MetroWest

Phase 2 Preliminary Business Case

Appendix D - MetroWest Phase 2 Forecasting Report

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Bath & North East Somerset, Bristol, North Somerset and South Gloucestershire
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MetroWest Phase 2 Preliminary (Strategic Outline) Business Case

Forecasting Report

Prepared for

West of England Authorities

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MetroWest Phase 2

Preliminary (Strategic Outline) Business Case
Forecasting Report

West of England Authorities

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1. Introduction

1.1 Background

MetroWest is an ambitious programme to improve local rail services across the West of England, and includes relatively major schemes (entailing both infrastructure and service enhancement) to smaller scale schemes. MetroWest is being jointly promoted and developed by the four West of England councils (Bath & North East Somerset, Bristol City, North Somerset and South Gloucestershire Councils).

The MetroWest programme will help address the core issue of transport network resilience, through targeted investment to increase both the capacity and accessibility of the local rail network. The concept is to deliver an enhanced local rail offer for the City Region comprising:

- Existing and disused rail corridors feeding into Bristol
- Broadly half-hourly service frequency (with some variations possible)
- Cross-Bristol service patterns (i.e. Bath to Severn Beach)
- A Metro-type service appropriate for a city region of 1 million population

MetroWest is being delivered in phases; MetroWest Phase 2 offers an hourly service for the re-opened Henbury line with stations at Henbury and North Filton and along the Filton Bank, coupled with a half-hourly service for the Yate to Bristol line, as illustrated in Figure 1.1. Phase 2 does not include the reopening of the Portishead Line and half hourly services on the Severn Beach Line and local stations to Bath Spa which are all part of Phase 1. Neither does it include the New Stations Package for Ashton Gate, Saltford and Corsham, Portway Park & Ride and long term aspirations for a station at Bathampton.

The purpose of this report is to document the forecasting approach for the assessment of MetroWest Phase 2 scheme benefits for transport network users, including demand forecasts at new stations.

