Important Notice – This document has been produced by Network Rail (NR) in response to a direct output requested by the EWR Consortium. The purpose of this document and its appendices is to share with DfT and the East West Railway Company (EWR Co) the output of the option development activity carried out by NR on behalf of DfT and EWR Co for the East West Rail Central Section in the period report (Dated 6th July 2015 known as Phase 2a & 2b). This document only represents work activities on the output of NR's evaluation in this phase 2a & 2b of route options and have been prepared only for the purpose of providing EWR Co with further assessment evidence, for use, by EWR Co, in identifying and developing a preferred route with a supporting Strategic Outline Business Case. This document should be used exclusively for the purposes of informing this further development activity to be carried out by EWR Co.

Should any other person other than DfT or EWR Co obtain access to this document, that person accepts and agrees that this document has been produced by NR in accordance with the instructions provided in the Agreement and was produced exclusively for the benefit and use of DfT and EWR Co for the purposes set out above. This document may therefore not include all matters relevant to any such person or the further development of options for East West Rail Central Section undertaken by EWR Co following the production of this document.

East West Rail Central Section

Phase 2a Final Report

Network Rail

5 October 2015

Notice

This document and its contents have been prepared and are intended solely for Network Rail's information and use in relation to East West Rail Central Section.

Atkins Ltd. assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 55 pages including the covers.

Document history

Job number: 5137459			**Document ref:**			
Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 1.0	Initial Draft for comment	WJ	PB	PB	PB	3/6/2015
Rev 2.0	Final Issue	WJ/SP	RA	PB	PB	5/10/2015

Client signoff

Client	Network Rail
Project	East West Rail Central Section
Document title	East West Rail Central Section Phase 2a
Job no.	5137459
Copy no.	
Document reference	

Table of contents

Tables

Figures

Executive summary

The East West Rail Central Section (EWR CS) project proposes the introduction of direct rail passenger services between Bletchley, Bedford/Luton and Cambridge, which would be enabled by a combination of building new infrastructure and upgrades to existing infrastructure. Together with East West Rail Western Section (EWR WS) between Oxford and Bedford, this scheme would enable direct passenger services between Oxford and Cambridge. The project also includes capacity to facilitate the exploitation of freight market afforded by the creation of a direct link between the main radial routes from London to the north and west. The current working assumptions is that rail services would start in 2024, and the appraisal is based on a 60-year period from 2024 to 2083.

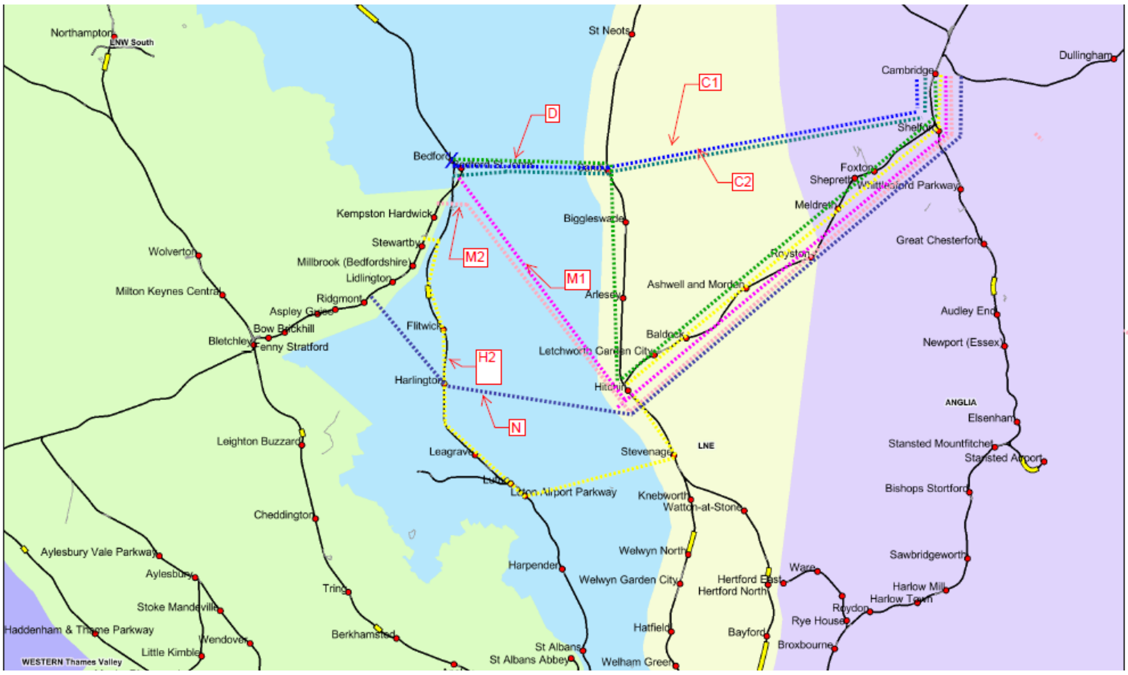
Corridor Options

Following the completion of the work that established the Conditional Outputs for East West Rail Central Section, the scheme promoters (East West Rail Consortium, Department for Transport and Network Rail and) have developed 5 corridor options – C, D, H2, M and N, the outline alignments of which are shown in Table 1-1 and Figure 1-1 below. Note that the locations listed merely describe the approximate physical alignment of the corridors and do not describe proposed stopping patterns of train services. Corridors C and M have variants – C1 and M1 go through central Bedford, while Corridors C2 and M2 would serve Bedford at a parkway location to the South of the town.

Table 1-1 Summary of Corridor Options

Option	Outline Alignment
C	Bletchley – Bedford – Sandy – Cambridge
D	Bletchley – Bedford – Hitchin – Cambridge
H2	Bletchley – Stewartby – Flitwick – Luton – Stevenage – Hitchin – Cambridge
M	Bletchley – Bedford – Hitchin – Cambridge
N	Bletchley – Ridgmont – Harlington – Hitchin – Cambridge

Figure 1-1 Summary Map Showing All Corridor Options



For appraisal purposes, a common set of 'Do Something' services is assumed for all corridor options:

- 1 train per hour (tph) London Paddington – Oxford – Cambridge semi-fast, an extension of the 'Do-Minimum' (see below) London Paddington – Bedford service (or diversion for Options H2 and N that do not serve Bedford);
- 1 tph Bletchley – Cambridge semi-fast; and
- 1 tph Bristol – Cambridge, with alternate trains extended to Norwich or Ipswich.

Maximum running speed is assumed to be 100 mph for the semi-fast services and 125 mph for the fast service over new infrastructure. Existing speeds, or speeds reflecting committed enhancement schemes, are assumed for any sections over existing infrastructure. Journey times between Oxford and Cambridge are as follows:

Table 1-2 Journey time assumptions

Option	Oxford – Cambridge journey time (mins)	
	Fast service	Semi-fast service
C	64	77
D	99	107
H2	97	111
M	82	94
N	77	90

For Corridor C there is the opportunity for a new station to the south of Cambourne.

This 'Do Something' is built upon a 'Do Minimum' scenario including the following:

- Thameslink Dec 2018 specimen timetable
- IEP Timetable on the East Coast Main Line
- Chiltern Evergreen 3
- East West Rail Western Section (EWR WS)
    - 1 tph Paddington – Oxford – Milton Keynes
    - 1 tph Paddington – Oxford – Bedford
    - 1 tph Marylebone – Milton Keynes
    - 1 tph Bournemouth – Manchester diverted via EWR WS and West Coast Main Line (with backfilling between Oxford and Birmingham and between Birmingham and Manchester)

In addition to the above, the 'Do Minimum' assumes that there is a station at Addenbrooke's and that all East West Rail services call there.

Demand Forecasting

A hybrid approach has been used for forecasting demand and revenue. For locations along and near the EWR route, a bespoke spreadsheet-based model has been used, combining a 'gravity' model and an elasticity-based model. For longer distance journeys, the PLANET Long Distance model has been used.

The spreadsheet model combines an elasticity-based incremental model, used where generalised journey time (GJT) is expected to change by less than 30% from 2011 base-year levels, and a regression-based gravity model, used where GJT is expected to change by more than 30%. This approach is adopted because a solely incremental model is not appropriate for use where services levels, and consequently demand, is expected to change markedly, often from a near zero level.

PLANET Long Distance (PLD) is a network model implemented in the EMME transport modelling software. The model is a rail assignment and nested mode choice model (i.e. between highway and public transport and, within public transport, between rail and air), with a supplementary simplified approach to estimating generated demand.

EWR CS is expected to generate approximately 8,000-11,000 additional daily rail trips in 2031 in terms of flows included in the spreadsheet model, with Cambridge being a significant demand generator. PLD outputs review that the highest journey time saving benefits tend to be found on Cambridge – Manchester and Cambridge – Birmingham flows.

Economic Appraisal

Outputs from the demand modelling suite, as well capital and operating costs have been fed into an economic appraisal model. The appraisal model covers a 60-year appraisal period between 2024 and 2083, calculates monetised benefits based on the latest WebTAG values of time, and presented values of (discounted) benefits and costs. We tested 2 growth scenarios, a 'core' scenario which takes population and employment growth forecasts from the National Trip Ends Model (NTEM) v6.2, and a 'high growth' scenario with growths calculated from information contained from Local Enterprise Partnerships' publications.

The appraisal suggests that EWR will bring significant benefits. Under the 'core' scenario, all of the 5 broad corridor options (C, D, H2, M, and N) have present values of benefits (PVB), ranging between £3.7bn and £4.6bn. Present values of costs (PVC) vary between £3.1bn and £4.9bn.

Table 1-3 Summary Appraisal Results – NTEM growth

Scenario	C	D	H2	M	N
Present Value of Benefits	4,616	4,062	3,756	4,559	3,783
Present Value of Costs	3,107	3,769	4,908	3,429	3,414
Net Present Value	1,509	293	-1,152	1,130	369
Benefit Cost Ratio	1.49	1.08	0.77	1.33	1.11

Table 1-4 Summary Appraisal Results – high growth

Scenario	C	D	H2	M	N
Present Value of Benefits	5,061	4,417	3,993	4,961	4,044
Present Value of Costs	3,109	3,799	4,901	3,459	3,426
Net Present Value	1,952	619	-908	1,502	618
Benefit Cost Ratio	1.63	1.16	0.81	1.43	1.18

The inclusion of Wider Economic Benefits (WEBs) does not change the relative performance of options, but does increase the benefits and hence BCR attached to each corridor. This is shown in Table 1-5 and Table 1-6.

Table 1-5 BCR of corridors including WEBs (NTEM Growth)

Scenario – NTEM	C1	D	H2	M1	N
Benefit Cost Ratio (inc WEBs)	1.82	1.30	0.92	1.58	1.32

Table 1-6 BCR of corridors including WEBs (High Growth)

Scenario – High Growth	C1	D	H2	M1	N
Benefit Cost Ratio (inc WEBs)	2.15	1.48	1.04	1.79	1.49

Conclusions

Corridors C and M have the highest BCRs (1.49 and 1.33 respectively in the core scenario, or 1.63 and 1.43 under high-growth assumptions). Assuming a station at Cambourne would improve Corridor C's BCR to up to 1.7. Any BCRs between 1.5 and 2.0 would fall into the 'medium value for money' category based on the Department for Transport's value for money (VfM) assessment. Corridors D and N have poorer BCRs of between 1 and 1.2. Corridor H2 is estimated to have a BCR of less than 1, with the lowest PVB and highest PVC. The direct corridors between Bedford and Cambridge appear to command the highest BCRs.

The consideration of Wider Economic Benefits (WEBs) does not change the relative performance of options, but does lead to an increase in the PVB and hence BCRs across the board. For Corridor C the BCR including WEBs increases to 1.82 to 2.15 for the core and high growth scenarios respectively. For Corridor M the range is from 1.58 to 1.79. For Corridor H2, including WEBs increases the BCR to 0.92 in the core scenario and 1.04 in the high growth scenario.

There are a number of sensitivities and uncertainties around these numbers, especially around options at stations such as Bedford, Sandy, and Hitchin, where trade-offs exist between proving fast journey times to through passengers, optimal access to the local catchment area, and convenient interchange with other services. Further detailed work would be required to firm up options at these stations. There are potential additional benefits that this phase of the work has not sought to quantify, including crowding relief, other long-distance service opportunities and freight.

From the multi-criteria analysis, Corridors C and M have the highest overall scores. Although Corridor C has the highest requirement for new infrastructure and hence has a relatively high comparative cost, it has the highest potential in terms of meeting the other criteria. Corridor M has the lowest comparative capital cost, but has higher planning and environmental constraints and lower long distance potential. Corridors D and N are close behind. Corridor N has the lowest overall score, due to having a combination of high requirements for both existing and new railway, therefore high cost, and poor long distance journey times resulting in overall low benefit realisation.

Taking all of this into account, our conclusion from the analysis completed to date is that Corridors C and M should be taken forward for more detailed development.

1. Introduction

This report presents and discusses results from the analysis conducted for Phase 2a of the business case appraisal work for East West Rail Central Section (EWR CS) between Bedford and Cambridge. For this stage of the work, 7 corridor options were considered, and these are outlined in Section 3.2.

Section 2 provides a brief overview of the suite of models used in the analysis - a regression based gravity model for the immediate study area, PLANET Long Distance for longer distance flows, an operating cost model, and an appraisal model that collates the results and produces WebTAG compliant BCRs.

Section 3 outlines the assumptions used in the analysis, including background growth (GDP, population and employment), the Do Minimum rail network and the Do Something service specification.

Results of the analysis are presented in Section 4. Here a Transport Economic Efficiency (TEE) Table is provided for all the scenarios under various assumptions, along with commentary of the relative merits of the options.

Section 5 discusses sensitivities and uncertainties. The main sensitivities are related to the potential infrastructure solutions at the nodes of Bedford, Sandy and Hitchin, where there are trade-offs between providing fast through journey times, optimal local access and interchange opportunities. It must be stressed that any node options chosen in the analysis are merely working assumptions and do not reflect final preferences, and further work is required to establish optimal node solutions. In addition, any benefits and costs that have not been fully or explicitly quantified are also identified in this section.

Section 6 is a multi-criteria assessment looking at qualitative aspects such as growth location connectivity, strategic long distance potential, and planning/environmental constraints.

Section 7 draws together all of the above and provides some conclusions based upon the analysis completed to date.

