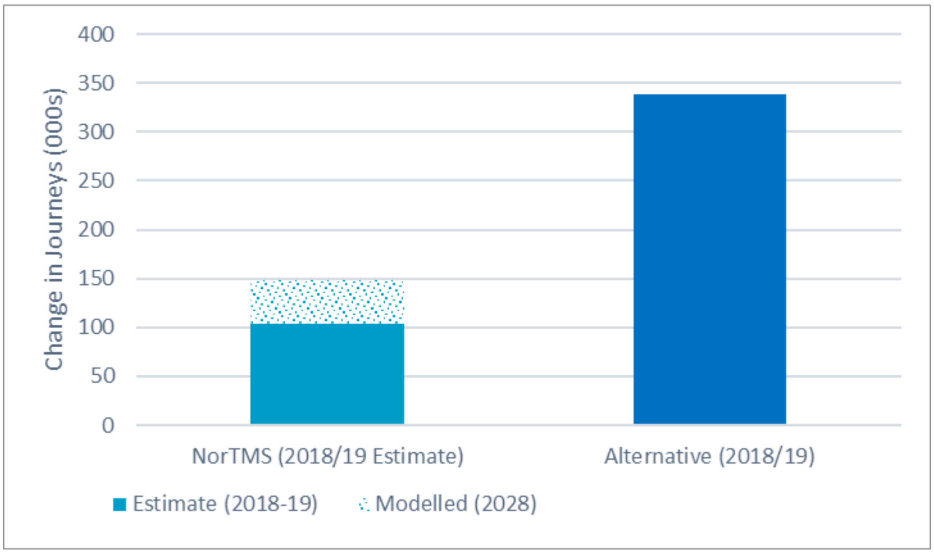
Steer previously undertook a Business Case assessment for this station using a Trip Rate model to calculate new and abstracted demand, and a GJT based approach to calculate the impact on existing users.

This approach produced an estimate of trips using Gamesley of **338,000** journeys per annum in 2018/19. However, 319,000 journeys were abstracted from existing stations and only 41,000 journeys were estimated to be new journeys. This is then offset by the disbenefit to existing users who pass through the new station experiencing a longer journey time. This reduces journeys by **46,000**. The net impact of adding Gamesley was therefore calculated at **-5,000** journeys per annum.

- Reduced demand MOIRA: -46,000
- Abstracted Demand from Existing stations: 319,000
- New journeys estimate: +41,000
- Net journeys estimate: **-5,000**

7.4 The results show similarities in forecasting the total net impact of adding Gamesley to the network would be a small reduction in overall rail demand (-12,000 using NorTMSNorTMS and -5,000 using the Trip rate approach). The total number of journeys using the new station is estimated to be between 65,000 and 350,000 (see Figure 7.1). This is a larger range than the net reduction figures, with NorTMS forecasting the lower figure.

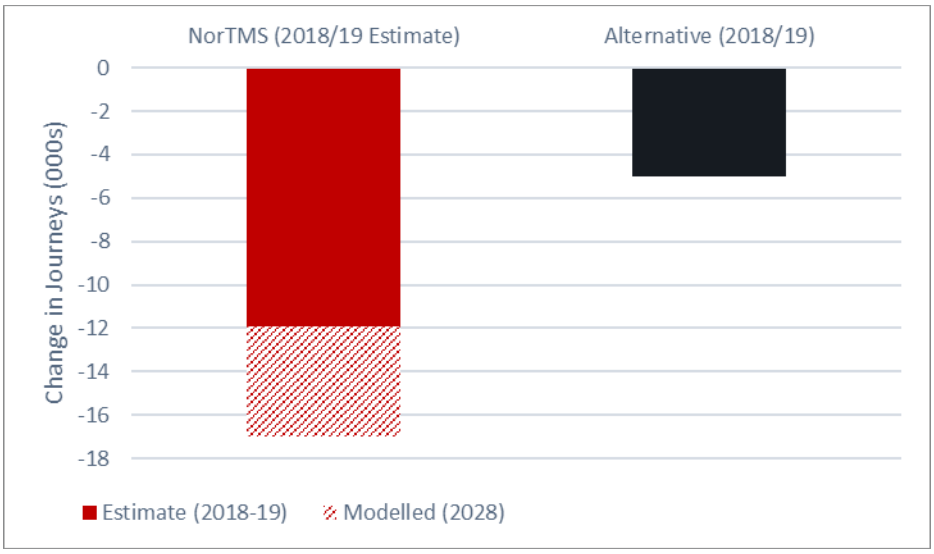
Figure 7.1: Estimated annual journeys to/from Gamesley



7.5 The Trip rate approach results in a similar level of annual demand as observed at Davenport (338,000 journeys in 2018-19) and Mossley (337,000 journeys in 2018-19) stations. However, the alternative modelling suggested the majority of this demand would be abstracted from nearby Broadbottom, Dinting and Glossop stations.