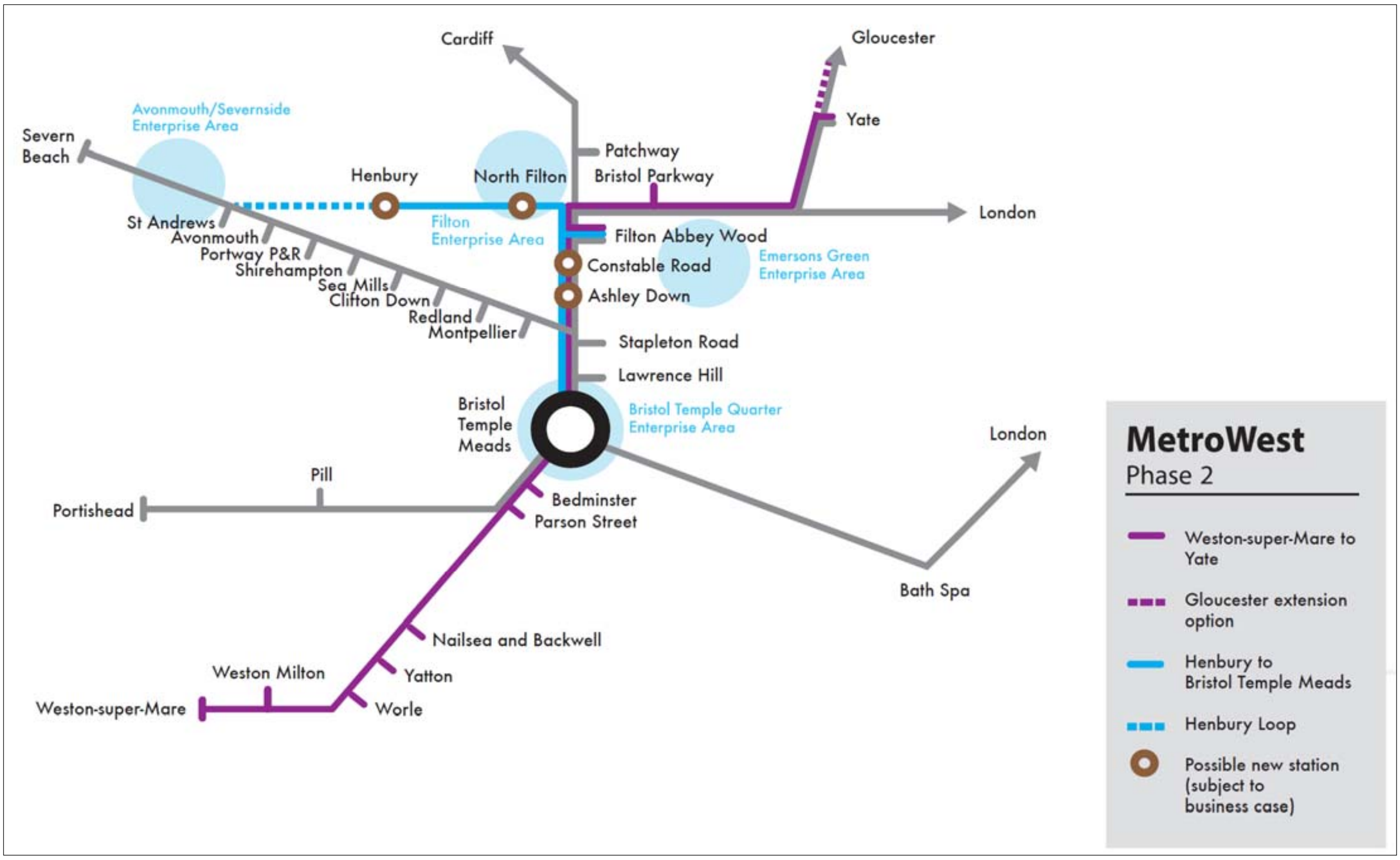

Figure 1-1: MetroWest Phase 2

1.2 MetroWest Phase 2

Four scheme options have been considered through the Preliminary Outline Business Case assessment. The specification of each option is described briefly as follows:

Option 1a – spur & Yate

- Re-opened Henbury line with hourly service operating as a spur from Bristol Temple Meads;
- New stations at Henbury, North Filton, Ashley Down and Constable Road; and
- Extension of existing service terminating at Bristol Parkway to Yate (providing a service of 2 trains per hour at Yate).

Option 1b – spur & Gloucester

- Henbury line service and new stations the same as Option 1a; and
- Extension of existing service terminating at Bristol Parkway to Gloucester (providing 2 trains per hour at Yate).

Option 2a – loop & Yate

- Re-opened Henbury line with hourly service operating as a loop from Bristol Temple Meads branching off the Severn Beach line near St.Andrews Road;
- New stations at Henbury, North Filton, Ashley Down and Constable Road; and
- Extension of existing service terminating at Bristol Parkway to Yate (2 trains per hour at Yate).

Option 2b – loop & Gloucester

- Henbury line service and new stations the same as Option 2a; and
- Extension of existing service terminating at Bristol Parkway to Gloucester (providing 2 trains per hour at Yate).

In addition, a 5th option was developed and appraised in the light of the results for the above options.

The current MetroWest Phase 2 programme is targeting a project opening year of 2021.

1.3 Modelling approach

The key rationale of the methodology is that it makes best use of available tools. In particular, it utilises tools and approaches accepted by the rail industry and the existing GBATS3 multi-modal model. The methodology is in accordance with both WebTAG and Guide to Railway Investment Projects (GRIP) demand forecasting requirements.

1.4 Structure of the report

Following this introductory chapter, the report is structured as follows:

- Chapter 2: Forecasting Approach;
- Chapter 3: New Station Demand Forecasting;
- Chapter 4: Highway Network Impacts
- Chapter 5: Additional option; and
- Chapter 6: Summary.

2. Forecasting Methodology

2.1 Introduction

The assessment approach makes best use of available assessment tools. In particular, it uses approaches accepted by the rail industry and the existing GBATS3 multi-modal model, a model accepted by the DfT as appropriate for (ultimately successful) applications for major schemes. The methodology used is in accordance with both WebTAG and Guide to Railway Investment Projects (GRIP) demand forecasting requirements.

Advice relating to demand forecasting of rail-based schemes is in TAG Units M1-1 and M4, noting in the first instance that there are two main approaches to modelling rail passenger demand. 'Multi-stage' modelling may be employed, such as making use of an existing multi-modal transport model. Alternatively, an elasticity based approach may be used.

The guidance notes there are advantages and disadvantages to both. In particular though, multi-stage models are cited as often being less accurate (than elasticity approaches) when forecasting rail. This is not necessarily a problem specific to rail but to 'minority modes' in general (rail accounts for only about 2% of all journeys in the UK). Multi-stage models do not always reflect growth in the demand for travel by modes, as they concentrate on overall demand modelled as a function of demographic characteristics and car ownership trends. For instance, the National Travel Survey (NTS) indicates a disconnect between demographic changes and growth in rail use, such that the rate of rail trip making has risen by more than simply population.