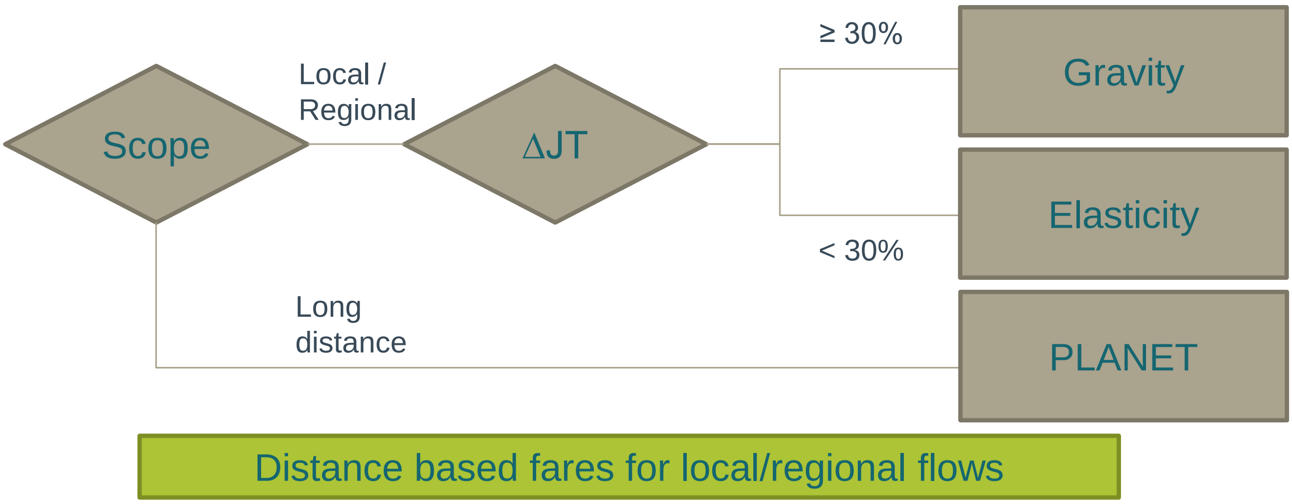
2. Modelling Framework

The modelling suite has the following principal components

- Spreadsheet based (regression/gravity) model for short-distance / regional flows;
- PLANET Long Distance for longer distance flows;
- Operating Cost Model; and
- Economic Appraisal Model.

Within the spreadsheet model, two broad types of model formulations are used. More details are provided in Section 2.1 below.

Figure 2-1 Modelling Framework



2.1. Spreadsheet Model

The main model is a regression based spreadsheet gravity model combined with an elasticity model for some flows. The gravity model is used where change in generalised journey time (GJT) is greater than or equal to 30%. Where the magnitude of change is less than 30%, a PDFH[1] incremental elasticity model is used, with elasticity values taken from PDFH v5.0. This approach is adopted because a pure elasticity based incremental model is not appropriate for use where a step change in service levels and demand is expected, and in many cases from a near-zero base. The change in GJT for each flow varies depending on the corridor option, the model would produce different benefits from different options not just because of journey time changes, but also because of differences in modelling approach. Therefore, a common set of model choice is imposed for all corridor options, and for Do Minimum and Do Something. This set is determined by applying the '30% rule' to the Do Something scenario of Corridor M. The Do Minimum scenario is a modelled scenario as it includes East West Rail Western Section, where many GJTs are shorter by 30% or more than in the Do Minimum. A more precise definition of the Do Minimum scenario is provided in Section 3.1.

The model base year is 2011. Exogenous growth is applied to produce forecasts for 2016, 2026 and 2031. Results are interpolated and extrapolated to cover a 60-year appraisal period between 2024 and 2083.

[1] Passenger Forecasting Demand Handbook

The model produces demand, revenue and passenger mile forecasts as well as journey time and user charge benefits at a station to station level as outputs, which are then aggregated and passed to the Economic Appraisal Model.

2.1.1. The Gravity Element

For the gravity element of the model, a number of model formulations were calibrated, and it was found that, for both season ticket and non-season ticket markets, the best calibrated and plausible model was one with the following combination of input variables:

- Generalised journey time (GJT);
- Origin population (Pop_O);
- Origin employment (Emp_O);
- Destination employment (Emp_D); and
- Fare per mile (F).

And the functional form is

$$Rail\ Demand = GJT^{e_1} Pop\_O^{e_2} Emp\_O^{e_3} Emp\_D^{e_4} F^{e_5}$$

Where the superscripts denote the parameters.

Fares are calculated on a per-mile basis recognising the fact with EWR fares would necessarily be different from existing levels, for flows such as Bedford – Cambridge due to the much shorter distance and not routing via London. See Section 2.1.3 for further detail.

Table 2-1 gives he parameters used in the model.

Table 2-1 Gravity Model Parameters

Parameter	Seasons	Non Seasons
Generalised journey time	-2.69	-0.83
Origin population (0-1km catchment)	0.14	0.03
Origin employment (0-1km catchment)	0.56	0.51
Destination employment (0.2km catchment)	0.84	0.69
Fare per mile	-2.76	-0.88

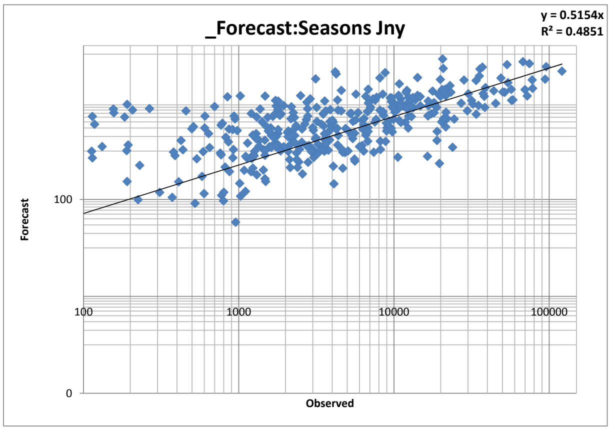
2.1.1.1. Calibration

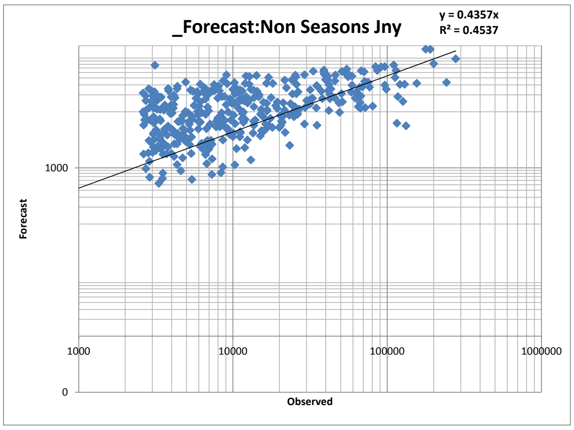
The gravity model was calibrated on the top 400 rail flows within the study area, for both season ticket and non-season ticket journeys. These flows have a wide range of origin and destination population and employment and journey lengths. MOIRA was used to extract GJTs, demand and revenue, and rail distance. Typical highway distances and journey times were obtained from Transport Direct. Population and employment data for various catchment areas were extracted from 2011 Census, and 2011 Business Register and Employment Survey data:

A large number of possible gravity model structures were tested separately for season and non-season journeys. The chosen models provided the best fit to the calibration data and provided an intuitive model structure and parameters, recognising that parameters should be independent so as not to distort the results.

Figure 2-2 below shows the calibration plots (observed vs forecast) for season ticket and non-season ticket forecast journeys.

Figure 2-2 Calibration plots





The plots show that the gravity model explains a considerable amount of the variation between station pairs although considerable variation remains and with a systematic tendency to forecast demand lower than observed as indicated by the trendline coefficients of below 0.5. Nevertheless, this conservative model structure is considered suitable for forecasting demand between O-D pairs where step changes in rail accessibility make forecasting an incremental change via GJT elasticity unreliable. There are several factors which are not explicit in the chosen gravity model, and they may account for some of the remaining variation in demand.

- Catchment areas – The model structure imposes a common catchment radius for all stations. In practice, Cambridge Station would have a much larger catchment area than Ridgmont, for example.
- Other socio-economic factors – trip rates might be affected by factors other than simple population and employment figures. Demographics (e.g. age and income) and type of employment would also have additional impacts on rail demand. Areas with a large student population could have high trip rates, for example.
- Modal competition - it is recognised that competitiveness against road journey times is not an explicit input variable in the model formulation. This has an effect of slightly overestimating demand for 'hair-pin' rail journeys in the Do Minimum, e.g. Bedford – Cambridge via London, where in practice the much shorter road journey time would render rail demand to be negligible. This potentially has an impact of reducing the difference between Do Minimum and Do Something, and painting a more conservative picture of the viability of the scheme.

2.1.2. The Incremental Elasticity Element

The elasticity equation is shown below

$$Forecast\ demand = Base\ Demand \times (1 + \Delta GJT)^{e}$$

Where *e* is the elasticity of demand to changes in GJT, which is assumed to be -0.9 for both season ticket and non-season ticket journeys, from table B4.5 from PDFH v5.0.

2.1.3. Preparing Model Inputs

Generalised journey times (GJT)

Generalised journey times were obtained from the rail industry's standard rail forecasting tool MOIRA. A bespoke version of MOIRA OR43 was created where all stations served by East West Rail services (both Western and Central sections) as well as select surrounding stations are represented as separate zones. Specimen timetables (see Section 3.2 for details) are coded into MOIRA for each corridor, as well as the Do Minimum, and GJTs are obtained via MOIRA's 'Data Inspector' outputs. These GJTs are calculated in accordance with PDFH guidance, taking into account various elements such as in-vehicle time, frequency (wait) penalty, interchange penalty, etc.

Rail fares

Yield (revenue per journey) is used as a proxy for fares for each flow for each of the Seasons and non-Seasons sectors. This is obtained through MOIRA which holds (processed) LENNON data. For flows with GJT changes of ≥30% where the gravity approach is used, fares of £0.20 and £0.26 per mile for Seasons and Non-Seasons are assumed, which are obtained through analysing LENNON data from across the model coverage area. Flows with GJT changes of less than 30% retain existing fare levels / yields.

Distances

Distances are required for several purposes: the calculation of distance-based fares, choosing the correct ticket type to journey purpose mapping based on flow distance, and the quantification of passenger km based benefits. Distances for Do Nothing have been obtained from MOIRA. For Do Minimum and Do Something scenarios, MOIRA distances are used where the change in GJT is less than 30%, and driving distances between stations are used as a proxy where the change in GJT is 30% or greater – it was not practical to calculate post EWR rail distances as this functionality is not available in MOIRA.

Exogenous drivers

Exogenous growth factors are used to forecast future year demand for 2016, 2021, 2026 and 2031. Forecasts are calculated in line with PDFH guidance, where rail demand changes with changes in GDP, population and employment (external environment effects), car ownership and road journey times (intermodal competition effect); and rail fares. Data sources and derived factors are detailed in Table 2-2. Elasticity values are obtained from PDFH v5.0.

Exogenous growth factors for population, employment and non-car ownership are obtained from district level forecasts from the National Trip Ends Model (NTEM) version 6.2. As the NTEM forecast is last updated in 2009 and the district level is not station specific, we have also created a 'high growth' sensitivity test with the population and employment growth rates that have been collated from the latest Local Plans for each in-scope station for the year 2031, and growth factors for 2016, 2021 and 2026 were obtained through interpolation.

Table 2-2 Sources of exogenous growth inputs and growth factors from 2011

Growth factor	Source	2016	2021	2026	2031
GDP per capita growth	TAG Databook	1.06	1.18	1.30	1.44
Population (core scenario)	National Trip End Model (NTEM) version 6.2	Varies by district			
Employment (core scenario)	National Trip End Model (NTEM) version 6.2	Varies by district			
Population (high-growth scenario)	Atkins estimates based on review of Local Authority planning policies	Varies by station			
Employment (high-growth scenario)	Atkins estimates based on review of Local Authority planning policies	Varies by station			
Car ownership	National Trip End Model (NTEM) version 6.2	Varies by district			
Fares growth	Government RPI+1 fares policy	1.05	1.10	1.16	1.22
Road journey times growth	TAG Databook	1.02	1.04	1.06	1.08

For the high-growth scenario, growth projections are taken from a variety of sources, including local enterprise partnership (LEP) economic plans, local authority core strategies and local plans. In many cases projections for additional housing units and employment are given for 2031, which is consistent with the final model year. In some cases projections are given for other years (e.g. 2026), then some minor adjustments are made to the data. These projections are converted into a percentage growth figure from a 2011 base level to 2031. Growths for intermediate model years are then derived through interpolation. In deriving the growth figures, a degree of judgement is used in determining the proportion of additional housing and jobs quoted in various documents that would fall in each station's catchment area, based on the best available information contained in the descriptions and explanations in these documents. Table 2-3 provides examples of 2031 population and employment growth forecasts for selected stations.

Table 2-3 Population and employment growth forecasts for selected stations, 2011-2031

Station	**Population**		**Employment**		**High-growth scenario source**
	Central	**High**	**Central**	**High**	
Cambridge	37%	41%	20%	35%	Greater Cambridge Greater Peterborough Enterprise Partnership Strategic Economic Plan
Bedford	25%	61%	7%	51%	South East Midlands Local Enterprise Partnership Infrastructure Investment Plan March 2014
Luton	11%	33%	12%	29%	
Oxford	13%	13%	9%	13%	Oxford Core Strategy 2026, March 2011
Hitchin	21%	23%	6%	11%	Hertfordshire Strategic Economic Plan March 2014
Milton Keynes	29%	95%	16%	105%	Milton Keynes Core Strategy July 2013
King's Lynn	14%	70%	20%	30%	King's Lynn & West Norfolk Local Development Framework Core Strategy July 2011
Welwyn North	29%	54%	16%	64%	Welwyn Hatfield Borough Council Strategic Housing Land Availability Assessment Nov 2014 Hertfordshire Strategic Employment Site Study April 2011

2.1.4. Model Coverage

This spreadsheet model covers the following 106 stations:

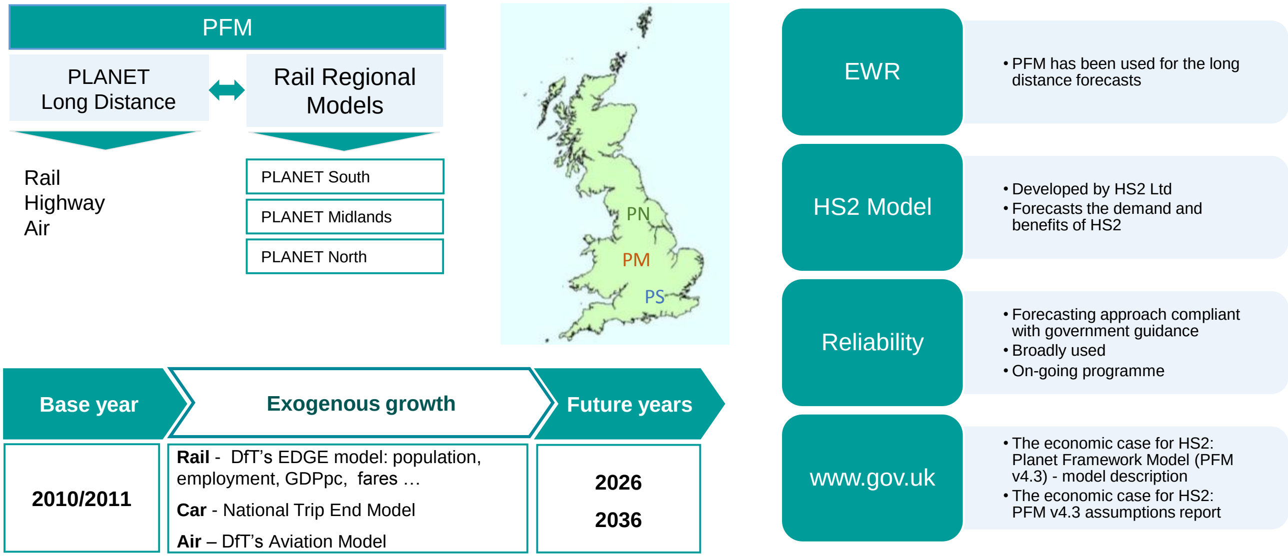
Table 2-4 Stations within spreadsheet model coverage

Appleford	Cholsey	Huntingdon	Needham Market	Stewartby
Arlesey	Corby	Islip	Newmarket	Stoke Mandeville
Ashwell & Morden	Culham	Kempston Hardwick	Newport Essex	Stowmarket
Aspley Guise	Didcot Parkway	Kennett	Northampton	Tackley
Attleborough	Diss	Kettering	Norwich	Thetford
Audley End	Dullingham	Kings Lynn	Oxford	Thurston
Aylesbury	Eccles Road	Kings Sutton	Pangbourne	Tilehurst
Aylesbury Vale Parkway	Elmswell	Knebworth	Peterborough	Tring
Baldock	Elsenham Essex	Leagrave	Princes Risborough	Twyford
Banbury	Ely	Leighton Buzzard	Radley	Waterbeach
Bedford Midland	Fenny Stratford	Letchworth	Reading	Wellingborough
Bedford St Johns	Flitwick	Lidlington	Reading West	Welwyn North
Berkhamsted	Foxton	Little Kimble	Ridgmont	Wendover
Bicester North	Goring & Strtley	Long Buckby	Royston	Whittlesea
Bicester Town	Great Chesterfrd	Luton	Sandy	Whittlesford
Biggleswade	Haddenham & Thames Parkway	Luton Airport Parkway	Shelford	Woburn Sands
Bletchley	Harling Road	Manea	Shepreth	Wolverton
Bow Brickhill	Harlington	March	Spooner Row	Wymondham
Brandon	Harpenden	Meldreth	St Neots	
Bury St Edmunds	Hertford East and North	Millbrook	Stansted Airport	
Cambridge	Heyford	Milton Keynes Central	Stansted Mountfitchet	
Cheddington	Hitchin	Monks Risborough	Stevenage	

2.2. PLANET Long Distance

Longer distance flows are modelled using the PLANET Framework Model (PFM) v4.3. PFM is a network model implemented in EMME. The model is a rail assignment and nested mode choice model, with a supplementary simplified approach to estimating generated demand. PFM combines 4 sub-models – PLANET Long Distance (PLD), PLANET South (PS), PLANET Midlands (PM) and PLANET North (PN). This model has been developed by HS2 Ltd for the purpose of developing the Business Case for High Speed 2 (HS2).