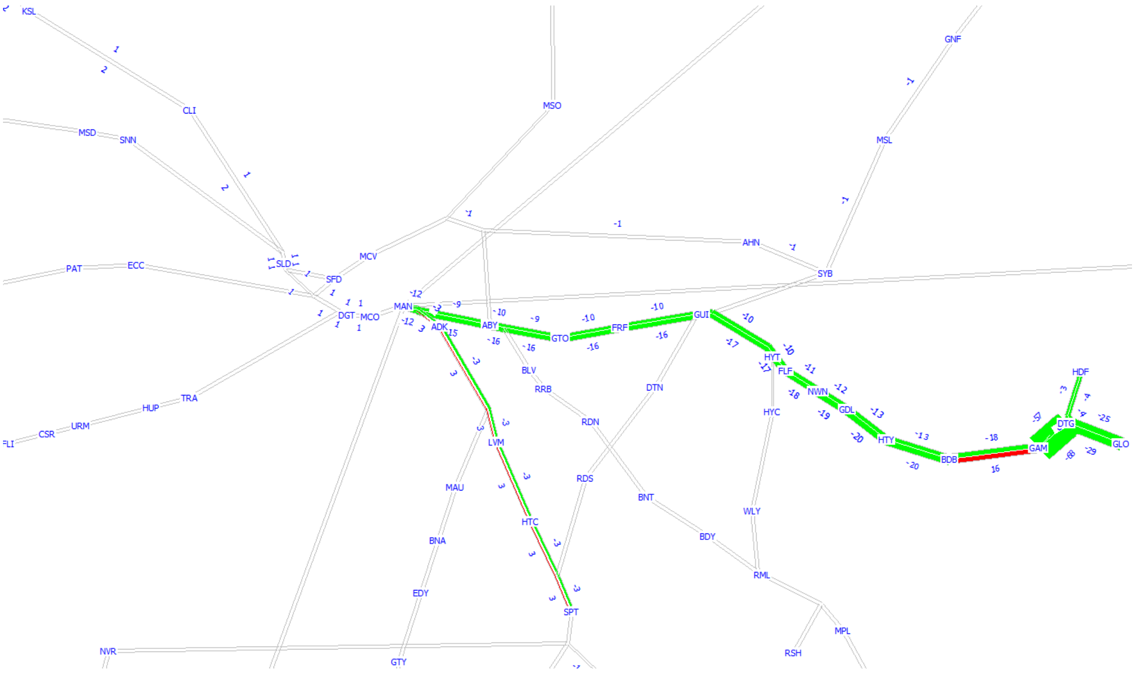
7.6 Coupled with the disbenefit to existing users who would experience longer journey times the net impact of opening the station is forecast to result in a reduction in overall rail demand as shown in Figure 7.2. The chart shows the overall net reduction to be of a similar magnitude in NorTMS and in the alternative approach.

Figure 7.2: Net impact of Gamesley on Annual rail demand



7.7 NorTMS outputs provided by TfN (Figure 7.3) show the change in journeys by route section. The chart shows an overall disbenefit on all relevant arcs with the exception of Gamesley to Broadbottom which shows an increase in demand in one direction only.

Figure 7.3: Change in annual journeys (inter-peak) shown in NorTMS model (green = reduction, red = increase).



Source: TfN

Summary

7.8 Both NorTMS and the Alternative approach forecast that a new station at Gamesley would result in a decrease in overall rail demand, despite different estimates of the number of annual journeys starting/ending at Gamesley.

7.9 NorTMS estimates a lower range of annual journeys to/from Gamesley, between 65,000 and 105,000. It indicates that the addition of Gamesley to the network would primarily lead to longer journey times for existing users, resulting in a net reduction in overall rail demand. It highlights an overall disbenefit on all relevant route sections except Gamesley to Broadbottom, which shows an increase in demand in one direction.