Elasticity approaches are therefore commonly used in rail forecasting. Those suggested in TAG Unit M4 (section 8) draw heavily on the Passenger Demand Forecasting Handbook (PDFH), which sets out relationships between rail demand and service related characteristics.

2.2 Rail forecasting

A combination of bespoke spreadsheet models and MOIRA were used to assess rail enhancements offered by MetroWest Phase 2. There are three main elements covered:

- Trips at new stations (whether on existing or re-opened lines);
- Diversions of existing rail trips to new stations; and
- Changes in demand at existing stations from new or amended services (including suppression of demand by extra station calls).

These tools combine to form a 'rail demand model' (RDM).

2.2.1 Demand at existing stations

MOIRA is used by the rail industry to forecast the impact of service related changes on passenger revenue, including analysing the effect of changes such as stopping patterns, infrastructure and rolling stock on the passenger numbers carried and the revenue impact. MOIRA1 has been used to assess the impacts of MetroWest Phase 2 on existing stations in the WoE as well as the wider rail network. In addition, generalised journey time, demand and revenue figures have been extracted from MOIRA1 for stations in the MetroWest area to use in the forecasts of the new stations. [1]

Note that the results of the analysis of changes in demand at existing stations are NOT discussed in the Forecasting Report, but are presented in the Network Rail Metro West Phase 2 Socio-economic appraisal report, which is another appendix to the Preliminary Business Case.

[Chapter 3 of this report discusses the forecasting of trips at new stations]

[1] MOIRA1 is updated several times a year, based on ticket sales. MetroWest Phase 2 demand at existing stations has been assessed by Network Rail using MOIRA1 updated in mid-2014 containing 2013-14 annual figures.

2.3 Rail appraisal

The value for money assessment of MetroWest Phase 2 has been undertaken using a Discounted Cash Flow (DCF) model developed by Network Rail. This model is used for socio-economic appraisal and was developed in accordance with WebTAG. It enables the quantification and monetisation of benefits and costs. The model considers a stream of costs and benefits, which are presented in 2010 present values over the appraisal period. The key outputs of the assessment is the Benefit Cost Ratio (BCR) to the Government, Transport Economic Efficiency (TEE) tables and associated Appraisal Summary Table (AST) inputs as required by DfT for enhancement schemes that require Government funding.

The DCF model was used to develop business cases that informed the development of DfT's High Level Output Statement (HLOS) and Network Rail's Business Plan for Control Period 5 (CP5). The model has been audited by a number of consultants commissioned by DfT.

The DCF model incorporates the following elements:

- Investment cost (capital expenditure);
- Operating cost;
- Other government impacts (e.g. indirect taxation);
- Revenue impact;
- Rail demand;
- Benefits to rail users;
- Benefits to non-rail users; and
- Disbenefits to rail and non-rail users.

More details about the DCF assessment are documented in the Network Rail Metro West Phase 2 Socio-economic appraisal report, an appendix to the Preliminary Business Case.

2.4 Highway network impacts

Without a network model, benefits to non-users are typically calculated using the External Cost of Car Use (ECCU) model from WebTAG Unit A5-4. The ECCU shows the unit rate of removing one mile of road journey for each road type and congestion level by Government Region. This unit rate comprises of impact on road congestion, greenhouse gases and noise and air pollution. The DCF model estimates the total road mileage removed by incorporating MOIRA rail mileage output and converted to equivalent road mileage following WebTAG. The ECCU unit rate for the South West region is then applied to the road mileage to calculate the non-rail user benefits.

Since the GBATS3 multi-modal model, which includes a highway assignment model, is available, this has been used as a cross check and update of highway benefits, in particular in assessing the benefits accrued via changes to highway trips. The principal tools used in this assessment are:

- Outputs from the RDM,
- The GBATS3 multi-modal transport model; and
- TUBA.

GBATS3

GBATS3 is the existing multi-modal model for the West of England area which has been developed to be WebTAG compliant and subsequently used to assess a number of schemes in the area that have been given funding approval by the DfT[2]. GBATS3 produces matrices of trips and journey data (time, cost and distance) for three time periods (AM peak, inter-peak and PM peak hours) and several modes (car, bus, rail and BRT), also sub-divided by user class (commuting, other home based trips and business journeys) and income level of travellers. Figure 2-1 shows the structure of the model and interactions between demand and assignment models.