Figure 2-3 PFM Overview



Consistent with appraisal work undertaken for East West Rail Western Section (EWR WS), only outputs from PLD have been used. PLD is an all-day multimodal supply/demand equilibrium model for long-distance travel and deals with three modes – rail, car (driver and passengers) and air – covering all domestic long distance trips in Great Britain. It is a strategic model and constitutes the core of overall PFM model suite.

The basis of the PLD zoning system is the Local Authority District level, with 235 zones. It is focused on the corridor of interest and the more remote areas are aggregated.

PLD incorporates three key models: a Demand Model, a Supply Model, and a Station Choice Model (SCM, only for rail), with the aim of modelling behavioural responses to changes in rail services, in terms of route choice (in the assignment), station choice (with SCM) and mode and frequency (with Demand model):

- Demand model deals with mode choice and generated demand, in response to changes in (generalised) cost.
- Supply models, based on networks, calculates the changes in cost, as a result of changes in demand. Separate networks for rail, car and air are incorporated in PFM.
- Station Choice Model (SCM) works as an intermediate model, which converts the rail demand matrices from a zone-to-zone basis to a station-to-station basis.

On the rail side, the assignment model calculates the routes through the network for each pair of stations, allocates the demand and derives the costs (with interface with the Regional Models). The costs are fed back into the demand model and the process iterates until a stable result is obtained.

PFM has two model years: 2026 and 2036. For each of these years, separate demand forecasts were produced by mode and purpose

- Rail forecasts were produced in line with WebTAG, using the Department for Transport's (DfT) EDGE model (Exogenous Demand Growth Estimation)
- Car forecasts were generated using the National Trip End Model in TEMPRO
- Domestic air forecasts were generated using the DfT Aviation Model.

2.3. Operating Cost Model

A simple operating cost model has been developed, based upon that successfully used for the EWR-Western Section. This model takes into account:

- Rolling Stock
  - Fleet sizes
  - Leasing Costs
  - Fuel Costs
  - Maintenance Costs
- Staff Costs
- Track Access
  - Fixed
  - Variable
  - Capacity Charge
  - Electric Asset Usage Charge
- New Station Operating Costs

All operating costs have been based upon rail services operating from 06:00 - 22:00 7 days per week, every day except Christmas Day. The operating cost model follows the majority of the current WebTAG guidance. However, this simplified version does not take into account rolling stock lifecycle costs as actual fleet that would operate the services is uncertain. This model therefore assumes that rolling stock costs increase progressively over time rather than in steps associated with fleet replacements.

The following sections describe the process and assumptions used to derive the unit costs that are applied in the operating cost model.

2.3.1. Rolling Stock

The costs for rolling stock leasing, fuel and maintenance are based upon those used for the 2014 EWR Western Section Business Case for the DfT. These are based upon standard industry assumptions from ATOC on the operating costs (in terms of fuel, energy and maintenance) of diesel and electric multiple units and specific advice from the DfT on the likely operating costs of the new Class 801 'Bi-Mode' Intercity Express (IEP) trains. Leasing costs are based upon Atkins experience of rolling stock costs, except for the IEP, where equivalent leasing costs were provided by the DfT.

Table 2-5 shows the Rolling Stock costs that have been assumed in the operating cost model.

Table 2-5 Rolling Stock Cost Assumptions in 2013/14 Prices

Cost Item	Unit	Unit Rate Assumption
Rolling Stock Leasing charge	Per vehicle/carriage	Class 153: £114,000 p.a. Class 166: £139,200 p.a. Class 319: £127,200 p.a. Class 801 (IEP): £297,600 p.a.
Fuel (Diesel)	Per vehicle mile	£0.48
Energy (Electric)	Per vehicle mile	£0.26
Maintenance (Diesel)	Per vehicle mile	£0.82
Maintenance (Electric)	Per vehicle mile	£0.45

2.3.2. Staff

The staff costs, used in the latest operating cost model, are based upon information available on current industry salaries. The salary costs have been uplifted to reflect the employment costs of those staff members. This uplift takes into account likely employment costs such as pensions, holidays, national insurance and productivity.

Staff numbers and costs have been estimated upon the basis of rail staff working a standard 35 hour week. The staffing costs that were used in the cost model are shown in Table 2-6.

Table 2-6 Staff Costs in 2013/14 prices

Staff Role	Annual Employment Cost
Staff Costs (Driver)	£80,000
Staff Costs (Guard)	£46,000
Staff Costs (Route Manager)	£68,000

2.3.3. Track Access

The basis for all track access costs has been the CP5 price book published by Network Rail and the Office of Rail and Road (ORR). There are several elements of track access charge that are taken into account within the operating cost model, the following section describes these charges and the assumptions that have been used to estimate them for this project.

Fixed Track Access & Access Charge Supplements

Fixed Track Access Charges are levied on Train Operating Companies as part of their franchise agreements to provide them with access to the rail network. The charge is collected by Network Rail and is determined by the ORR.

Access Charge Supplements are paid by franchised Train Operating Companies to Network Rail. The amount of the charge is determined by the ORR. The Access Charge Supplement is in effect an insurance scheme. Payment of the supplement entitles the franchised TOC to compensation payments for delays and revenue losses due to engineering possessions.

As the EWR-CS route does not yet exist the fixed charge and supplement for it is not available from the ORR. Once opened, it is assumed that EWR including the Central Section will form either a stand-alone franchise or become an extension to a new or existing franchise. Therefore a Fixed Track Access Charge and supplement will be due.

EWR-CS will interface with 4 franchised rail operations once completed, these are:

- First Great Western (FGW);
- Chiltern Railways (CR);
- London Midland (LM); and
- Cross Country (XC).

EWR-CS will also interface with the Thameslink, Great Northern and Southern Franchise (TSGN). However the data which we need to input into our calculations is not yet available from the ORR, hence this has been excluded from the current calculations.

In the absence of other available information we have decided to calculate the fixed and supplementary charges for each of the above operators during CP5 and use the average charge as the basis of calculating the fixed charge for EWR-CS.

Using information published by the ORR and available from within the rail industry we have calculated the charges for the four TOC's, as named above. This is shown in Table 2-7.

Table 2-7 Determination of EWR Fixed Access Charges + Supplements

TOC	Average Annual FTAC during CP5	Average Annual Supplement during CP5	Average Timetabled Train Mileage (CP4)	Average No of carriages per train	Cost per train mile	Cost per vehicle mile
FGW	£33,200,000	£24,400,000	25,600,000	4.4	£2.10	£0.47
CR	£5,700,000	£840,000	5,800,000	2.6	£1.05	£0.40
LM	£17,800,000	£5,300,000	13,700,000	3.3	£1.57	£0.48
XC	£23,200,000	£15,200,000	19,300,000	3.9	£1.85	£0.48
Average Cost Per Vehicle Mile						**£0.46**

Variable Track Access

This access charge varies by the type of rolling stock. Different types of rolling stock have different weights, number of wheels and speeds, all of these lead to differing amounts of wear and tear on the rail network infrastructure. The variable access charge is designed to reflect the differing rates of wear imposed by different types of rolling stock to provide funding to enable Network Rail to implement an appropriate maintenance regime to reflect the likely impacts of differing rolling stock on different routes.

This charge is determined by the ORR and collected by Network Rail. ORR has published a schedule of the track access costs for all rolling stock operating on the UK network. An extract of this is shown in Table 2-8 for the rolling stock assumed to be utilised in the EWR options.

Table 2-8 CP5 Price List – 2013/14 prices Passenger Variable Track Usage Charge

Class	Type	Price (pence / vehicle-mile)
153	Diesel Multiple Unit	5.6
166	Diesel Multiple Unit	5.6
Class 319	Electric Multiple Unit	6.7
Class 801	Electric/Diesel Multiple Unit	10.3

Capacity Charges

Capacity Charge is an access charge that has to be paid by TOC's per train mile on busy sections of the rail network. The costs are route section specific to reflect the capacity issues along that section. The purpose of the charge is to compensate Network Rail (NR) for the performance impact of the services and potential compensation that NR may have to pay to other operators along the section of route in question should operational difficulties ensue.

Depending upon the route option the EWR-CS options interface with some of the following key routes:

- Midland Main Line – Bedford to Luton
- Great Western Main Line
- Oxford to Reading Line
- East Cost Main Line – Sandy to Stevenage
- Shepreth Branch – Hitchin to Shepreth Branch Junction
- West Anglia Main Line – Shepreth Branch Junction to Cambridge
- Ipswich to Cambridge Line
- Norwich to Cambridge Line

Routes options which require services to utilise existing sections of main lines (as highlighted above) will incur a capacity charge for the sections that they run along.

Table 2-9 shows the current capacity charges paid on the various services. These charges will be applied to the EWR services that operate over these sections.

Table 2-9 Capacity Charges incurred by EWR-CS services

Description	Service Group	Average Daily Rate (£/Train mile)
Stevenage to Hitchin (ECML)	EG05	£4.05
Sandy to Hitchin (ECML)	EG05	£4.05
Bedford to Luton (MML)	EG01	£1.98
Hitchin to Cambridge	EG05	£2.99
Bristol to Didcot (GWML)	EF01	£2.66
Didcot to Oxford (OXF – RDG)	EF07	£1.70
Cambridge to Norwich (Breckland Line)	EB05	£0.32
Cambridge to Ipswich	EB05	£0.22

2.3.4. Station Costs

New station facilities assumed as part of the EWR-CS options include a new station at Bedford South Parkway and a potential new station south of Cambourne.

The charges within the operational cost model have been based upon updating the figures to a 2013/14 cost base and reflecting the long term station charges for similar stations operated by FGW, Chiltern and London Midland.

The typical annual cost per station has been estimated to be approximately £100,800 p.a.

2.3.5. Summary of charges

Table 2-10 provides a summary of all of the charges that have been used to derive the operating costs for EWR.

Table 2-10 Summary of Charges used in Operating Cost Model

Cost Item	Unit of Measurement	Unit Rate
Rolling Stock Leasing charge	Per vehicle/carriage	Class 166: £139,200 p.a. Class 153: £114,000 p.a. Class 319: £127,200 p.a. Class 801: £297,600 p.a.
Fuel	Per vehicle mile	Diesel: £0.48 Electric: £0.26
Maintenance (Diesel)	Per vehicle mile	£0.82
Maintenance (Electric)	Per vehicle mile	£0.45
Staff Costs (Driver)	Per staff member/year	£79,666
Staff Costs (Guard)	Per staff member/year	£45,523
Staff Costs (Route Manager)	Per staff member/year	£68,285
Fixed Access Charge (including Supplements)	Per vehicle mile	£0.46
Variable Track Access Charge	Class 153 DMU per vehicle mile	£0.056
	Class 166 DMU pence per vehicle mile	£0.056
	Class 319 EMU pence per vehicle mile	£0.067
	Class 801 Bi/Mode pence per vehicle mile	£0.103
Capacity Charges	Stevenage to Hitchin (ECML)	£4.05
	Sandy to Hitchin (ECML)	£4.05
	Bedford to Luton (MML)	£1.98
	Hitchin to Cambridge	£2.99
	Bristol to Didcot (GWML)	£2.66
	Didcot to Oxford (OXF – RDG)	£1.70
	Cambridge to Norwich (Breckland Line)	£0.32
	Cambridge to Ipswich	£0.22
Station Costs	Per Station per annum	£100,800

Operating Cost Summary

By combining the cost and charge rates outlined above and applying these to the proposed service specification (As outlined in section 3.2) , the overall operating cost estimates for has been calculated. Table 2-11 presents these costs:

Table 2-11 Summary of Annual Operating Cost Estimates (2013/14 prices)

Item	Corridor C Cost (£ millions)	Corridor D Cost (£ millions)	Corridor H2 Cost (£ millions)	Corridor M Cost (£ millions)	Corridor N Cost (£ millions)
Fleet Size (trains)	- 9 Class 319 4 Car Units - 10 Class 801 5 Car Units	- 13 Class 319 4 Car Units - 10 Class 801 5 Car Units	- 13 Class 319 4 Car Units - 10 Class 801 5 Car Units	- 11 Class 319 4 Car Units - 10 Class 801 5 Car Units	- 11 Class 319 4 Car Units - 10 Class 801 5 Car Units
Lease Cost	£19,459,200	£21,494,000	£21,494,000	£20,477,000	£20,476,800
Fuel/Energy/Maintenance/Staff Costs	£30,345,000	£35,228,000	£35,391,000	£33,683,000	£32,111,000
Other Costs (Track Access/Capacity Charges/Stations)	£18,995,000	£27,126,000	£27,119,000	£24,307,000	£23,053,000
Total Cost for New Services	£68,800,000	£83,849,000	£84,004,000	£78,467,000	£75,641,000
Cost Savings	£14,995,000	£14,995,000	£14,995,000	£14,995,000	£14,995,000
Net Operating Cost	£53,805,000	£68,854,000	£69,008,000	£63,472,000	£60,646,000

All of the costs derived from the Operating Cost model are passed through into the Economic Appraisal Model to allow the analysis of each of the corridor options.