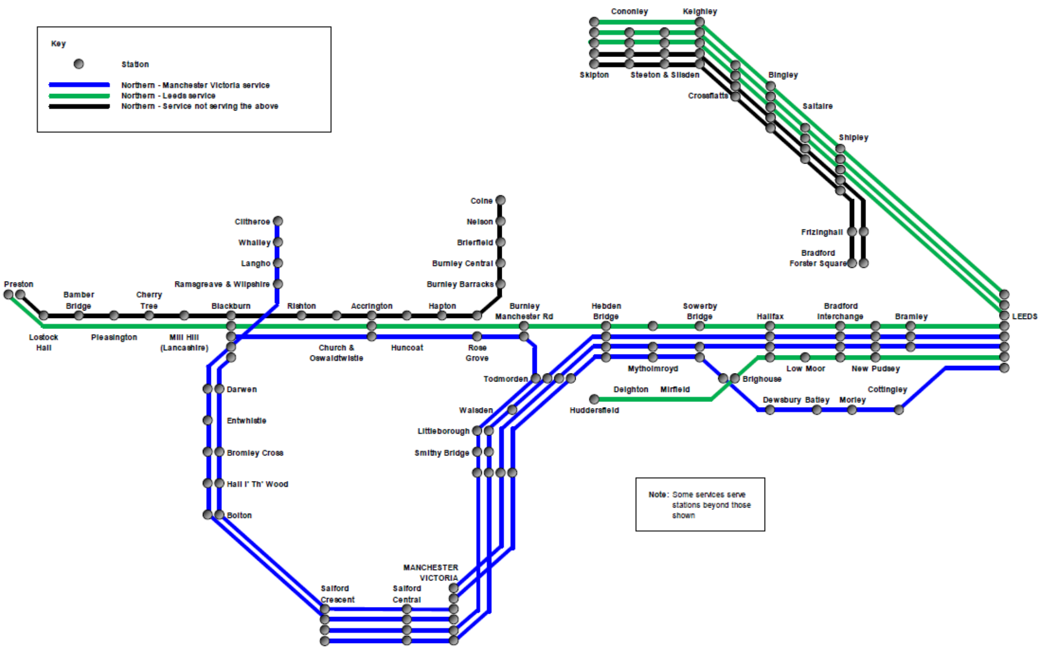
7.10 The Alternative Method forecasts a higher level of annual demand, comparable to nearby stations such as Davenport and Mossley. It suggests that most of the demand would be abstracted from nearby Broadbottom, Dinting, and Glossop stations.

8 New Line/Line Reopening

8.1 This case study models the reopening of the Skipton-Colne line. The typical off-peak service pattern in the Base timetable is shown in Figure 8.1. It includes:

- 3 trains per hour between Leeds and Skipton
- 2 trains per hour between Bradford Forster Square and Skipton
- 1 train per hour between Preston and Colne.

Figure 8.1: Base service pattern

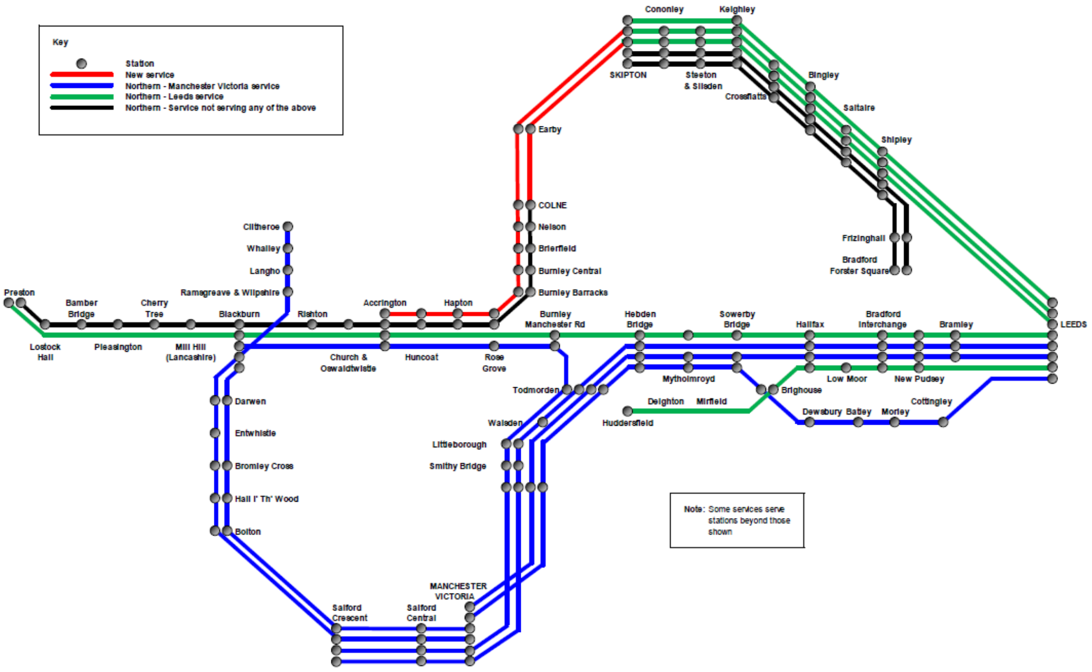


8.2 As part of the project to reconnect Skipton and Colne, a new station is planned for Earby. This station would provide local residents with improved access to the rail network, potentially generating new trips and accommodating some of the existing demand from nearby stations, such as those in Skipton or Colne. Additionally, the station is anticipated to serve people from Barnoldswick and the surrounding areas.