GBATS3 has developed in recent years with several slightly different local versions being developed for particular purposes, each with an emphasis on different areas and/or transport schemes. Following

[2] Ashton Vale to Bristol City Centre Rapid Transit, North Fringe to Hengrove Package, South Bristol Link and Local Sustainable Transport Fund.

discussions with officers of the West of England authorities, the 'SBL' (South Bristol Link) version of GBATS3 has been used for the Preliminary Business Case. Further information about the GBATS3 SBL model, including further details of forecasting assumptions, can be found in the following reports which are included as supporting documents to the Preliminary Business Case:

- South Bristol Link Data Collection Report, April 2013
- South Bristol Link HAM Validation Report, April 2013
- South Bristol Link PTAM Validation Report, April 2013
- South Bristol Link Demand Model Report, April 2013
- South Bristol Link Forecasting Report, April 2013

GBATS3 has two forecast years, 2016 and 2031. As such, 2016 has been used as the proxy for the scheme opening year of 2021. This results in a conservative estimation of highway benefits.

The methodology for undertaking a cross-check of highway benefits involves taking the results from the RDM and using them to adjust the inputs to GBATS3 (and hence TUBA) accordingly. The steps in the methodology are shown in Figure 2-2.

2.5 Modelling responsibilities

The modelling approach has been carried out jointly by CH2M and Network Rail, with the lead taken on individual elements as appropriate. This is summarised as follows (and illustrated in Table 2.1):

- CH2M takes the lead on developing the new stations model and diversions model, building on models previously developed for the West of England Rail Studies.
- Network Rail take the results of this modelling, incorporating them into the overall demand forecasts that constitute outputs from the RDM.
- Network Rail prepare the socio-economic appraisal (value for money assessment and BCR), including the impact on non-user benefits (e.g. carbon and environment) estimated using the external costs of car use assumptions from WebTAG, using the DCF.
- CH2M responsible for the highway benefits cross check, taking outputs from the RDM and utilising GBATS3 and TUBA to calculate benefits.
- CH2M and Network Rail finalise the socio-economic assessment prepared using the DCF with GBATS3/TUBA results from the highway benefits cross check.

Table 2.1 MetroWest modelling lead for each key element

Models	**CH2M**	**Network Rail**
RDM		
New stations model	✓	
Diversions model	✓	
MOIRA		✓
Future year		✓
Socio-Economic Analysis		
DCF		✓
GBATS3	✓	
TUBA	✓	