2.4. Economic Appraisal Model

The appraisal model takes inputs from the forecasting models and operating cost model, as well as capital cost assumptions provided directly by Network Rail. These inputs are processed to produce a WebTAG compliant business case. The main elements of the processing are as follows

- Appraisal period – a 60-year appraisal period between 2024 and 2083

- Demand growth cap – Demand is assumed to stop growing from 2036.

- 'Rule of a half' - Benefits are calculated using the 'rule of a half' where appropriate, reflecting the varying levels of consumer surplus for new users on various parts of the demand curve (existing users derive full consumer surplus). Numerical integration (intermediate points) has not been employed. In its absence, a factoring of appropriate benefits by 75% has been applied, based on experience from East West Rail Western Section (EWR WS), to take into account the concavity of the demand curve.

- Monetisation – Journey time saving benefits are calculated using WebTAG values of time (Table A1.3.2, November 2014).
- Common price base – all monetary benefits and costs are presented in 2010 prices
- Discounting – all benefits and costs are discounted to 2010 for the calculation of present values

In additional to the above, marginal external benefits are also quantified in the Economic Appraisal Model, in accordance with WebTAG guidance and data book. These include

- Congestion – a new rail scheme alleviates road congestion through modal shift;
- Infrastructure – Reduced car use as a result of a new rail scheme leads to reduced road infrastructure wear and tear;
- Accident – Mode shift away from roads reduces accident rates on roads;
- Local air quality – Lower number of cars on the road has a positive impact on local air quality;
- Noise – Lower number of cars on the road has a positive impact on noise;
- Greenhouse gas – Modal shift from car to rail reduces greenhouse gas emission;
- Indirect taxation – Modal shift away from car to rail reduces tax income to the Treasury (fuel attracts VAT and fuel duty), which is a dis-benefit; and

- Bus revenue – There will be some modal shift from bus to rail, resulting in reduced bus operator income, which is a dis-benefit.

All mode shift effects mentioned above are calculated using average rail diversion factors from the National Transport Model (NTM), rather than explicitly modelled within the modelling framework, so caution should be exercised in interpreting these figures. Marginal external benefits represent a small part of total monetised benefits (between 1-2%).

3. Scenarios

3.1. Do Minimum

The Do Minimum scenario assumes the following rail services

- Thameslink December 2018 specimen timetable
- IEP Timetable on the East Coast Main Line
- Chiltern Evergreen 3
- East West Rail Western Section (EWR WS)

  - 1 tph Paddington – Oxford – Milton Keynes
  - 1 tph Paddington – Oxford – Bedford
  - 1 tph Marylebone – Milton Keynes
  - 1 tph Bournemouth – Manchester diverted via EWR WS and West Coast Main Line (with backfilling between Oxford and Birmingham and between Birmingham and Manchester)

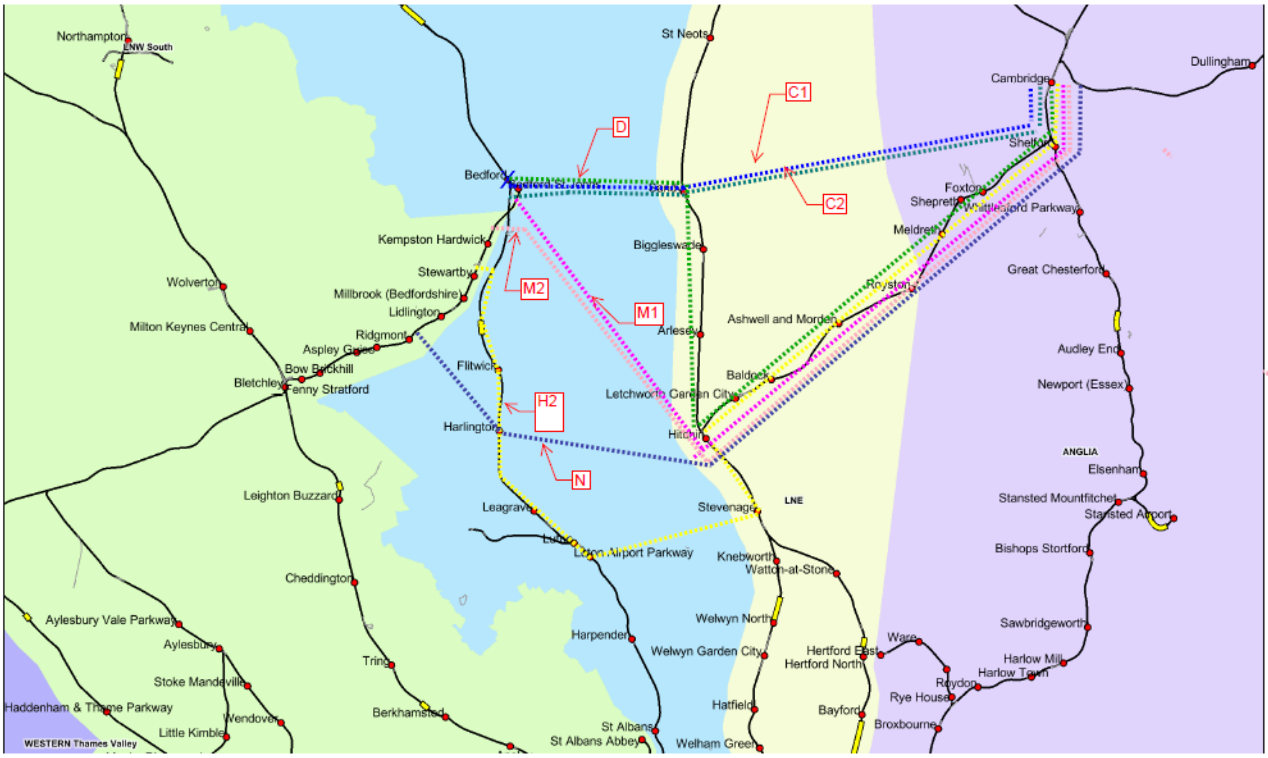
3.2. Do Something Corridor Options

Seven corridor options were identified to be carried forward for analysis as part of Phase 2a. Table 3-1 and Figure 3-1 provide a summary of these options. The alignments outlined in Table 3-1 give the approximate geographic locations of the corridors, and not stopping patterns. Proposed train service stopping patterns are given in Sections 3.2.1 to 3.2.5.

Table 3-1 Summary of Corridor Options

Option	Outline Alignment
C1	Bletchley – Bedford (central) – Sandy – Cambridge
C2	Bletchley – Bedford (south parkway) – Sandy – Cambridge
D	Bletchley – Bedford (central) – Hitchin – Cambridge
H2	Bletchley – Stewartby – Flitwick – Luton – Stevenage – Hitchin – Cambridge
M1	Bletchley – Bedford (central) – Hitchin – Cambridge
M2	Bletchley – Bedford (south parkway) – Hitchin – Cambridge
N	Bletchley – Ridgmont – Harlington – Hitchin – Cambridge

Figure 3-1 Summary Map Showing All Corridor Options



For presentational purposes, Options C1 and C2, and Options M1 and M2, have been combined into Options C and M, and the specific station location at Bedford is treated as a sensitivity in Section 5.1.1. In what follows, options C, D and M all assume a central location for a station at Bedford (i.e. C1 and M1 are assumed to be the default).

There has been an evolution of node options at Bedford, Sandy and Hitchin throughout the duration of Phase 2a of this project. The options selected are for modelling purposes only and do not necessarily reflect any preferences to these by either Network Rail or Atkins. It is anticipated that further detailed analysis of node options at Bedford, Sandy and Hitchin will be carried out in Phase 2b of the appraisal.

A 3-trains-per-hour (tph) service pattern is assumed for all corridor options

- 1 tph London Paddington – Oxford – Cambridge semi-fast, an extension of the Do-Minimum London Paddington – Bedford service (or diversion for Options H2 and N that do not serve Bedford);
- 1 tph Bletchley – Cambridge semi-fast; and
- 1 tph Bristol – Cambridge, with alternate trains extended to Norwich or Ipswich.

The semi-fast services are assumed to be operated using Class 319 rolling stock, and the fast service is assumed to be operated by bi-mode IEP rolling stock. Over any new infrastructure, maximum running speed is assumed to be 100 mph for the semi-fast services and 125 mph for the fast service.

Stopping patterns are given separately for each of the options as follows

3.2.1. Corridor C

Table 3-2 Corridor C Stopping Pattern & Route Diagram

Semi-fast	Fast		Route Diagram
Oxford	Bristol		
Bicester	Bath		
Bletchley	Swindon		
Woburn Sands	Oxford		
Ridgmont	Bicester		
Bedford	Bletchley		
Sandy	Bedford		
Addenbrooke's	Addenbrooke's		
Cambridge	Cambridge		
	Ely	Bury	
	Norwich	Stowmarket	
		Ipswich	

3.2.2. Corridor D

Table 3-3 Corridor D Stopping Pattern & Route Diagram

Semi-fast	Fast		
Oxford	Bristol		
Bicester	Bath		
Bletchley	Swindon		
Woburn Sands	Oxford		
Ridgmont	Bicester		
Bedford	Bletchley		
Sandy	Bedford		
Hitchin	Hitchin		
Addenbrooke's	Addenbrooke's		
Cambridge	Cambridge		
	Ely	Bury	
	Norwich	Stowmarket	
		Ipswich	

3.2.3. Corridor H2

Table 3-4 Corridor H2 Stopping Pattern & Route Diagram

Semi-fast	Fast		
Oxford	Bristol		
Bicester	Bath		
Bletchley	Swindon		
Woburn Sands	Oxford		
Ridgmont	Bicester		
Luton	Bletchley		
Luton Airport P.	Luton Airport Parkway		
Stevenage	Stevenage		
Hitchin	Addenbrooke's		
Addenbrooke's	Cambridge		
Cambridge	Ely	Bury	
	Norwich	Stowmarket	
		Ipswich	

3.2.4. Corridor M

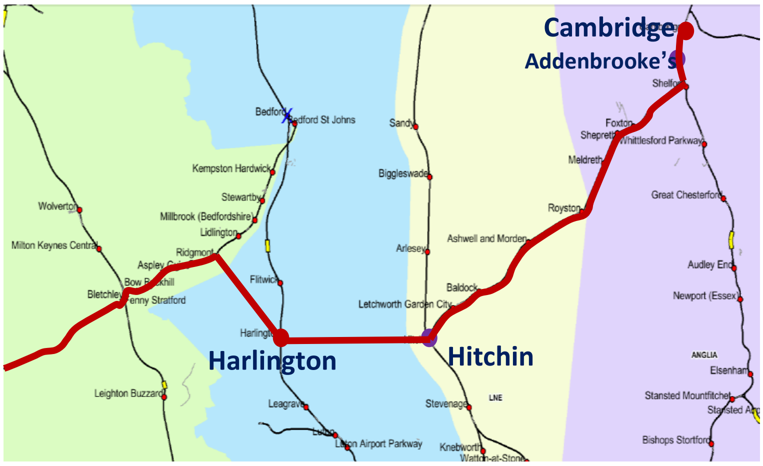
Table 3-5 Corridor M Stopping Pattern & Route Diagram

Semi-fast	Fast		
Oxford	Bristol		
Bicester	Bath		
Bletchley	Swindon		
Woburn Sands	Oxford		
Ridgmont	Bicester		
Bedford	Bletchley		
Hitchin	Bedford		
Addenbrooke's	Cambridge		
Cambridge	Ely	Bury	
	Norwich	Stowmarket	
		Ipswich	

3.2.5. Corridor N

Table 3-6 Corridor N Stopping Pattern & Route Diagram

Semi-fast	Fast	
Oxford	Bristol	
Bicester	Bath	
Bletchley	Swindon	
Woburn Sands	Oxford	
Ridgmont	Bicester	
Harlington	Bletchley	
Hitchin	Harlington	
Addenbrooke's	Addenbrooke's	
Cambridge	Cambridge	
	Ely	Bury
	Norwich	Stowmarket
		Ipswich



3.2.6. Journey Times

The analysis uses sectional journey times developed by Network Rail. These typically do not include allowance for any station stops. Each station stop is assumed to add 2 minutes to the journey time. A summary of journey times between Oxford and Cambridge for all options is given below. These journey times include allowance for all station stops as detailed above.

Table 3-7 Journey time assumptions

Option	Oxford – Cambridge journey time (mins)	
	Fast service	Semi-fast service
C	64	77
D	99	107
H2	97	111
M	82	94
N	77	90

3.2.7. Addenbrooke's

All options assume a stop at the proposed Addenbrooke's station. All journey times to Cambridge include a 2-minute allowance for this stop. Cambridge's catchment area has been modified to include Addenbrooke's (taking into account growth in the surrounding area). It is assumed that Addenbrooke's station leads to on average a 1-minute saving in access for journeys to/from Cambridge's catchment area. Since access time is normally double weighted (PDFH guidance), this translates to an assumed 2-minute reduction in generalised journey time (GJT) for flows to/from Cambridge. Station capital and operating costs are not included as the station itself is assumed to be part of the Do Minimum.

3.2.8. Bedford

Options C and M have also been tested with an alternative assumption of a parkway station to the south of Bedford (Bedford South Parkway), which may be located next to an existing development site at Wixams. This station is assumed to be a bi-level station with platforms also on the Midland Main Line. EWR Journey times through Bedford South Parkway is 1 minute shorter than through central Bedford. All Thameslink services to Bedford (4 tph) are assumed to stop here, with journey time between Bedford South Parkway and Bedford Midland assumed to be 4 minutes. For EWR journeys that start and end at Bedford, some passengers would continue to access Bedford Midland station and change at Bedford South Parkway, experiencing a journey time increase compared with a central Bedford option, while others would drive to

Bedford South Parkway where they would previously drive to the central Bedford Station. It is assumed that on average, passengers to/from Bedford would experience a (weighted) 10-minute access penalty.

3.2.9. Cambourne

Corridor C has an opportunity for a station at Cambourne. It is assumed that journey time between Cambourne and Cambridge would be 10 minutes. Given the likely route alignment, Cambourne Station is likely to be some 4 miles south of the town, and a (weighted) 15 minute access penalty is also applied in the construction of GJTs to/from Cambourne.

3.3. Costs

3.3.1. Capital Costs

Capital costs have been provided by Network Rail in 2014/15 prices. 'Real inflation' was applied to these costs, recognising that construction costs tend to rise faster than general inflation, using the 'All-in' Tender Price Index (TPI), using an assumed spend profile in Table 3-8. The capital costs without contingency have been used, but a 66% optimism bias has been applied reflecting the GRIP0 stage of the scheme, in accordance with WebTAG guidance. All costs are then expressed in 2010 prices and discounted to 2010 for appraisal purposes.

Table 3-8 Assumed spend profile

Year	% of total spend
2019	10%
2020	25%
2021	30%
2022	25%
2023	10%

3.3.2. Operating Costs

As explained in Section 2.3, operating costs cover rolling stock leasing and operating costs, staff costs, track access charges and new station operating costs, with assumptions from Network Rail CP5 price book and Atkins' experience from other projects. In line with WebTAG guidance, a 41% optimism bias is applied to the operating costs at the GRIP0 of the scheme.

4. Results

This section details the results of the modelling and appraisal. It begins by summarising demand and benefits generated by each of the corridor options, from both the top flows covered by the spreadsheet model study area, and also those from PLANET Long Distance. This section finishes with discussions on overall appraisal results, taking into account both costs and benefits.