8.3 The Do Something service pattern chosen to be modelled for this test is shown in Figure 8.2. It includes two trains per hour each way using the Skipton to Colne Line:

- Combining the Preston – Colne service and one of the Leeds – Skipton services into a single through service via Earby.
- Extending another of the Leeds – Skipton services to Accrington via Earby.

Figure 8.2: Do Something Service Pattern showing 2 tph between Skipton and Colne



8.4 Tests were undertaken using this proposed service pattern in NorTMS and compared with the alternative modelling.

Results

NorTMS

The NorTMS modelling suggests approximately **205,000** journeys per annum would be made due to the new rail link. Earby station was estimated to have **35,000** journeys per annum including trips abstracted from existing stations in 2028.

Removing growth to estimate a comparable figure to Alternative Modelling would give an estimate of **25,000** journeys per annum at Earby, and a net position of **146,000** journeys per annum resultant from the scheme in 2017/18.

Alternative Methods

Steer undertook Business Case assessment for this scheme previously using two models:

- 1. Existing flows benefit model, using MOIRA; and
- 2. New flows "gravity" model

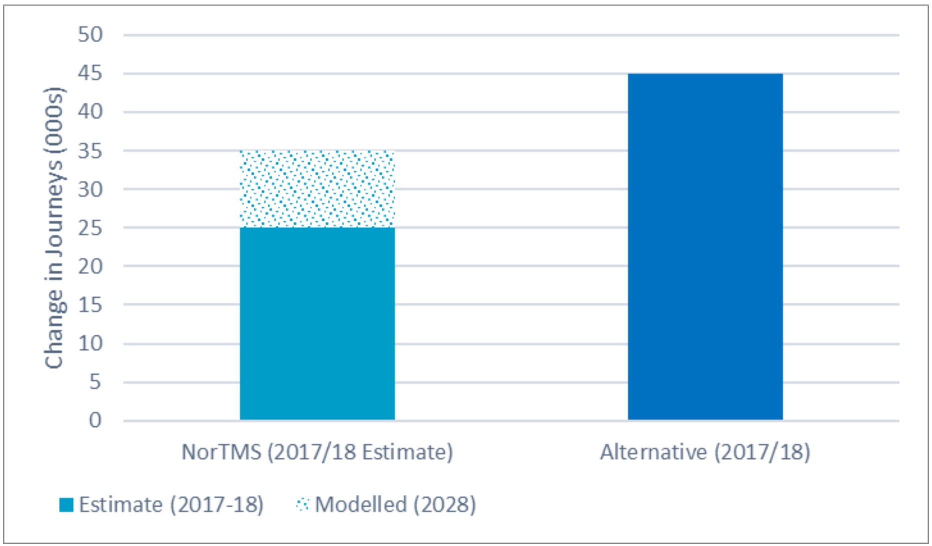
This approach produced an estimate of:

- **36,000** additional journeys per annum from Existing flows and**:**
- **49,000** additional journeys per annum from New flows.
- Thus a total of **87,000** net new journeys per annum.

The new station at Earby was estimated to have **45,000** journeys per annum in 2017/18. However, this includes trips abstracted from existing stations.