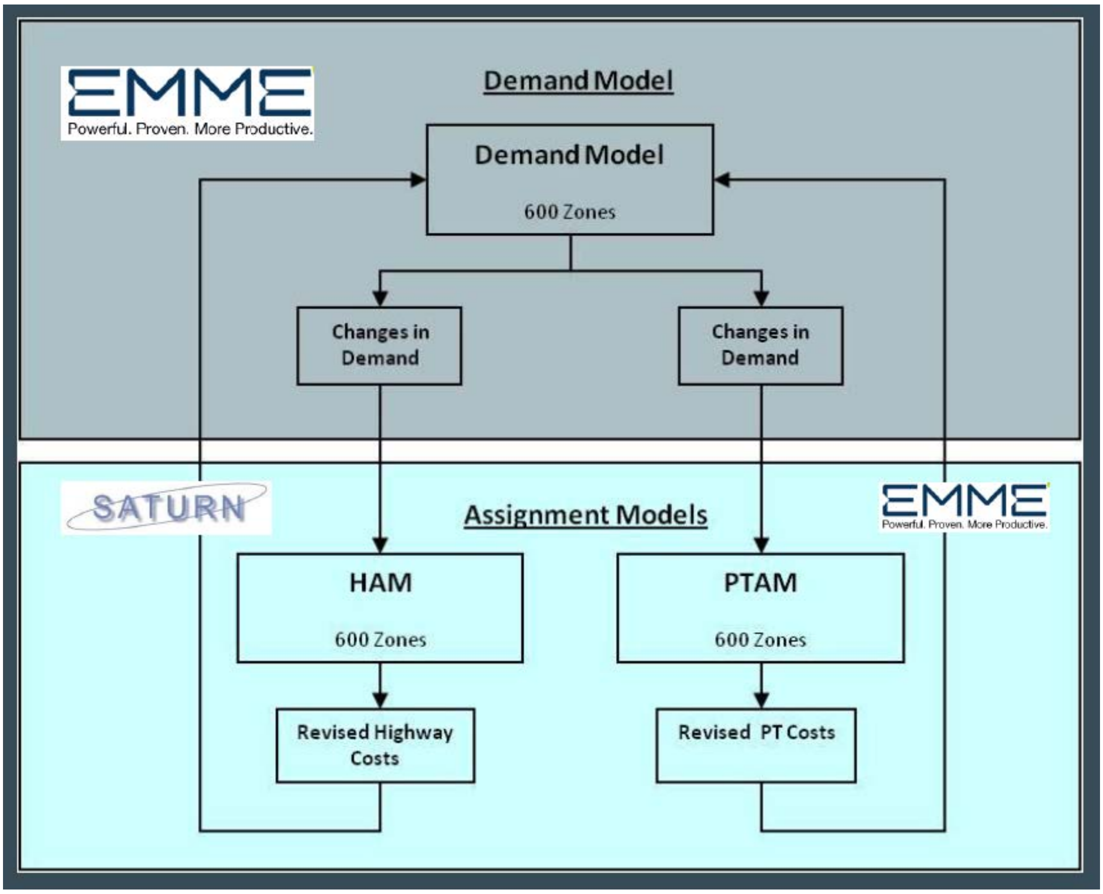

Figure 2-1: GBAT3S Demand model structure

Identify core scenario development and infrastructure assumptions for 2016 and 2031, in line with WebTAG unit M4

↓

Develop a core scenario 'Do Minimum' model in GBATS3, incorporating the assumptions identified

↓

Code MetroWest (Phase 2) scheme and run a multi-modal assignment in GBATS3

↓

Develop correspondence table between MetroWest stations and GBATS3 zones

↓

Adjust GBATS3 scheme forecast rail matrices to generate station totals in GBATS3 that match rail demand forecast from the RDM

↓

Make corresponding adjustments to car matrices retaining relative shift from alternative modes to rail in line with GBATS3 forecast changes

↓

Re-assign highway matrices to highway networks in GBATS3 as fixed matrix assignments to derive final travel costs for highway trips

↓

Run TUBA using highway demand and cost matrices generated above

Figure 2-2: Highway benefits cross-check – methodology

3. New Station Demand Forecasting

3.1 Methodology

Forecasts of demand for the new stations proposed as part of MetroWest Phase 2 have been carried out using a methodology derived from that used for recent studies associated with the original development of MetroWest Phase 1, as well as previous work on MetroWest Phase 2 and the 'new stations package'. The methodology makes use of rail industry data and derived techniques to forecast demand at new stations broadly based on relationships at existing stations elsewhere. No data has been specifically collected, forecasts have therefore employed existing data sources.

Note that demand forecasts described and presented in this section of the report are for MetroWest Phase 2 scheme appraisal purposes, and relate solely to new stations in Phase 2. As such, they do not include other effects, such as MetroWest Phase 1. Furthermore, sensitivity testing and risk assessments, such as into the likelihood of achieving the demand postulated, has not been carried out. This should be considered in using the forecasts for financial assessments.

3.2 Main data sources

National Rail Travel Survey (NRTS)

The NRTS estimates the number of rail trips at stations on a typical day and includes origins and destinations of trips using the rail network, both the rail journeys themselves (first, intermediate and last stations used) and the 'true' origin and destination of trips (including the locations where the overall journey started and finished, such as home, work or other location and the mode of station access/egress). Other journey characteristics derived from NRTS data includes ticket types, journey purposes and journey frequency. NRTS data is used as part of the modelling for new stations, in particular relating to diversions from existing stations.

Office of Rail and Road (ORR) station usage statistics

Passengers entering and exiting stations. The latest ORR station usage estimates were published in late 2014, covering the annual period 2013-14. ORR station usage totals are used in conjunction with other data sources to update figures as required.

West of England annual station survey

Passenger counts and surveys at stations in the West of England have been undertaken over a number of years, being conducted on or around the same day in November each year. Counts are annual, with questionnaires included every other year. Survey results are used in conjunction with ORR station statistics where appropriate.

MOIRA

As noted earlier, MOIRA1 has been used to assess the impacts of MetroWest Phase 2 on existing stations in the WoE as well as the wider rail network. In addition, generalised journey time, demand and revenue figures have been extracted from MOIRA1 for stations in the MetroWest area, and form a key data source used in the forecasts of the new stations. [3]

Passenger Demand Forecasting Handbook (PDFH)

The PDFH summarises knowledge of the effects of changes to services, fares and other factors on rail passenger demand, and provides guidance on applying this to forecasts. Values in the PDFH can be used to assess demand responses to timetabling and operating decisions. PDFH relationships have been used to adjust forecasts where needed (such as scaling demand from a station relating to service frequency).