4.1. Spreadsheet Model

This sub-section provides a snapshot of additional daily journeys the various corridor options would attract in 2031 on flows covered by the spreadsheet model. Table 4-1 shows journeys in both directions across all journey purposes. They reveal that EWR CS adds approximately 8,000-11,000 daily regional and local journeys to the network. Cambridge is a major generator of new demand, with Cambridge – Bedford gaining the highest number of additional passengers (between 250 and 600) out of the flows shown, for 3 of the 5 corridor options. For Corridor H2, Stevenage – Luton performs extremely strongly with over 800 additional journeys per day, followed by Cambridge – Luton at over 500.

Table 4-1 Summary of 2031 daily journeys on selected flows

	Do minimum	Additional journeys under each option				
		C	D	H2	M	N
Cambridge - Bedford	185	586	240	52	344	80
Cambridge - Luton / Airport	474	216	67	535	126	184
Cambridge - MK / Bletchley	275	387	209	201	274	297
Cambridge - Oxford	177	297	178	178	225	243
Hitchin - Bedford	102	30	185	22	236	41
Hitchin - Luton / Airport	197	0	23	267	41	72
Hitchin - MK / Bletchley	133	42	140	109	164	178
Hitchin - Oxford	83	37	109	82	110	117
Stevenage - Bedford	172	34	63	50	77	3
Stevenage - Luton / Airport	465	0	0	834	2	6
Stevenage - MK / Bletchley	85	40	54	143	61	65
Stevenage - Oxford	135	50	71	178	67	72
Total journeys	**35,066**	**10,673**	**9,179**	**9,800**	**10,099**	**7,944**

4.2. PLANET Long Distance

This section shows daily journey time benefits for some of the key flows modelled in PLANET Long Distance (PLD) for all the options. The numbers represent savings in generalised journey time (GJT), with appropriate weightings applied to various legs of the journey, e.g. wait and walk times, crowded and uncrowded times, aggregated across all journey purposes. Flows shown are between PLD zones. For all corridor options, Cambridge – Manchester benefits from the highest journey time savings, usually followed by Cambridge – Birmingham and other West Midland zones.

Table 4-2 PLD journey time savings – Corridor C

Flow	Minutes Saved
Manchester including Metrolink area - Cambridge City & South	3699
Cambridge City & South - Birmingham	1429
Cambridge City & South - Warwickshire South	913
Cardiff - Cambridge City & South	900
Cambridge City & South - Worcestershire	858
Cambridge City & South - Liverpool	576
Cheltenham & Cotswold - Cambridge City & South	192
Cambridge City & South - Coventry	169
Oxford City - Cheltenham & Cotswold	142
Stockport - Cambridge City & South	119

Table 4-3 PLD journey time savings – Corridor D

Flow	Minutes Saved
Manchester Including Metrolink Area - Cambridge City & South	2264
Cambridge City & South - Warwickshire South	663
Cambridge City & South - Worcestershire	610
Cardiff - Cambridge City & South	440
Cambridge City & South - Birmingham	392
Cheltenham & Cotswold - Oxford City	380
Northamptonshire WCML - City Of Bristol	246
Cambridge City & South - Liverpool	212
Cheltenham & Cotswold - Cambridge City & South	130
Swindon - Birmingham	89

Table 4-4 PLD journey time savings – Corridor H2

Flow	Minutes Saved
Manchester Including Metrolink Area - Cambridge City & South	1915
Cambridge City & South - Warwickshire South	593
Cambridge City & South - Worcestershire	541
Cheltenham & Cotswold - Oxford City	425
Cambridge City & South - Birmingham	404
Cardiff - Cambridge City & South	351
Luton - Birmingham	272
London Central - Northamptonshire WCML	254
Leeds - Oxford City	200
Cardiff - Hertfordshire ECML	197

Table 4-5 PLD journey time savings – Corridor M

Flow	Minutes Saved
Manchester including Metrolink area - Cambridge City & South	3780
Cambridge City & South - Birmingham	1152
Cambridge City & South - Warwickshire South	899
Cambridge City & South - Worcestershire	843
Cambridge City & South - Liverpool	814
Cardiff - Cambridge City & South	498
Stockport - Cambridge City & South	185
Cambridge City & South - Coventry	147
Cheltenham & Cotswold - Cambridge City & South	145
Cheltenham & Cotswold - Oxford City	142

Table 4-6 PLD journey time savings – Corridor N

Flow	Minutes Saved
Manchester including Metrolink area - Cambridge City & South	3502
Cambridge City & South - Birmingham	1784
Cardiff - Cambridge City & South	1101
Cambridge City & South - Warwickshire South	915
Cambridge City & South - Worcestershire	862
Cambridge City & South - Liverpool	374
Cheltenham & Cotswold - Cambridge City & South	192
Cambridge City & South - Coventry	192
Oxford City - Cheltenham & Cotswold	142
Stockport - Cambridge City & South	121

4.3. Economic Appraisal

Table 4-7 is a Transport Efficiency Table (TEE) for the 5 options. This represents forecasts under a core scenario where:

- NTEM population and employment growths are assumed;
- 125mph running for the Bristol – Norwich/Ipswich service, and 100mph running for other services, over new infrastructure (existing speeds, or speeds reflecting committed network improvements are assumed for existing infrastructure and EWR Western Section);
- The journey time impact of stopping at Addenbrooke's (improved access to Addenbrooke's surrounding areas and increased journey time to Cambridge itself) as well as associated train operating costs are included. Addenbrooke's station capital and operating costs are not included as the station itself is assumed to be part of the Do Minimum;
- Options C and M assume a centrally located station at Bedford; and
- A station at Cambourne is not assumed for Corridor C.

Table 4-7 TEE Table (£m, 2010 discounted), 'Core' scenario – NTEM growth assumptions

Scenario	C	D	H2	M	N
GJT	3,453	2,915	2,782	3,228	2,787
Crowding	42	46	48	82	47
User Charge	1,077	1,021	845	1,133	871
Total User Benefits	**4,572**	**3,982**	**3,674**	**4,443**	**3,705**
Indirect Tax	8	49	8	55	20
Marginal External	36	32	73	61	58
PVB	**4,616**	**4,062**	**3,756**	**4,559**	**3,783**
Revenue	-122	115	-140	87	-53
Operating Costs	1,943	2,649	2,653	2,409	2,290
Capital Costs	1,285	1,005	2,395	933	1,178
PVC	**3,107**	**3,769**	**4,908**	**3,429**	**3,414**
NPV	**1,509**	**293**	**-1,152**	**1,130**	**369**
BCR	**1.49**	**1.08**	**0.77**	**1.33**	**1.11**

Table 4-8 provides the TEE table for the High-growth scenario.

Table 4-8 TEE Table (£m, 2010 discounted), 'Core' scenario – High growth assumptions

Scenario	C	D	H2	M	N
GJT	3,783	3,165	2,966	3,513	2,977
Crowding	42	46	48	82	47
User Charge	1,189	1,118	896	1,242	937
Total User Benefits	**5,014**	**4,330**	**3,911**	**4,837**	**3,961**
Indirect Tax	8	55	6	60	23
Marginal External	39	33	75	63	60
PVB	**5,061**	**4,417**	**3,993**	**4,961**	**4,044**
Revenue	-119	145	-147	117	-41
Operating Costs	1,943	2,649	2,653	2,409	2,290
Capital Costs	1,285	1,005	2,395	933	1,178
PVC	**3,109**	**3,799**	**4,901**	**3,459**	**3,426**
NPV	**1,952**	**619**	**-908**	**1,502**	**618**
BCR	**1.63**	**1.16**	**0.81**	**1.43**	**1.18**

4.3.1. Explanation of Rows

This section provides a brief explanation of the rows in Table 4-7 and Table 4-8.

- **GJT** – user benefit from savings in generalised journey time

- **Crowding** – benefit from reduced crowding as a result of additional capacity. Note crowding has only been modelled in PLD, outside the core study area. Crowding relief on routes into London has not been modelled.

- **User Charge** – user benefit from reduced fares on journeys where previously no direct journey opportunities exist

- **Total User Benefits** – The sum of GJT, crowding and user charge benefits

- **Indirect tax** – According to WebTAG, increased consumer spending on rail trips is assumed to reduce spending elsewhere in the economy. Rail fares are zero rated whereas spending in the wider economy attracts an average tax rate of 19%. Therefore for every extra pound spent on rail fares the impact on tax collected is -£0.19.

- **Marginal external** – benefits such as road decongestion, road accident reduction, and bus revenue reduction as outlined in Section 2.4.

- **PVB** – present value of benefits – the sum of total user benefits, indirect tax and marginal external effects.

- **Revenue** is presented here as a cost item – a negative value indicates a net revenue increase to the rail industry. What is presented here is net **change** in rail industry revenue, rather than revenue carried by East West Rail services. There are two effects that counteract each other:

    - **Yield effect** – currently a Bedford – Cambridge journey made by rail has to be via London, and has yields of £31 for non-Seasons. With East West Rail, distance-based fare assumptions lead to a non-Season yield of £8. Each existing passenger pays a much lower fare under Do Something (the gravity model tends to over-forecast Do Minimum rail demand for location pairs that have no direct rail services, as explained in Section 2.1, so exaggerates this effect).

    - **Volume effect** – increased demand on any particular flow increases revenue to the industry

      There is a high level of uncertainty over projected revenue changes. Given the order of magnitude of these figures, rail industry revenue change due to EWR CS should be taken to be approximately neutral. As discussed, crowding relief on London routes has not been modelled, so the extent to which spare capacity would be filled up and 'lost' revenue due to the yield effect recovered, is as yet unquantified. That EWR CS has a neutral impact on rail industry revenue is likely to be a very conservative conclusion.

- **Operating Costs** – as explained in Section 3.3.2, the cost of operating the train services, including rolling stock and staff costs, track access charges and new station operating costs plus optimism bias.

- **Capital Costs** – as explained in Section 3.3.1, the cost of constructing new infrastructure and any upgrades to existing infrastructure, supplied by Network Rail and with optimism bias applied.

- **PVC** – present value of costs – the sum of revenue, operating costs and capital costs over the sixty year appraisal period.

- **NPV** – net present value – the difference between PVB and PVC

- **BCR** – benefit-cost ratio, PVB/PVC.

4.4. Results Commentary

As can be seen from Table 4-7 and Table 4-8 above, corridors C and M are the best performing options, with estimated benefit-cost ratios (BCRs) ranging between 1.33 and 1.63. The 2 options have similar overall PVBs at around £4.6-5.0bn. Corridor C has the lowest journey time between Oxford and Cambridge (64 minutes on the fast service) out of all the corridor options. It would appear that, although Corridor M picks up additional benefits by serving Hitchin (and Letchworth and Stevenage through an interchange), a similar quantity of benefits is 'lost' on flows to/from Cambridge due to the longer journey times. On the cost side, although Corridor C has a higher capital cost, Corridor M attracts higher operating costs due to higher train mileage and running times, leading to Corridor M having an overall higher PVC. Difference in forecast revenue amplifies the difference in BCRs of the two options. However, but as explained above (Section 4.3.1), revenue forecasts here should be treated with a high degree of caution. Cambourne is an opportunity that is unique to corridor C, and this could improve the BCR of corridor C to up to about 1.7.

Corridors D and N have estimated BCRs ranging from 1.08 to 1.18, with PVB between £550m and £850m lower than Corridor C under the core scenario. It has become clear that the longer distance flows, such as Cambridge to Oxford and Milton Keynes/Bletchley have a dominating impact on overall benefits, and longer journey times for such journeys tend to lower scheme BCRs even though benefits are realised to/from intermediate destinations. Longer journey times also lead to higher operating costs, which in these cases outweigh savings in capital costs. PVCs for corridors D and N are some £300m - £700m higher than corridor C under the core scenario. Corridor N also has the disadvantage of serving neither Bedford nor Luton directly.

Corridor H2 has estimated BCRs of below 1. This is due to several factors. Firstly, it has a very high capital cost (in excess of £2bn) due to requirements for two pairs of tunnels between Luton and Stevenage, as well as 6-tracking between Flitwick and Luton (which requires a further pair of tunnels at Ampthill). Even if 6-tracking is not required (i.e. if signalling improvements on the Midland Main Line is sufficient), saving approximately £1bn in capital costs, the BCR would only be improved to approximately 1.05. Corridor H2 has one of the longest journey times between Oxford and Cambridge, at 97 minutes on the fast service. Despite the fact that Stevenage – Luton is a very strong journey time, limited benefits on longer-distance flows mean that corridor H has one of the lowest estimated PVBs at less than £3.7bn.

4.5. Increments and Variants

This section explains how modifications to certain assumptions would change the economic performance of the scheme.

4.5.1. High Growth

A high growth scenario has been tested for all 5 scenarios. This scenario takes into account growth projections from Local Enterprise Partnership's Strategic Economic Plans. These are somewhat aspirational in nature, but present a realistic upper bound in terms of the growth in housing/population and employment. This is in contrast to NTEM forecasts, which are from 2010 and do not reflect changes in planning and growth aspirations brought about by the abolition of regional plans and the introduction of LEPs. The NTEM and high growth based forecasts should therefore be seen as providing the lower and upper bounds of potential growth scenarios with the most likely outcome being somewhere in between these two scenarios. Assuming high growth increases scheme PVB by between £250m and £650m, but without changing the ordering or BCRs. The BCR for C increases from 1.49 to 1.63, and that for Corridor H2 increases from 0.77 to 0.81.

4.5.2. 100 mph Running

100 mph running has been tested as a sensitivity on Corridor C only. This reduces the PVB by less than £100m. This is expected as 100 mph running only incurs a 3 minute journey time penalty over the Central Section, and this is only for 1 out of 3 trains every hour. A similar effect is expected for other corridors. Note it is assumed that there is no difference in capital or operating costs between 100 mph and 125 mph operations.

4.5.3. Addenbrooke's

The addition of a station at Addenbrooke's has been modelled as improved access in the Cambridge area. A sensitivity test was taken (for Corridor C only) to exclude this effect of improved local access at Addenbrooke's. This produces a reduction in PVB of less than £50m. It should be stressed that, no modification has been applied to journey times to Cambridge (i.e. removing the stopping allowance at Addenbrooke's) in this sensitivity test. This means that Addenbrooke's station is not a significant provider of benefits in the EWR-CS corridor scenarios.

4.5.4. Bedford

As discussed in Sections 3.2, Corridors C and M have been tested with an alternative station location at Bedford South Parkway. The parkway station option has an overall capital cost advantage of approximately just over £100m, but this is offset by just under £200m in dis-benefit due to inferior access into Bedford itself. Overall, this has a negligible impact on scheme BCR.

There are additional uncertainties around the choice of station location at Bedford, which are explained in more detail in Section 5.1.1.

4.5.5. Cambourne

Cambourne Station adds about £450m to corridor C's PVB and about £40m to operating and capital costs. This has an effect of boosting corridor C's BCR from 1.49(NTEM)/1.63(high growth) to 1.55/1.71 respectively.

In terms of flows within the gravity model's scope, this result is likely to be an over-estimate of benefits realised by Cambourne station, as the remote location of the station places substantial limits on its attractiveness for a trip to Cambridge, compared to undertaking this journey by car (the gravity model is liable to overestimate rail demand where road journey time is competitive). This would especially be the case if a high-quality bus service operates between Cambourne and Cambridge via the A428.