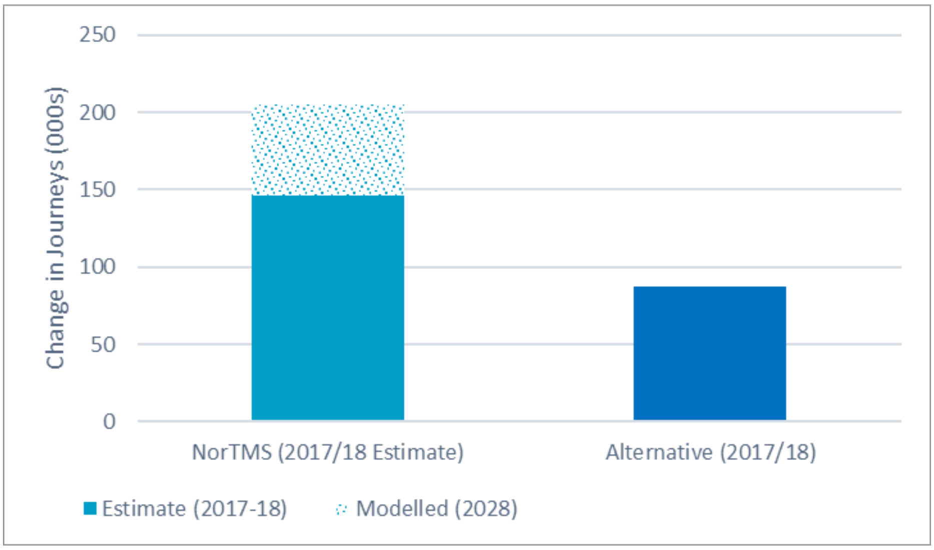
8.5 The results show similarities in the magnitude of the impact of reopening Skipton – Colne. The total journeys forecast at Earby (Figure 8.3) is 25,000 (alternative approach) and 45,000 (NorTMS) journeys per annum. The two forecasts have a similar magnitude of demand at a proposed new Earby station. Earby is a small town with a population of around 5,000. Its forecast patronage would be comparable to similar sized stations at Ravensthorpe (42,548) near Dewsbury, Dodworth (46,244) on the Penistone Line between Huddersfield and Sheffield or Sherburn in Elmet (47,488) between Leeds and York.

Figure 8.3: Comparison of forecast annual demand at Earby



8.6 The total net additional journeys is forecast between 87,000 (alternative approach) and 150,000 (NorTMS). This is shown in Figure 8.4.

Figure 8.4: Annual forecast change in demand between DS and Reference Case for Skipton - Colne



8.7 NorTMS outputs showing the change in journeys by route corridor form Figure 8.5 . The figure shows that demand increases significantly on the route between Leeds, Skipton and Colne. This trend continues between Colne and Burnley and Accrington. The magnitude of the increase decreases between Accrington and Preston. It can be seen that some demand is abstracted from alternative routes, in particular the Copy Pit route between Burnley, Todmorden and onto the Calder Valley route between Halifax, Bradford and Leeds.

Figure 8.5: NorTMS forecast annual change in inter peak demand resultant from the Skipton – Colne scheme (green = reduction, red = increase)

Source: TfN

8.8 Summary

8.9 Both the NorTMS and Alternative approaches indicate a net increase in total rail demand will result from the scheme.

8.10 NorTMS shows the demand on the route between Leeds, Skipton, and Colne will increase with a trend of increasing demand between Colne and Burnley, as well as Accrington, but with some demand abstracted from alternative routes, particularly from the Copy Pit route between Burnley and Todmorden, extending onto the Calder Valley route between Halifax, Bradford, and Leeds.

8.11 Both approaches provide comparable forecasts of annual demand at the new station at Earby, with expected annual journeys ranging between 25,000 and 45,000.

9 Overall Summary and Conclusions

Summary

9.1 TfSE requires demand, revenue, and benefit analyses for its identified proposed rail enhancement schemes. Comparison of the Northern Transport Modelling System (NorTMS) against traditional forecasting methods for rail network enhancements has been undertaken, focusing on three case studies:

- Route Upgrades,
- New Stations, and
- Line Reopenings.

9.2 NorTMS and traditional methods showed similarities in the results of the demand forecasting. These are summarised below.

9.3 **Case Study 1: Route Upgrade**: The Preston-Leeds route upgrade involved increasing service frequency and reducing journey times, with similar results found. NorTMS showing a slightly larger demand increase compared to the traditional MOIRA model, particularly at the larger stations.

9.4 **Case Study 2: New Station**: The new station at Gamesley was evaluated, with NorTMS and traditional methods both predicting a net reduction in overall rail demand. Forecasts for overall station usage at the proposed new station were not as close, but while a full appraisal would need to be done to confirm this view, it is not considered that the differences would lead to different conclusions on the value for money of the proposal.

9.5 **Case Study 3: Line Reopening**: The reopening of the Skipton-Colne line showed both methods predicting an increase in total rail demand, with similar forecasts for the total annual patronage at the proposed new Earby station. Again while a full appraisal would need to be done to confirm this view, it is not considered that the differences would lead to different conclusions on the value for money of the proposal.