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[3] MOIRA1 is updated several times a year, based on ticket sales. MetroWest Phase 2 demand at existing stations has been assessed by Network Rail using MOIRA1 updated in mid-2014 containing 2013-14 annual figures.

3.3 Demand forecasts

A series of approaches have been used to assess different aspects of new stations. The three main elements that together enable the net total benefit to the railway to be established, along with supporting assumptions and ancillary models, are described briefly below, and include:

- Total trips generated by the new station;
- Existing rail trips diverted to the new station; and
- Suppression of demand at existing stations by an extra station call by passing services.

3.3.1 Total station demand

This has employed a simple regression technique, which takes into account the relationship between journeys and catchments at a number of similar stations. Regression has been used to identify a series of demand/catchment relationships for several types of movements, including journeys made using full price tickets, reduced price tickets and season tickets, and between 'independent' stations, 'regional' stations and 'urban' stations, as the characteristics of such trips can differ.

Information used in the regression is drawn from MOIRA extracts (trips and generalised journey times, GJT) and 2011 Census (population and employment). MOIRA information used is for trips between all stations in the MetroWest area and the rest of the national rail network. Each station in the MetroWest area is classified as 'regional' (large stations, for example Bristol Parkway), 'urban' (other stations within urban areas, generally where there is more than one station in the urban area, which includes many of the stations served by MetroWest enhancements) and 'independent' (stations in stand-alone locations such as smaller towns, for example Keynsham). Relationships between the 'urban' stations of the MetroWest area and their respective journey pairs are used in the regression used to determine demand at the MetroWest Phase 2 new stations.

For a new station, the models are applied to a full set of potential origin-destination pairs. This generates demand for each movement and ticket type. Initially, this is calibrated to local stations (total demand by ticket type). MetroWest Phase 2 new stations models are calibrated using demand quantum and catchments at Patchway station for Henbury line stations and Montpelier station for Filton Bank stations, as good representatives for the respective new stations:

- Patchway is located just off the north-eastern side of the Cribbs Patchway New Neighbourhood (CPNN), where Henbury and North Filton are located on the southern edge of the development area. Population and employment at Patchway is similar to that at Henbury in the immediate vicinity (<1km) and more closely related to North Filton within 2km. The train service pattern at Patchway is the same, at 1/hr per direction.
- Montpelier is the closest station to Ashley Down, albeit located on the Severn Beach line. Its demographic characteristics are similar, though with a slightly greater density of residents within 1km. There are currently 1.5 trains per hour (equivalent) per direction at Montpelier.

Catchments – adjacent and overlapping catchments

Because the proposed new stations in MetroWest Phase 2 are all within the urban areas of Bristol and South Gloucestershire, they are located relatively close to other stations, both existing stations and each other. As such, in calculating demand at the new stations allowance has been made for the degree to which catchments overlap. For instance, the potential Ashley Down and Constable Road stations are less than 1km apart. Similarly, Ashley Down is less than 2km from Montpelier and both North Filton and Constable Road are around 2km from Filton Abbey Wood, whereas Henbury is relatively isolated in an urban context, being more than 4km from any existing stations and around 3km from North Filton.

In essence, population and employment of each station is taken from the 2011 Census, based on centroid points for Output Areas (OA) and Workplace Zones (WZ). Up to 1km this is not altered. For distances beyond 1km, where there is a clear overlap between new stations and existing stations or other new stations, the relevant OA and WZ centroids are allocated to one or other of the stations concerned. This allows for a directional element, where one station may be more logical for some journeys but not others, and is biased in favour stations that have better train services (such as, in particular, Filton Abbey Wood). Table 3.1 shows the catchment population and employment figures used in the forecasting, showing the initial 1km and 2km catchment populations and employment, and adjusted (i.e. reduced) 2km figures.

Table 3.1: New station catchments

Station	**Population**			**Employment**		
	<1km	**<2km**		**<1km**	**<2km**	
		basic	adjusted		basic	adjusted
Henbury	8,450	18,000	18,000	2,350	6,000	6,000
with CPNN	10,950	23,000	23,000	2,850	7,000	7,000
North Filton	3,700	26,950	14,300	5,600	18,800	13,550
with CNNN	3,700	26,950	14,300	9,600	23,800	18,550
Ashley Down	17,050	77,550	41,950	6,250	22,550	13,100
Constable Road	13,950	53,350	36,100	2,800	19,700	13,850

Catchments – new development

The potential new stations of Henbury and North Filton are located immediately adjacent to the Cribbs Patchway New Neighbourhood (CPNN) development area, the majority of which is the former Filton Airfield site. Indeed, the Henbury railway line marks the boundary between the Airfield (and hence CPNN) and existing development in Filton, Brentry and Henbury.