4.6. Wider Economic Benefits

In addition to the conventional transport benefits expressed in the TEE tables, we have also examined the potential for each corridor to deliver 'Wider Economic Benefits' (WEBs) as defined by WebTAG, these being:

- **Agglomeration** – By reducing journey times across the study area, the relative agglomeration[2] of business will increase. This will have a direct impact on the productivity and GDP of the UK;
- **Output change in imperfectly competitive markets** – Decrease in travel costs allows businesses to operate more efficiently, improves their output and intensity of activities, and hence the benefits; and
- **Labour supply impacts** – This captures tax revenues arising from the welfare effects to the UK economy of having a wider human resource pool. Lower travel costs attracts more workers to the workplace.

Appendix A provides a detailed derivation of the WEBs. The overall results of the WEBs analysis is presented below in Table 4-9.

Table 4-9 Results of WEBs analysis for each corridor

PVB and WEBs in £m		C1	D	H2	M1	N
NTEM growth	PVB (excluding WEBs)	£4,616	£4,062	£3,756	£4,559	£3,783
	WEBs only	£1,052	£843	£754	£865	£720
High Growth	PVB (excluding WEBs)	£5,061	£4,417	£3,993	£4,961	£4,044
	WEBs only	£1,635	£1,212	£1,099	£1,238	£1,069

[2] Agglomeration is a term used to infer the ability of an economy to act through the density of companies to interact with one another.

Table 4-9 shows that the calculated WEBS will increase the benefits of each of the corridor options by between 20% and 32%. The impact of this on the overall assessment of each corridor is shown in Table 4-10 and 4-11.

Table 4-10 Overall Assessment of corridors including WEBs (NTEM Growth)

Scenario - NTEM	C1	D	H2	M1	N
PVB (inc WEBs)	£5,668	£4,905	£4,510	£5,424	£4,503
Present Value of Costs	£3,107	£3,769	£4,908	£3,429	£3,414
Net Present Value (inc WEBs)	£2,561	£1,136	-£398	£1,995	£1,089
Benefit Cost Ratio (inc WEBs)	1.82	1.30	0.92	1.58	1.32

Table 4-11 Overall Assessment of corridors including WEBs (High Growth)

Scenario – High Growth	C1	D	H2	M1	N
PVB (inc WEBs)	£6,696	£5,629	£5,092	£6,199	£5,113
Present Value of Costs	£3,109	£3,799	£4,901	£3,459	£3,426
Net Present Value (inc WEBs)	£3,587	£1,830	£191	£2,740	£1,687
Benefit Cost Ratio (inc WEBs)	2.15	1.48	1.04	1.79	1.49

Analysis of Table 4-10 and 4-11 show that the inclusion of WEBs has increased the BCR of all corridor options, with Corridor C in the High Growth scenario achieving a BCR greater than two and hence entering the ‘High Value for Money’ category. However, the inclusion of WEBs does not make any change in the relative performance of corridor options in respect to each other. Further details are contained in Appendix A.

5. Sensitivities and Uncertainties

This section brings together all uncertainties and sensitivities surrounding the appraisal results. Some of these have already been covered in previous sections of this report, although there are additional uncertainties that should be born in mind.

5.1. Node Options

There has been an evolution in node options at Bedford, Sandy and Hitchin for all corridor options. As a result, there may be elements of working assumptions that have not been holistically addressed. Essentially, at each node, there are trade-offs between 3 types of markets:

- Passengers who originate from or are destined to the station and its catchment area;
- Passengers who stay on the train through the station; and
- Passengers who interchange at the station.

This section seeks to address these trade-offs which are not necessarily fully reflected in the modelling. It must be stressed that the analysis underpinning the discussion here is very high level, and a high degree of caution should be exercised in reaching any conclusions.

In addition, as the project is at a very early stage, new evidence may come to light which changes the feasibility of the options, which may result in some of the current working assumptions no longer being realistic in their current forms.

5.1.1. Bedford

The working assumption for Corridor C1 at central Bedford is a relocated St John’s Station. This option provides competitive journey times for through passengers, and its central location offers good access to Bedford itself. However, interchange with services on the Midland Main Line would rely on an hourly connection between Bedford St Johns and Bedford Midland, or a walk through the town centre. For Corridor C1, the market that requires an interchange at Bedford, e.g. Luton – Cambridge, is approximately 10% of the total ‘in scope’ market, meaning that approximately £500m of PVB may be at risk. This could potentially reduce the BCR of C1 from 1.49 (core scenario) to 1.30-1.40.

Other options for central Bedford include a reversal at Bedford Midland, or a route through Bedford Midland exiting Bedford on the north side. These have implications on cost and journey time penalties for through passengers.

For Corridor C2 (Bedford South Parkway), the effect of increased running time on Thameslink services between Flitwick and Bedford Midland has not been formally quantified, both in terms of revenue and operating costs, although these are expected to be minimal.

5.1.2. Sandy

The working assumption for Corridor C1 at Sandy is a station on the North side of the village, away from the existing Sandy station. Flows requiring a change at Sandy (with ECML services), e.g. Bedford – Stevenage, is again approximately 10% of the total identified market, so that if interchange is not possible at Sandy, the BCR for C1 could fall to 1.30. If interchange is poor at both Bedford and Sandy for C1, its BCR could be as low as between 1.15 and 1.25 (under core scenario).

5.1.3. Hitchin

All corridors other than corridor C go through Hitchin. Current assumptions are that trains would be able to serve the existing Hitchin Station. It could transpire that an option that bypasses Hitchin with trains stopping at Letchworth instead might be more feasible and offer better through journey times. It could be assumed that a call at Letchworth attracts an equivalent immediate market as one at Hitchin. For corridor M, flows requiring an Interchange at Hitchin represent about 6% of the total market, and were an interchange not available the BCR of Corridor M may drop from 1.33 to around 1.25. It has been suggested at an operator workshop that an alignment offering interchange at Arlesey could be explored.

5.1.4. Luton Airport & Southern Corridors

Luton Airport's expansion plan was approved in July 2014. The expansion of the airport would provide additional growth in passenger demand for East West Rail, in particular Corridor H2. A sensitivity test was carried out where a 'Luton expansion overlay' was applied to the demand forecasts, which is described in more detail in Appendix B. In addition, it is recognised that, although Corridor H2 has a poor BCR, there are nevertheless significant benefits that a northern corridor would not realise, and that there may be scope for investigating an alternative scheme serving this southern corridor. Further discussion is provided in Appendix B.

5.2. Revenue and Crowding

As discussed previously in Section 4, the revenue line in the TEE table represents net change in industry revenue. It appears that yield effect and volume effect are approximate equal in size so that net industry revenue change is approximately zero. This is likely to be a conservative estimate as crowding relief on the London routes is not modelled. Assignment modelling would need to be undertaken to understand how much revenue would be carried by East West Rail services. This could be undertaken at a later stage of project development if required.

5.3. Other Limitations

The modelling framework has a defined geographical scope, mainly the 106 stations covered in the gravity model and the PLD matrix. There are flows that are 'out of scope' that could potentially benefit from EWR CS. One example would be the Cambridge – London express service which could take advantage of the faster infrastructure of corridor C.

In addition, there are other service options that could potentially boost the viability of the scheme, but that might require additional infrastructure investment. One such option is extending the Cambridge – Bletchley semi-fast service to Milton Keynes, where further work is required to establish capacity requirements between Bletchley and Milton Keynes. There is further opportunity to extend this service to Birmingham, where again timetabling feasibility needs to be examined. Outputs from PLD suggest that Birmingham – Cambridge is among the top flows benefitting from EWR CS.

5.4. Freight

There is potential for freight trains to be routed via EWR CS. Although the timetable specification has been built with enabling freight paths in mind, no analysis has so far been taken to explore the market potential and quantify potential benefits.

More work is required with the Freight Operating Companies to fully understand the potential benefits of routing freight traffic via EWR-CS.

6. Option Appraisal

In addition to the economic appraisal, a multi-criteria analysis was prepared to assess the more qualitative aspects of the options. The criteria are:

- Local economic growth realisations
- Key growth location connectivity
- Strategic long distance passenger service potential
- Long distance freight strategy complementarity
- Planning and environmental constraints
- Operational issues and constraints
- Infrastructure requirements (existing railway)
- Infrastructure requirements (new railway)
- Comparative cost

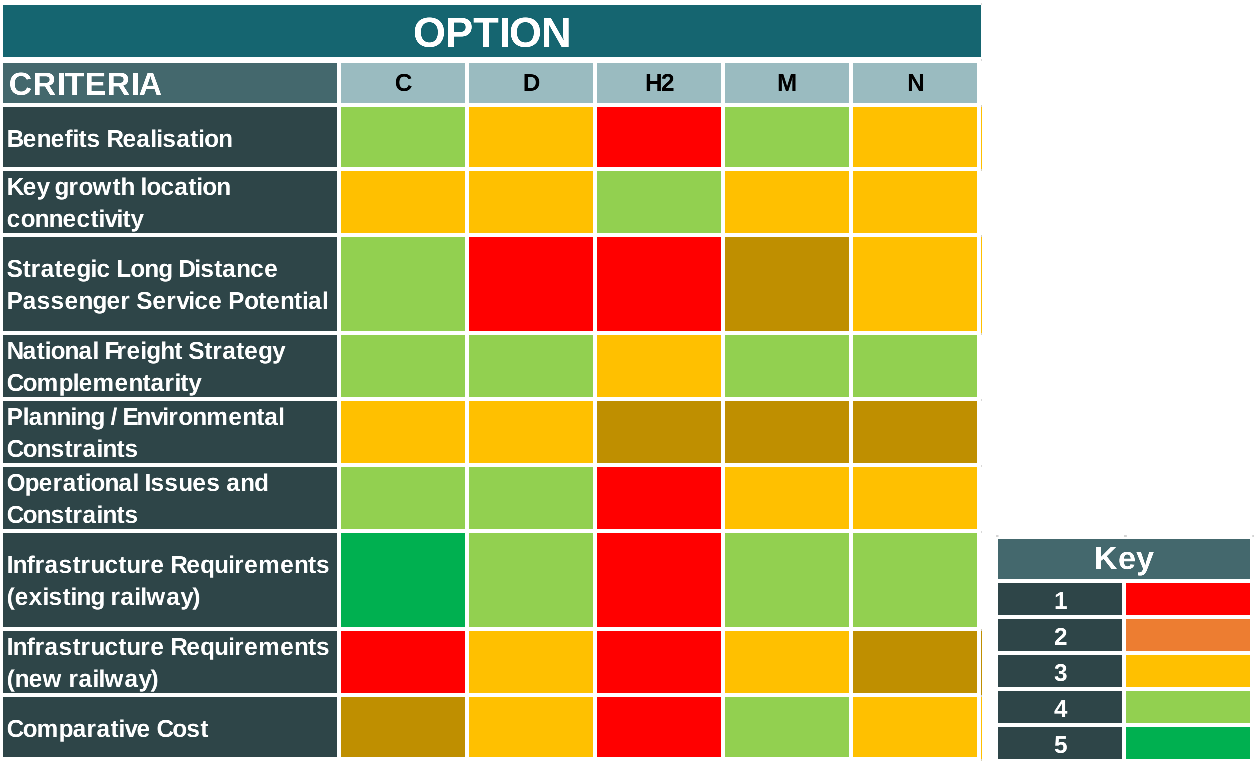
Table 6-1 below provides more detailed descriptions to each of the criteria and the scoring method. This is followed by the outcome of the analysis in Table 6-2.

Table 6-1 Multi-criteria analysis scoring method

Criteria	Basis of assessment	Score
Local Economic Growth Benefits Realisation	Based upon results of latest economic assessment using the benefit cost rations (BCRs) for the schemes to derive the ranking.	Level of benefit realisation : **1 = Very poor 2 = Poor** **3 = Moderate 4 = Good** **5 = Very Good**
Key growth location connectivity	Driven by number of locations with high forecast employment and housing growth profiles served by in-scope priority COS journey pairs that the option has potential to deliver	Scale of connectivity : **1 = Very Low 2 = Low** **3 = Moderate 4 = High** **5 = Very High**
Strategic Long Distance Passenger Service Potential	Takes into account the indicative journey times along each of the route options, with the key CO of achieving and OXF-CBG time of 60 minutes. **[** 1 = (>90 mins) / 2 = (80 – 90 mins) / 3 =(70 – 80 mins) / 4 (60 – 70 mins) / 5 = (< 60 mins) **]**	Potential of route for strategic longer distance passenger services: **1 = Very poor 2 = Poor** **3 = Moderate 4 = Good** **5 = Very Good**
Long Distance Freight Strategy Complementarity	Driven by potential to introduce new and additional freight paths of value to long distance freight, or create potential passenger-freight pathing conflicts on key freight corridors identified in Long Distance Freight Strategy	View of complementarity with Long Distance Freight Strategy **1 = Strongly conflicts** **2 = Conflicts 3 = Neutral** **4 = Aligns** **5 = Strongly Aligns**
Planning / Environmental Constraints	Driven by number, nature and significance of potential planning and environmental barriers in corridor and any known availability of a route for rail infrastructure / alignment to be accommodated	Level of constraint / challenge: **1 = Extreme 2 = Major** **3 = Moderate 4 = Minor** **5 = Negligible**

Operational Issues and Constraints	Driven by known current and planned utilisation of rail lines and associated consequent capacity on rail lines and at stations on route	Level of constraint / challenge: **1 = Extreme 2 = Major** **3 = Moderate 4 = Minor** **5 = Negligible**
Infrastructure Requirements (existing railway)	Based upon latest Network Rail scheme options and cost estimates. 1 = (>£1bn) / 2 = (£0.75 - £1bn) / 3 = (£0.5 - £0.75bn) / 4 = (£0.25 - £0.5bn) / 5 = (<£0.25bn)	Scale of requirements : **1 = Very Significant** **2 = Significant 3 = Moderate** **4 = Minor 5 = Low**
Infrastructure Requirements (new railway)	Based upon latest Network Rail scheme options and cost estimates. 1 = (>£1bn) / 2 = (£0.75 - £1bn) / 3 = (£0.5 - £0.75bn) / 4 = (£0.25 - £0.5bn) / 5 = (<£0.25bn)	Scale of requirements : **1 = Very Significant** **2 = Significant 3 = Moderate** **4 = Minor 5 = Low**
Comparative Cost	Based upon latest Network Rail scheme options and cost estimates.	Indicative scale of cost: **1 = Very High (>£1.5bn)** **2 = High (£1.25-£1.5bn)** **3 = Moderate (£1.0-£1.25bn)** **4 = Minor (£0.75 – £1.0bn)** **5 = Low (<£0.75bn)**

Table 6-2 Multi-criteria assessment outcome



Corridors C and M have the highest overall scores. Although Corridor C has the highest requirement for new infrastructure and hence has a relatively high comparative cost, it has the highest potential in terms of meeting the other criteria. Corridor M has the lowest comparative capital cost, but has higher planning and environmental constraints and lower long distance potential. Corridors D and N are close behind. Corridor N has the lowest overall rating, due to having a combination of high requirements for both existing and new railway, therefore high cost, and poor long distance journey times resulting in overall low benefit realisation.