9.6 The findings suggest that NorTMS is a viable alternative to traditional methods for certain rail network enhancements, effectively supporting TfSE's strategic objectives. The choice therefore depends on factors including the number of schemes to evaluate in total, and the number of schemes to evaluate which would involve transformational changes to the current rail usage. Additionally, the overall cost of procuring modelling would be a consideration.

9.7 The TfSE SIP is a portfolio of proposed schemes each at a different stage of development. A full list is included in Appendix A. It includes:

- Over 30 route upgrades with potential service enhancements

- Up to 10 potential new stations
- Approximately 15 New Lines/Line reopenings.

9.8 Each of the service enhancements would be relatively simple to model with a traditional elasticity approach to GJT as provided by MOIRA. Whilst a similar tool to NorTMS would also be capable of successfully modelling these schemes, there is likely to be little benefit in procuring a tool such as NorTMS to undertake such a test for a single scheme. The need to test numerous schemes together may result in time saved by creating a single large model, similar to NorTMS, for testing these schemes. It would also allow cumulative effects of different proposals to be assessed.

9.9 There are some new station studies proposed. An out-of-the-box model such as MOIRA is not appropriate for these cases on its own and a bespoke trip rate, trip end model with catchment analysis would be required. Alternatively, a tool such as NorTMS would be appropriate.

9.10 Line reopenings are limited to the Waterside branch and Lewes-Uckfield. Again, an out of the box model such as MOIRA is not appropriate for these cases on its own and a bespoke gravity model with catchment analysis is likely to be required. A tool such as NorTMS would also be appropriate.

9.11 TfSE is not proposing a project of the same scale as NPR, which is a new high speed line offering transformational changes to frequency and journey time for many cities across the north.

Attributes		**NorTMS**	**Alternative Approaches**
Overview of Approach		Multi-modal Variable Demand Model	A choice of bespoke models with use of MOIRA/MOIRA2 where appropriate
Chosen Approach for Comparison Study	Route Upgrade	NorTMS	MOIRA
	New Station		Catchment model + MOIRA
	New/Reopened Line		Direct Demand Model + Catchment Analysis + MOIRA
Model Functionality	Demand	Demand forecasts for internal trips use a four-stage model (generation, mode choice, destination choice and assignment) Demand forecasts for external trips (1 or both trip-ends outside the study area) use an elasticity approach to GJT.	Bespoke models using PDFH principles with use of MOIRA/MOIRA2 where appropriate. MOIRA and MOIRA2 use an elasticity approach to GJT.
	Crowding	Included	Use of MOIRA2 or a separate bespoke model required.
	Fares	Impact of fare/fare policy change not included	PDFH spreadsheet based revenue model

	Revenue	Included in NorTMS	Build bespoke models or use of MOIRA/MOIRA2
	Appraisal interface	RailEval tool included in NorTMS	Build bespoke TAG compliant model
Key differences in approach	Rail Demand Approach	Frequency or "Headway" approach to rail service analysis + boarding penalty.	MOIRA uses clock face timings of service at each station mapped against rooftop model
	Wait times & interchange penalties	5 minute interchange penalty with boarding penalty of 15 minutes (total interchange penalty of 20 minutes)	Interchange penalties based on the size of the station and timings of arrival and departure times at stations.
Cost/Procurement		Up front cost to procure model + maintenance/licence fees + set up and run time for individual studies	Cost to procure analysis and creation of bespoke models on a case by case basis

Conclusions

9.12 The comparison of the Northern Transport Modelling System (NorTMS) with traditional forecasting methods for rail network enhancements has shown that NorTMS provides comparable demand forecasts to traditional methods for rail interventions. Whilst NorTMS would primarily be used for schemes that significantly alter the service offer or introduce new rail options to the market, it also provided comparable results for the Line Upgrade case study.

9.13 Overall, the findings suggest that the NorTMS model offers an alternative to traditional demand forecasting methods. The flexibility and comprehensiveness of the NorTMS suite make it particularly well-suited for capturing the impacts of transformative interventions, effectively supporting Transport for the South East's (TfSE) strategic objectives. Using NorTMS would enable a number of different types of intervention to be assessed within a single modelling platform.

9.14 TfSE is not proposing a large transformational new rail project of the same scale as NPR. The case for TfSE procuring a tool similar to NorTMS is therefore less clear and likely to come down to a decision driven by cost and timescales. Procuring a model such as NorTMS is likely to incur a large up-front cost, compared to analysing schemes individually which will likely incur costs on an "as required" basis when modelling is requested. Moreover, there would be a period where a NorTMS model is calibrated and validated for the South East's geography before it becomes available for general use.