Hence, in basic geographical terms, almost half of the immediate catchment of both stations is currently undeveloped land, and significant new development is committed within the immediate vicinity of both of these new stations in the future. As such, development of CPNN is taken into account in the forecasts of demand at Henbury and North Filton by adding anticipated new development to the current day population catchments of the stations derived from Census data. Table 3.1 also shows assumptions for totals population and employment within catchments with a completed CPNN.

To reflect that CPNN is only just beginning its development, and it will not (on current anticipated build-out rates) be complete for another 15 years or so, the effects of new development have to be scaled into forecasts over the duration of the build-out. To do this, two basic forecasts are made, one with no development of CPNN and one with full development. The resulting annual demand is calculated for each year using an assumed build-out profile.

Distribution of trips

Total new station demand has been derived from the regression model. This is distributed to determine the destinations of trips from the new stations using a synthetic gravity model. A gravity model has been set up that makes use of the full catchment of destination stations for rail users in the MetroWest area (derived from local stations). Generalised journey times have been derived for each potential movement from MOIRA data, and population/employment catchments extracted from Census data.

Gravity model powers were broadly calibrated with reference to Patchway and Montpelier stations' trip distributions, to build in inherent local tendencies to make long or short distance trips. This process doesn't manifestly change the total demand, adjusting it slightly to accentuate or reduce the new stations' propensity for longer trips compared to the calibration stations.

Most importantly though, it facilitates calculation of revenue based on the mix of short, medium and longer distance trips in the distribution.

Station parking charges

The demand forecasts implicitly assume that the new stations would not charge for parking, in the first instance because key similar stations in the area either do not have car parks or are also free to park, and this is likely to be the same at the potential new stations of MetroWest Phase 2. If a car park charging regime is considered as the project develops, car park access and capacity considerations would then be built into the models to assess in more detail. This is likely to be a requirement for future development of MetroWest Phase 2 through the Outline Business Case.

Henbury line 'loop' and 'spur' services [4]

For all four of the MetroWest Phase 2 options being considered in the Preliminary Business Case, the new stations proposed are served by the relevant hourly Henbury line services, whether this is run as a loop or spur. Hence, there is a basic hourly train service for all of the new stations, with variation being in whether the service provides direct links to the Severn Beach line as well as Bristol Temple Meads (in the case of the loop) or just serves Temple Meads (the spur). As such, the basic regression based station demand is the same for all options.

In order to understand the potential for differential levels of demand with a loop service, a specific add-on approach has been taken within the new stations model that differentiates between the loop and spur. In essence, this takes the station-to-station movements that are quicker when the service is a loop and estimates the potential additional demand that could accrue.

The approach has identified specific movements that could benefit from direct links provided by a loop services with reference to the potential future timetables for Henbury line services. It should be noted from the outset that there are not many station-station pairs for which a loop service would provide a quicker journey, and all of which are essentially local movements. Particular movements that benefit vary from new station to new station, but typically include movements between MetroWest Phase 2 new stations and Severn Beach line stations (with diminishing benefits along the Severn Beach line towards Narroways Junction). Table 3.2 illustrates the differences in journey time between new stations and Severn Beach line stations that would have direct linkages with a loop service. For these journeys, an elasticity approach was used to estimate the additional demand that would be generated with a faster journey (using elasticities derived from PDFH).

Table 3.2: Comparative spur and loop local journey times between stations

New station		Avonmouth	Shirehampton	Sea Mills	Clifton Down	Redland	Montpelier
Ashley Down	Spur	42	39	35	28	26	24
	Loop	25	34	35	28	26	24
Constable Rd	Spur	43	40	36	29	27	25
	Loop	24	33	36	29	27	25
North Filton	Spur	52	49	45	38	36	34
	Loop	15	24	28	32	36	34
Henbury	Spur	56	53	49	42	40	3
	Loop	11	20	24	28	36	38

Notes: Journey times shown for direct loop services versus similar journeys using a spur service (with a change at Stapleton Road) based on indicative timetables produced as part of the Capability Modelling.

3.3.2 Diversions of existing trips to new station

An estimate of how many trips are new to the railway or transferring from other stations has been made using a station access logit model, with generalised costs calculated for journeys from origin (usually home) to existing stations, compared with a similar trip using a new station. This is based on true origin to station trips in NRTS data, for stations in the MetroWest area. The NRTS identifies true origin and destination of rail users, as well as the time taken and distance from true origin to the origin station.