7. Conclusion

This stage of the appraisal work has identified that East West Rail Central Section has the clear potential to develop into a viable rail scheme, with some options giving benefit-cost ratios of between 1.3 and 1.7. Any BCRs between 1.5 and 2.0 would fall into the 'medium value for money' category based on the Department for Transport's value for money (VfM) assessment. All of the 5 broad corridor options (C, D, H2, M, and N) have present values of benefits (PVB), ranging between £3.7bn and £4.6bn under the core scenario. Present values of costs (PVC) vary between £3.1bn and £4.9bn. Corridors C and M have the highest BCRs (1.49 and 1.33 respectively in the core scenario, or 1.71 and 1.43 under high-growth assumptions). Corridors D and N have poorer BCRs of between 1 and 1.2. Corridor H2 is estimated to have a BCR of less than 1, with the lowest PVB and highest PVC. The direct corridors between Bedford and Cambridge appear to command the highest BCRs.

The consideration of Wider Economic Benefits (WEBs) does not change the relative performance of options, but does lead to an increase in the PVB and hence BCRs across the board. For Corridor C the BCR including WEBs increases to 1.82 to 2.15 for the core and high growth scenarios respectively. For Corridor M the range is from 1.58 to 1.79. For Corridor H2, including WEBs increases the BCR to 0.92 in the core scenario and 1.04 in the high growth scenario.

There are a number of sensitivities and uncertainties around these numbers. Further detailed work would be required to better understand trade-offs between various markets at the nodes. There are potential additional benefits that this phase of the work has not sought to quantify, including crowding relief, other long-distance service opportunities and freight.

From the multi-criteria analysis, Corridors C and M have the highest overall scores. Although Corridor C has the highest requirement for new infrastructure and hence has a relatively high comparative cost, it has the highest potential in terms of meeting the other criteria. Corridor M has the lowest comparative capital cost, but has higher planning and environmental constraints and lower long distance potential. Corridors D and N are close behind. Corridor H has the lowest overall score, due to having a combination of high requirements for both existing and new railway, therefore high cost, and poor long distance journey times resulting in overall low benefit realisation.

Taking all of this into account, our conclusion from the analysis completed to date is that Corridors C and M should be taken forward for more detailed development.

Appendices

Appendix A. Wider Economic Benefits

This appendix outlines the results for the Wider Impacts (WI) assessment for five options of the proposed East West Rail Central Section (EWR CS) scheme. The methodology adopted in this assessment was aligned with the guidance in WebTAG Unit A2.1.

A.1. Assessment Specification

Scope

The assessment covers three types of WI's as set out below:

- Agglomeration – By reducing journey times across the study area, the relative agglomeration[3] of business will increase. This will have a direct impact on the productivity and GDP of the UK;
- Output change in imperfectly competitive markets – Decrease in travel costs allows businesses to operate more efficiently, improves their output and intensity of activities, and hence the benefits; and
- Labour supply impacts – This captures tax revenues arising from the welfare effects to the UK economy of having a wider human resource pool. Lower travel costs attracts more workers to the workplace.

Appraisal period and model years

The assessment captures the aforementioned WI's accrued over a 60-year period from the opening year 2024 to 2083. The technical analysis was mainly based on modelling outputs for future years 2021, 2026 and 2031, with interpolation and extrapolation applied where necessary. Ramp-up was applied during the profiling of the calculated WEBs impacts in line with the same approach in the conventional cost benefit analysis undertaken for EWR previously. Benefits in the opening year (2024) were taken as only 70% of the calculated value, then 85% and 95% for the second (2025) and third years (2026), respectively, before 100% benefits were applied from the fourth year.

Forecasting scenarios and modelling tools

One Do Minimum and five different EWR-CS Do Something scenarios were considered. Two sets of demand scenarios were evaluated, based on assumptions in NTEM / TEMPRO and Local Plan growth, respectively. Input for each scenario such as demand and generalised travel costs was based on information from the rail demand gravity model and other technical analysis documented in 'East West Rail Central Section Phase 2a Draft Report', which presents demand and supply assumptions in more detail.

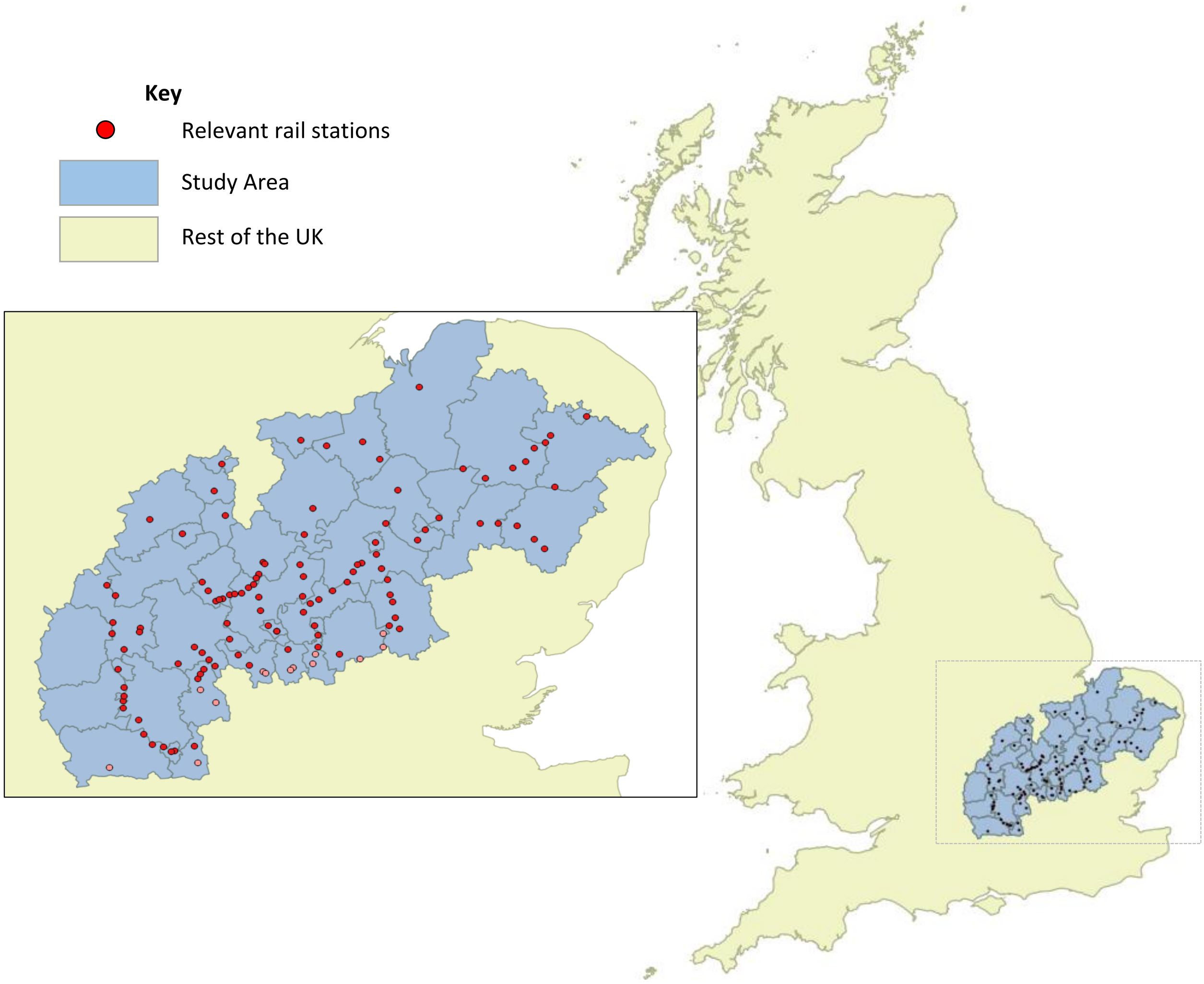
Geographical Detail

The full geographical coverage of the WI assessment was the entire Great Britain, which was split into a two-tier sector system, the core study area and the rest of the UK. This is illustrated in the figure overleaf.

The core study area is aligned with the geographical coverage of the previously developed rail demand gravity model, which envelopes the catchment areas of 106 individual railway stations as shown in the figure overleaf. WI assessment within the core area is based on individual Local Authority District (LAD) following the suggestion in the WebTAG. Changes to rail travel costs for journeys between LAD's within the core study area as a result of the proposed scheme were captured during the WI assessment. Correspondence between the LAD areas and station-based catchment were established. Overall 40 different zones were defined in the core study area.

Outside the core study area, varying levels of geographical resolution were used, mainly based on the boundaries of regional government offices. Rail travel costs to or from these outer areas were assumed to remain constant during the analysis. The outer area was split into 11 different zones so in total there are 51 zones in the WEBs assessment.

[3] Agglomeration is a term used to infer the ability of an economy to act through the density of companies to interact with one another.



A.2. Data collation

Basic economic and parametric values were taken from the DfT Wider Impacts Dataset and WebTAG Databook. This includes but not limited to value of time and indices, employment numbers, local GDP per worker, mean gross workplace-based earnings, median wage of marginal worker entering the labour market, agglomeration elasticities by industrial sector, distance decaying parameter values and elasticity of labour supply with respect to net return from working.

2011 Census data (tables WU03UK and WU01UK) was also analysed to obtain the number of workers by residence and workplace, and infer the likely commuting demand by car and rail for each pair of movement

Transport model data such as rail travel generalised journey time (GJT's), demand and fare (based on average yield) were extracted from the existing gravity model and MOIRA. Weighting by demand was undertaken where necessary when information across different geographical granularity was processed.

As no highway transport model was available, car travel distance, journey time and costs were obtained using a combination of information extracted from the Planet Long Distance model and online journey planning portal. These were used for infilling all origin / destination pairs within the entire UK following the defined geographical resolutions.

A.3. Data synthesis

The collated data was used to synthesise a range of detailed inputs required for the WI analysis, as outlined in the rest of this sub-section.

Employment by industrial sector

Employment numbers in the DfT Wider Impact Dataset were aggregated accordingly following the defined geographical resolution.

Car related travel information

Highway travel demand, journey time and vehicle operating costs (VOC) were derived using a mix of data sources as outlined in the table below.

<table>
<tr><th>Information \ movements</th><th>Internal to internal</th><th>Internal to external</th><th>External to external</th></tr>
<tr><td>Travel demand</td><td>N/A</td><td>Planet Long Distance (PLD)</td><td>PLD</td></tr>
<tr><td>Journey time</td><td rowspan="2">Journey planning portal</td><td>PLD</td><td>PLD</td></tr>
<tr><td>VOC</td><td>PLD</td><td>PLD</td></tr>
</table>

The journey planning online portal gives more control over the selection of origin and destination so was mainly used for inferring the highway travel costs within the core study area (internal movements). Car travel costs were subsequently derived by monetising car travel time for different journey purposes and calculating VOC following the standard formulae and parametric values in the WebTAG based on inferred speed and journey distance.

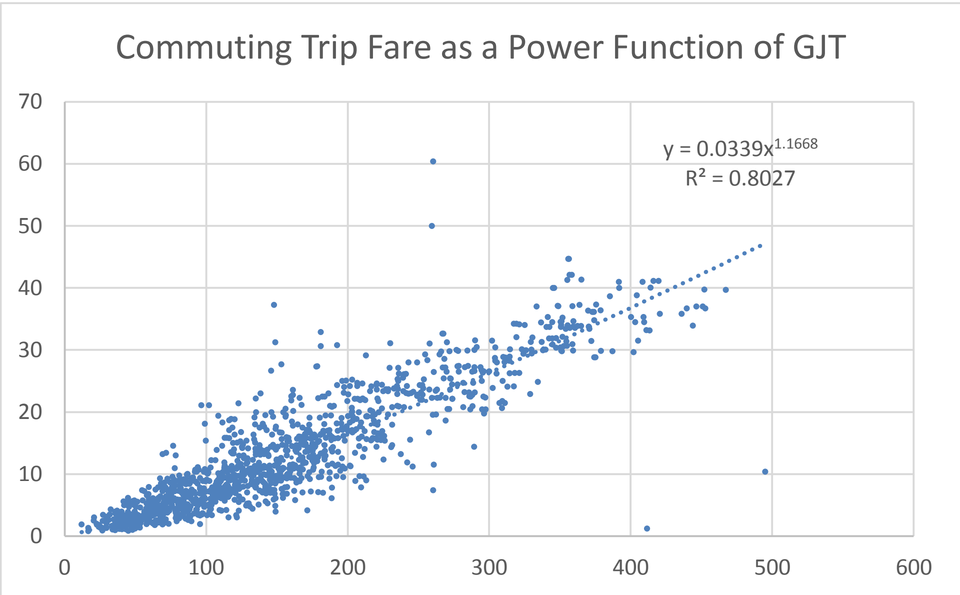
Car travel demand within the internal study area was not readily available. However, the ratio of car demand between commuting and business trips was inferred based on information from Planet Long Distance model. This information was used to derive the weighted average travel costs for car across these two purposes, for individual movements.

Rail travel demand by purpose

Output from the gravity model was broken down by referring individual ticket types to the likely journey purpose (full price ticket for business trips and season ticket for commuting trips).

Rail fare

Most fare information was derived from MOIRA output using the average yield. Zero fare / yield was reported for valid movement where there was no demand captured in MOIRA. Such fare was inferred using a fare to GJT regression through a power function, as illustrated in the graph below.



Number of workers by residence and workplace

2011 Census data (Tables WU03UK and WU01UK).

A.4. Summary of results

The three aforementioned WI's were quantified based on the mathematical formula given in Appendix D of TAG Unit A2.1. A summary of results from the analysis is given in this sub-section. Three individual WIs are presented separately at first.

Agglomeration impacts (WI1)

As expected, agglomeration impacts are the dominating benefits, which are summarised in the table below. It can be observed that this impact accounts for approximately 15% to 27% of the conventional economic benefits, and options under the Local Plan growth scenario generally lead to higher impacts as anticipated.

PVB and WI1 in £m		C1	D	H2	M1	N
NTEM growth	PVB (ex WEBs)	£ 4,616	£ 4,062	£ 3,756	£ 4,559	£ 3,783
	Agglomeration only	£ 858	£ 678	£ 598	£ 681	£ 561
	WI1 as a % of PVB	19%	17%	16%	15%	15%
Local Plan Growth	PVB (ex WEBs)	£ 5,061	£ 4,417	£ 3,993	£ 4,961	£ 4,044
	Agglomeration only	£ 1,418	£ 1,030	£ 930	£ 1,035	£ 896
	WI1 as a % of PVB	28%	23%	23%	21%	22%

More detail on the distribution of agglomeration impacts across different local authorities in the core study area is given in Table A-1 of this appendix. The locations attracting the highest impacts include Oxford, Milton Keynes, Central Bedfordshire, Cambridge, Norwich, Cherwell, Stevenage, Peterborough and St Edmundsbury etc. These highlighted locations are all logical to benefit from the improved connection resultant from the proposed rail scheme.

Between the five different options, the aforementioned locations remain in the top although the ranking may change slightly. The only exception is Bedford, which appeared in the top locations with large benefits for options C1, D and M1, but were forecasted to receive dis-benefit for options H2 and N. Again, this pattern is expected as the proposed routes in options H and N bypass Bedford, and from Do Minimum to Do Something case, the proposal includes the diversion of a Western Section service away from Bedford, therefore certain journeys would have less frequent options, such as Bedford to Reading.

Output change in imperfectly competitive markets (WI2)

Following the guidance in TAG Unit A2.1, WI2 was estimated by simply taking 10% of the business user benefits in the conventional cost benefit analysis, as given in the table below.