9.15 There is no question that traditional modelling approaches can be used to underpin business cases for the types of scheme in TfSE's programme. Using traditional modelling approaches scheme assessment could begin as soon as TfSE wishes. It would also avoid the up-front costs of setting up NorTMS for the South East. On the other hand, a NorTMS approach would allow a wide range of options to be tested within a single model platform and schemes would be assessed on a consistent basis. However, in the absence of an intervention that would be more challenging to assess than schemes that currently make up the TfSE programme, from this work it is not clear that the advantages of NorTMS outweigh the costs and time required to create a South East application.

9.16 The need to test numerous multimodal schemes together may result in time savings by creating a single, large model, similar to NorTMS. It would also allow the cumulative effects of different proposals to be assessed. However, the upfront costs of developing a multimodal model like NorTMS are significant, and TfSE does not currently have a scheme such as NPR to provide funding for such development.

9.17 While TfSE is not proposing a large, transformational new rail project like NPR at present, the refreshed transport strategy promotes a more multimodal approach and prioritises sustainable travel modes. Additionally, the ongoing development of the rail strategy and the SIP refresh may offer new insights into investment priorities in the region. Therefore, a NoRTMS-like integrated multimodal solution presents a promising long-term approach.

9.18 A reasonable approach would be to build the components of the NorTMS (Figure 3.1) incrementally, in line with what has already been planned within TfSE's analytical framework. In the meantime, rail scheme assessments can continue to be supported using traditional methods until the full analytical framework has been developed.

A TfSE Strategic Investment Plan – Rail Schemes

Table A.1: TfSE Strategic investment Plan Rail Schemes

Proposal Name	Proposal Category
A1 Solent Connectivity Strategic Study	Other
A2 Botley Line Double Tracking	Route Upgrade with potential service enhancements
A3 Netley Line Signalling and Rail Service Enhancements	Route Upgrade with potential service enhancements
A4 Fareham Loop / Platform	Route Upgrade with potential service enhancements
A5 Portsmouth Station Platforms	Route Upgrade with potential service enhancements
A6 South West Main Line - Totton Level Crossing Removal	Infrastructure only
A7 Southampton Central Station Upgrade and Timetabling	Route Upgrade with potential service enhancements
A8 Eastleigh Station Platform Flexibility	Route Upgrade with potential service enhancements
A9 Waterside Branch Line Reopening	New/Reopened Line
A10 West of England Service Enhancements	Service Enhancements
A11 Additional Rail Freight Paths to Southampton	Freight
South Hampshire Rail Enhanced	
B1 Southampton Central Station - Woolston Crossing	Infrastructure only
B2 New Southampton Central Station	New Station
B3 New City Centre Station	New Station
B4 South West Main Line - Mount Pleasant Level Crossing Removal	Infrastructure only
B5 Cosham Station Mobility Hub Medium	Infrastructure only
B6 Eastleigh to Romsey Line - Electrification	Route Upgrade with potential service enhancements
B7 Havant Rail Freight Hub	Freight
B8 Fratton Rail Freight Hub	Freight
B9 Southampton Container Port Rail Freight Access and Loading Upgrades	Freight

B10 Southampton Automotive Port Rail Freight Access and Loading Upgrades	Freight
London - Sussex Coast	
J1 Croydon Area Remodelling Scheme	Route Upgrade with potential service enhancements
J2 Brighton Main Line - 100mph Operation	Route Upgrade with potential service enhancements
J3 Brighton Station Additional Platform	Route Upgrade with potential service enhancements
J4 Reigate Station Upgrade	Route Upgrade with potential service enhancements
J5 Arun Valley Line - Faster Services	Service Enhancements
J6 East Coastway Line - Faster Services	Service Enhancements
J7 Brighton Main Line - Reinstate Cross Country Services	Service Enhancements
J8 New Station to the North East of Horsham	New Station
J9 Newhaven Port Capacity and Rail Freight Interchange Upgrades	Freight
J10 Uckfield Branch Line - Hurst Green to Uckfield Electrification	Route Upgrade with potential service enhancements
J11 Redhill Aerodrome Chord	New/Reopened Line
London - Sussex Coast Reinstatement	
K1 Uckfield - Lewes Wealden Line Reopening - Traction and Capacity	New/Reopened Line
K2 Uckfield - Lewes Wealden Line Reopening - Reconfiguration at	New/Reopened Line
"K3 Spa Valley Line Modern Operations Reopening - Eridge to	
Tunbridge Wells West to Tunbridge Wells"	New/Reopened Line
Wessex Thames Rail	
O1 Western Rail Link to Heathrow	New/Reopened Line
O2 Southern Access to Heathrow	New/Reopened Line
O3 Reading to Basingstoke Enhancements	Route Upgrade with potential service enhancements
O4 North Downs Line - Decarbonisation	Route Upgrade with potential service enhancements
O5 North Downs Line - Level Crossing Removals	Route Upgrade with potential service enhancements
O6 North Downs Line - Service Level and Capacity Enhancements	Route Upgrade with potential service enhancements
O7 Guildford Station Redevelopment Medium	Route Upgrade with potential service enhancements
O8 New Station Guildford West (Park Barn)	New Station