Business User PVB and WI2 in £m		C1	D	H2	M1	N
NTEM growth	PVB (ex WEBs)	£ 4,616	£ 4,062	£ 3,756	£ 4,559	£ 3,783
	PVB (business users)	£ 1,891	£ 1,602	£ 1,516	£ 1,790	£ 1,553
	WI2 only	£ 189	£ 160	£ 152	£ 179	£ 155
	WI2 as a % of Business PVB	10%	10%	10%	10%	10%
Local Plan Growth	PVB (ex WEBs)	£ 5,061	£ 4,417	£ 3,993	£ 4,961	£ 4,044
	PVB (business users)	£ 2,069	£ 1,739	£ 1,619	£ 1,945	£ 1,664
	WI2 only	£ 207	£ 174	£ 162	£ 195	£ 166
	WI2 as a % of Business PVB	10%	10%	10%	10%	10%

Labour supply impacts (WI3)

The WI3 assessed in this study only captures tax revenues arising from the welfare effects to the UK economy of having a wider human resource pool. No assessment of impacts relating to employment relocation was undertaken due to the lack of a land use transport interaction model.

Findings from the analysis suggest that WI3 is significantly lower than the aforementioned two WI's. This is likely due to the fact that the value of WI3 is directly affected by changes in the average round trip travel costs, weighted by rail and highway travel demand. As overall rail modal share for commuting is significant less than its counterpart for car journeys, any improvement in rail (resultant from the proposed scheme) is suppressed significantly in the average travel cost after the high weighting for highway travel costs is applied. For the calculation of WI1, on the contrary, its value is not affected by demand for individual modes at all as no weighting is required for the calculation of the effective density.

WI3 in £m	C1	D	H2	M1	N
NTEM growth	£5	£5	£5	£5	£4
Local Plan growth	£10	£7	£7	£7	£7

Total WEB's (WI1 + WI2 + WI3)

A summary of the total WEB's is given in the table below.

PVB and WEBs in £m		C1	D	H2	M1	N
NTEM growth	PVB (ex WEBs)	£4,616	£4,062	£3,756	£4,559	£3,783
	WEBs only	£1,052	£843	£754	£865	£720
	WEBS as a % of PVB	23%	21%	20%	19%	19%
Local Plan Growth	PVB (ex WEBs)	£5,061	£4,417	£3,993	£4,961	£4,044
	WEBs only	£1,635	£1,212	£1,099	£1,238	£1,069
	WEBS as a % of PVB	32%	27%	28%	25%	26%

The following two tables compare impacts from WEBs on the cost benefit analysis under the NTEM growth scenario. It can be observed that the Value for Money is higher with WEBs on board and the ranking of different options (based on BCR only) has not changed.

Scenario - NTEM	C1	D	H2	M1	N
PVB (exl WEBs)	£4,616	£4,062	£3,756	£4,559	£3,783
Present Value of Costs	£3,107	£3,769	£4,908	£3,429	£3,414
Net Present Value (exl WEBs)	£1,509	£293	-£1,152	£1,130	£369
Benefit Cost Ratio (exl WEBs)	1.49	1.08	0.77	1.33	1.11
Ranking (exl WEBs)	1	4	5	2	3

Scenario - NTEM	C1	D	H2	M1	N
PVB (inc WEBs)	£5,668	£4,905	£4,510	£5,424	£4,503
Present Value of Costs	£3,107	£3,769	£4,908	£3,429	£3,414
Net Present Value (inc WEBs)	£2,561	£1,136	-£398	£1,995	£1,089
Benefit Cost Ratio (inc WEBs)	1.82	1.30	0.92	1.58	1.32
Ranking (inc WEBs)	1	4	5	2	3

Similar results can be observed under the Local Plan growth scenario, as summarised in the next two tables.

Scenario – Local Plan	C1	D	H2	M1	N
PVB (exl WEBs)	£5,061	£4,417	£3,993	£4,961	£4,044
Present Value of Costs	£3,109	£3,799	£4,901	£3,459	£3,426
Net Present Value (exl WEBs)	£1,952	£619	-£908	£1,502	£618
Benefit Cost Ratio (exl WEBs)	1.63	1.16	0.81	1.43	1.18
Ranking (exl WEBs)	1	4	5	2	3

Scenario – Local Plan	C1	D	H2	M1	N
PVB (inc WEBs)	£6,696	£5,629	£5,092	£6,199	£5,113
Present Value of Costs	£3,109	£3,799	£4,901	£3,459	£3,426
Net Present Value (inc WEBs)	£3,587	£1,830	£191	£2,740	£1,687
Benefit Cost Ratio (inc WEBs)	2.15	1.48	1.04	1.79	1.49
Ranking (inc WEBs)	1	4	5	2	3

A.5. Limitations and Exclusions

Considering the limitation in data available and the tight timescale, the following assumptions / simplifications were made during the assessment:

- Other travel modes such as bus, walking and cycling were not included by default. The only exception is that, for movements where no rail option was available (mostly shorter trips within the same district), the corresponding highway travel costs were factored by 2 and used as a proxy for the same journey using other forms of public transport such as buses;
- Land use changes as a result of different transport provisions has not been considered;
- Other sensitivity tests such as freight trips impact and values of the decaying parameter were not included at this stage of the assessment;
- Intra-zonal journeys were not modelled or assessed; and
- Costs for access to / egress from railway stations were represented by simple ‘proxies’ rather than output from transport model(s).

Table A-1 Breakdown of Agglomeration Impact by Origin under NTEM Growth Scenario

	Total Agglomeration in £m	£ 858	£ 678	£ 598	£ 681	£ 561
Index	Area	C1	D	H2	M1	N
1	Peterborough	29	24	14	18	12
2	Luton	12	7	42	7	12
3	West Berkshire	7	2	2	3	3
4	Reading	10	2	3	3	3
5	Wokingham	4	1	0	1	0
6	Milton Keynes	126	116	81	109	82
7	Central Bedfordshire	71	69	41	50	47
8	Bedford	51	46	-14	44	-9
9	Aylesbury Vale	8	5	5	5	5
10	Wycombe	9	5	5	5	4
11	Cambridge	63	36	41	43	40
12	East Cambridgeshire	11	9	10	8	7
13	Fenland	5	3	3	3	3
14	Huntingdonshire	17	15	9	11	11
15	South Cambridgeshire	22	12	12	15	14
16	Uttlesford	6	2	2	3	3
17	Dacorum	6	5	3	4	3
18	East Hertfordshire	4	3	6	3	3
19	North Hertfordshire	7	20	19	20	19
20	St Albans	5	2	7	2	5
21	Stevenage	6	7	39	6	6
22	Welwyn Hatfield	5	7	8	6	5
23	Breckland	11	6	6	8	8
24	King's Lynn and West Norfolk	10	6	5	5	5
25	Norwich	46	27	28	33	33
26	South Norfolk	9	4	4	6	6
27	Corby	6	4	1	5	0
28	Daventry	3	2	2	2	2
29	Kettering	7	5	2	5	-1
30	Northampton	16	12	8	13	9
31	South Northamptonshire	12	13	11	10	11
32	Wellingborough	8	5	2	5	-1
33	Cherwell	31	25	26	27	25
34	Oxford	126	116	104	118	113
35	South Oxfordshire	9	4	4	5	4
36	Vale of White Horse	24	14	22	19	18
37	West Oxfordshire	9	7	7	7	7
38	Forest Heath	7	4	4	6	6
39	Mid Suffolk	15	6	6	13	14
40	St Edmundsbury	25	19	17	23	24

Appendix B. Luton Stevenage Corridor

B.1. Introduction

Phase 2a of the business case appraisal work for East West Rail Central Section (EWR CS) has identified that corridor options C (via Sandy) and M (via Hitchin), are emerging as the strongest performing of the 5 options identified, and that corridor H2 (via Luton and Stevenage) performs poorly in terms of value of money. Nonetheless, it has been recognised that under option H2 there are a number of strong performing flows, especially Luton – Stevenage, and there is potential for a different scheme to serve such journeys. In addition, the East West Rail Consortium (the Consortium) has asked Atkins to review the impact of Luton Airport's expansion and the level of additional benefit it could contribute towards East West Rail. This short technical note therefore provides an overview discussion of the following 3 topics

- The additional value Luton Airport expansion can add to East West Rail;
- The value of flows enabled by option H2 that is not (fully) enabled by the other options; and
- Finally, the extent to which the stronger performing options could cater for flows best served by option H2.

B.2. Luton Airport

B.2.1. Assumptions

The Assumptions used in adding the overlay are as follows.

- An upper bound of **18 million passengers a year** is taken as a base year (2011) total air passengers at Luton. Although this is clearly an overestimate, as the 18 million figure represents the airport's capacity post expansion, it was felt that presenting a 'base case' scenario would be appropriate here in terms of understanding the potential scale of additional benefit in the context of East West Rail.
- Table 30 of the Transport Assessment gives the distribution of passenger surface access journey origins by county. In addition, Figure 17 shows the rail mode share for trips from each origin county. These are summarised in Table 1 below. For example, Hertfordshire represents the origin of 12.8% of Luton Airport's total air passengers, and of those, 6% travel to the airport by rail.

Table 1. Passenger Surface Access Journey Origin by County and Rail Mode Share, 2009

County	Origin %	Rail Mode Shire	County	Origin %	Rail Mode Shire
Greater London	37.7%	33%	Oxfordshire	2.8%	1%
Hertfordshire	12.8%	6%	Essex	2.2%	4%
Bedfordshire	9.5%	10%	Berkshire	2.1%	19%
Buckinghamshire	7.4%	2%	West Midlands	1.7%	0%
Northamptonshire	4.2%	8%	Other	15.9%	-
Cambridgeshire	3.7%	3%			

- It was then assumed that East West Rail would have a positive impact on rail demand for flows from Hertfordshire, Buckinghamshire, Northamptonshire, Cambridgeshire and Oxfordshire. A notional rail station is assumed for each county, and the number of additional annual passengers from that station to Luton Airport for the Do Minimum scenario is calculated. Once the Do Minimum additional demand is established, the change in demand in the Do Something scenario is assumed to be in the same proportion as the Gravity Model predicts without this overlay. The additional demand calculated for base year 2011 is shown in Table 2.

Table 2. Additional Passengers by Origin

Origin County	Origin Station	Origin % of Total Market	Rail Mode Share for Flow	Journeys Overlay – DM	Journeys Overlay – DS
Hertfordshire	Stevenage	3.2% *	6%	34,560	97,980
Buckinghamshire	Aylesbury	7.4%	2%	26,640	39,805
Northamptonshire	Northampton	4.2%	8%	60,480	93,545
Cambridgeshire	Cambridge	3.7%	3%	19,980	41,982
Oxfordshire	Oxford	2.8%	1%	5,040	8,771
Total				146,700	282,083

* There are 4 rail corridors in Hertfordshire: West Coast Main Line, Midland Main Line, East Coast Main Line and West Anglia Main Line. Only the East Coast Main Line corridor benefits from option H2 of EWR CS, so 12.8% has been factored down to 3.2%.

- Having established the base year (2011) demand, demand is then assumed to grow into the future, in line with the 'high growth' model parameters for these flows.

B.2.2. Results

Results for Option H2 before and after the overlay are as follows

Table 1. Summary Results for Option H2, £m, 2010 prices, discounted to 2010

	No Overlay	With Overlay	Difference
Present Value of Benefits (PVB)	3,993	4,164	171
Present Value of Costs (PVC)	4,901	4,867	-34
Net Present Value (NPV)	-908	-703	205
Benefit Cost Ratio	0.81	0.86	

The inclusion of the airport passenger overlay adds approximately £200m of NPV to the scheme. The reduction in costs reflects an increase in operator revenue. The BCR remains below one, in the 'poor value for money' category in the Department for Transport's Value for Money Assessment.

B.3. Value of the Southern Corridor

It was suggested that despite the poor value for money of option H2, there nevertheless could be a case for an alternative scheme linking Luton with Stevenage. An estimation has been made of the value of such a scheme. This is estimated by isolating the flows that are improved by H2 which would not be improved by a northern Corridor (e.g. Corridor C), at least to the same extent. The following types of flows fall into this Category:

- Luton/Luton Airport – Stevenage/Hitchin/Letchworth
- Luton/Luton Airport – East Coast Main Line and Cambridge Line
- Stevenage/Hitchin/Letchworth – rest of Midland Main Line
- Rest of Midland Main Line north of Luton – rest of East Coast Main Line (centred around the Luton – Stevenage axis)

These flows account for approximately 16% of the total benefits of Option H2, suggesting that they represent approximately **£600m-650m** in terms of present value of benefits (PVB) over a 60-year period. In practice, some of these flows would be partially improved by a northern corridor (e.g. Corridor C), e.g. Luton – Cambridge via an interchange at Bedford, so the £600m-650m figure is likely to represent an upper bound for the PVB.

B.4. Journey Times under a Northern Corridor

This section provides examples of journeys from Luton and Stevenage that are enabled by East West Rail should a northern alignment be taken, and compares journey times with 'Do Nothing' and 'Do Minimum' scenarios, as well as highway and 'rail heading' journey times. Journeys illustrated here are Luton – Cambridge and Stevenage – Bedford. The 'Do Something' journey times assume Corridor C and that good-quality interchanges exist at Bedford and Sandy.

As Table 2 shows, there are significant differences in journey times between the 'Do Nothing' (existing timetable) and 'Do Minimum' (committed schemes) scenarios. The main difference here is the Thameslink Programme (and the committed Govia Thameslink timetable). Improved interchange at St Pancras low level (compared with having to walk between St Pancras and King's Cross), and the increased frequency of fast trains between London and Stevenage both lead to significant overall journey time reductions.

The rail heading assumptions for the two selected flows are as follows

- Luton – Cambridge – drive to Hitchin and catch a train from Hitchin to Cambridge
- Stevenage – Bedford – drive to Luton Airport Parkway and catch a train from there to Bedford

Highway journey times come from Google Maps.

Table 2. Journey Time Comparisons

Journey	Do Nothing	Do Minimum	Rail heading	Highway	Do Something
Luton - Cambridge	120 minutes, 2 tph	80 minutes, 2 tph	75 minutes	70 minutes	50 minutes, 3 tph
Stevenage - Bedford	96-120 minutes, 2 tph	66 minutes, 2 tph	64 minutes	40 minutes	50 minutes, 2 tph

As can be seen, a northern corridor has the potential to deliver journey time improvements to these flows. The scale of improvement for Stevenage – Bedford is more limited, primarily due to higher interchange times between lower frequency services, compared with using Thameslink. However, it is more than likely that a via-EWR fare will be substantially cheaper than a via-London fare, therefore a northern corridor option for EWR would deliver rail demand growth and benefits higher than would be suggested by journey time improvements alone.

B.5. Conclusions

Reviewing assumptions about airport passenger demand at Luton Airport Parkway does not appear to have had sufficient effect in improving the case for Option H2. The value of benefits of an alternative scheme linking Luton and Stevenage appears to be in the range of £600m-650m, suggesting a scheme with a total cost in the range of £300-400m could be viable. In the absence of corridor H2, there are still journey opportunities from Luton and Stevenage that would be improved from a northern alignment of East West Rail Central Section.

Paul Bate
Atkins
Trent House
RTC Business Park
London Road
Derby
DE24 8UP

Email: Paul.Bate@Atkinsglobal.com