O9 New Station Guildford East (Merrow)	New Station
O10 Redhill Station Track Capacity Improvement	Route Upgrade with potential service enhancements
O11 Dorking Deepdene Station Upgrade	Route Upgrade with potential service enhancements
O12 South West Main Line / Portsmouth Direct Line - Woking Area Capacity Enhancement	Route Upgrade with potential service enhancements
O13 South West Main Line / Basingstoke Branch Line - Basingstoke Enhancement Scheme	Route Upgrade with potential service enhancements
O14 Cross Country Service Enhancements	Service Enhancements
O15 Portsmouth Direct Line - Line Speed Enhancements	Route Upgrade with potential service enhancements
O16 Portsmouth Direct Line - Buriton Tunnel Upgrade	Route Upgrade with potential service enhancements
O18 Theale Strategic Rail Freight Terminal	Freight
O19 West of England Main Line - Electrification from Basingstoke to Salisbury	Route Upgrade with potential service enhancements
O20 Reading to Waterloo Service Enhancements	Service Enhancements
Kent Medway and East Sussex	
S1 St Pancras International Domestic High Speed Platform Capacity	Route Upgrade with potential service enhancements
S2 London Victoria Capacity Enhancements	Route Upgrade with potential service enhancements
S3 Bakerloo Line Extension	New/Reopened Line
S4 South Eastern Main Line - Chislehurst to Tonbridge Capacity Enhancements	Route Upgrade with potential service enhancements
S5 London Victoria to Shortlands Capacity Enhancements	Route Upgrade with potential service enhancements
S7 North Kent Line / Hundred of Hoo Railway - Rail Chord	New/Reopened Line
S8 Thameslink - Extension to Maidstone and Ashford Short FBC	New/Reopened Line
S9 North Kent Line - Service Enhancements	Service Enhancements
S10 Chatham Main Line - Line Speed Enhancements	Route Upgrade with potential service enhancements
S11 Otterpool Park / Westenhanger Station Platform Extensions and Station Upgrade	Infrastructure only
S12 Integrated Maidstone Stations	Route Upgrade with potential service enhancements
S13 Dartford Station Remodelling / Relocation	Route Upgrade with potential service enhancements
S14 Canterbury Rail Chord	Route Upgrade with potential service enhancements
S15 New Station - Canterbury Interchange	New station

S16 New Strood Rail Interchange	New station
S17 Rail Freight Gauge Clearance Enhancements	Freight
S18 Crossrail - Extension from Abbey Wood to Dartford / Ebbsflett	New/Reopened Line
S19 High Speed 1 / Waterloo Connection Chord - Ebbsfleet Southern Rail Access	New/Reopened Line
S20 Ebbsfleet International (Northfleet Connection)	New/Reopened Line
S21 Ebbsfleet International (Swanscombe Connection)	New/Reopened Line
S22 Gatwick - Kent Service Enhancements	Service Enhancements
High Speed	
T1 High Speed East Dollands Moor connection	New/Reopened Line
T2 High Speed 1 / Marsh Link - Hastings, Bexhill and Eastbourne	New/Reopened Line
U1 High Speed Rail North U1 High Speed 1 - Link to Medway (via Chatham)	Route Upgrade with potential service enhancements
U2 High Speed 1 - Additional Services to West Coast Main Line	Service Enhancements

steer

Control Information

Prepared by	Prepared for
Steer 67 Albion Street Leeds LS1 5AA +44 113 389 6400 www.steergroup.com	Transport for the South East (TfSE) County Hall, St. Anne's Crescent Lewes, BN7 1UE

Steer project/proposal number	Client contract/project number
24544801	

Author/originator	Reviewer/approver
Duncan Baines (Steer)	Neil Chadwick (Steer)

Other contributors	Distribution
Alastair Hutchinson (Steer), Eliza Maravilla (Transport for the North)	Client: Joshua Jiao Steer: Project Team & TfN Project Team

Version control/issue number	Date
1.0	01-05-2025