The model calculates propensity to change stations based on proximity of other stations in the area. NRTS figures for time and distance between origins and stations are adjusted using factors derived from straight-line distances calculated from true origin to existing station versus the distance from origin to new station. A forecast 'station share' is calculated based on the new station versus existing station.

[4] An add-on approach was taken for the potential increase in demand from existing stations. This used MOIRA to calculate the additional demand attributed to pseudo services providing quick and direct journeys between Filton Abbey Wood and the Severn Beach Line. The additional demand generated was not particularly significant, because the need to change at Filton Abbey Wood to benefit from direct loop services was off-set for many journeys by a quick journey to Bristol Temple Meads and interchange to more frequent Severn Beach line services.

This initial 'station shift' derives the theoretical share based purely on generalised cost, which if not adjusted could result in higher transfers than would be realistic. As such, this has been calibrated using behaviour at existing stations, comparing interaction between existing stations and main principle being that unrealistic transfers are eliminated. For example, it is considered unlikely that anything other than local trips (to the new stations in MetroWest Phase 2) would transfer away from Filton Abbey Wood station, which is reasonably close to all the new stations, because its service levels are superior to that planned for MetroWest Phase 2 stations. Also, care has been taken to consider longer distance railhead movements that use major stations such as Bristol Parkway or Bristol Temple Meads.

3.3.3 Suppression of demand

Overlaying demand of a new station is potential loss of existing rail passengers, where there is potential to affect demand on services passing through (and stopping) at the new station, and lengthening journey times. This could have a significant effect on revenue if the services are fast and/or long distance, where the journey time penalty is greater and/or fares paid are higher than more local journeys. The new stations at Henbury and North Filton are not located on a current passenger rail line, and no existing services would be delayed to stop at them. As such, suppression of demand does not explicitly apply to these new stations. Similarly, while the new stations at Ashley Down and Constable Road are located on existing lines, they would only be served by the new Henbury rail service (whether loop or spur). As this is a new service, and there are no additional stops to existing services, suppression of demand also does not apply to these stations.

3.3.4 Future demand

Rail demand growth

Demand for rail travel has grown significantly in recent years, with, for example, a just over 70% increase in passenger numbers being recorded through stations in the West of England between 2004/05 and 2013/14 (ORR figures). This includes larger increases on specific routes, such as more than doubling of patronage on the Severn Beach line. Historic growth rates at groups of West of England stations are shown in Table 3.3 and Figure 3-1. Apart from a levelling in 2007/08, growth has continued in spite of the recession. It is likely to continue, albeit being debatable whether rates will be as high.

Looking to the future, the Great Western RUS (published in March 2010) forecast that demand in the Bristol area would rise by 41% at peak times between 2008 and 2019 (a rate of 3.2% per annum), and 37% off peak (2.9% per annum), with an average growth rate of 3.0% per annum. The Network Rail Long Term Planning Process (LTPP) Regional Urban Markets study (published October 2013) uses a series of wider economic scenarios to frame changes in rail use, and forecasts are presented for rail use in/around key urban centres. The resulting growth rates for the Bristol area vary from 0.6% per annum to 3.9% per annum. More details of the LTPP growth rates are shown in Table 3.4.

Table 3.3: ORR historic patronage growth in West of England area

2004-2014 figures

Station groupings	12/13 – 13/14 per annum	11/12 – 12/13 per annum	04/05 – 13/14 TOTAL	04/05 – 13/14 per annum
Main stations (Bristol Temple Meads, Bristol Parkway & Bath Spa)	3.6%	1.7%	64%	5.1%
Severn Beach Line [3]	8.1%	10.3%	213%	12.1%
Other Bristol urban stations [4]	10.6%	12.2%	201%	11.6%
B&NES stations (excluding Bath Spa)	8.3%	9.0%	107%	7.6%
South Gloucestershire stations (excluding Bristol Parkway)	13.4%	9.5%	167%	10.3%
North Somerset stations	3.5%	6.4% [2]	59%	4.8%
OVERALL	4.6%	2.6%	74.2%	5.7% [1]

Notes
1: As a comparison, the West of England station survey showed a 6.5% per annum increase from 2005 to 2012
2: 2010/11-2011/12 figures: ORR figures for Weston-super-Mare are surprisingly low in 2012/13
3: Excludes Lawrence Hill and Stapleton Road
4: Includes Parson Street, Bedminster, Lawrence Hill and Stapleton Road

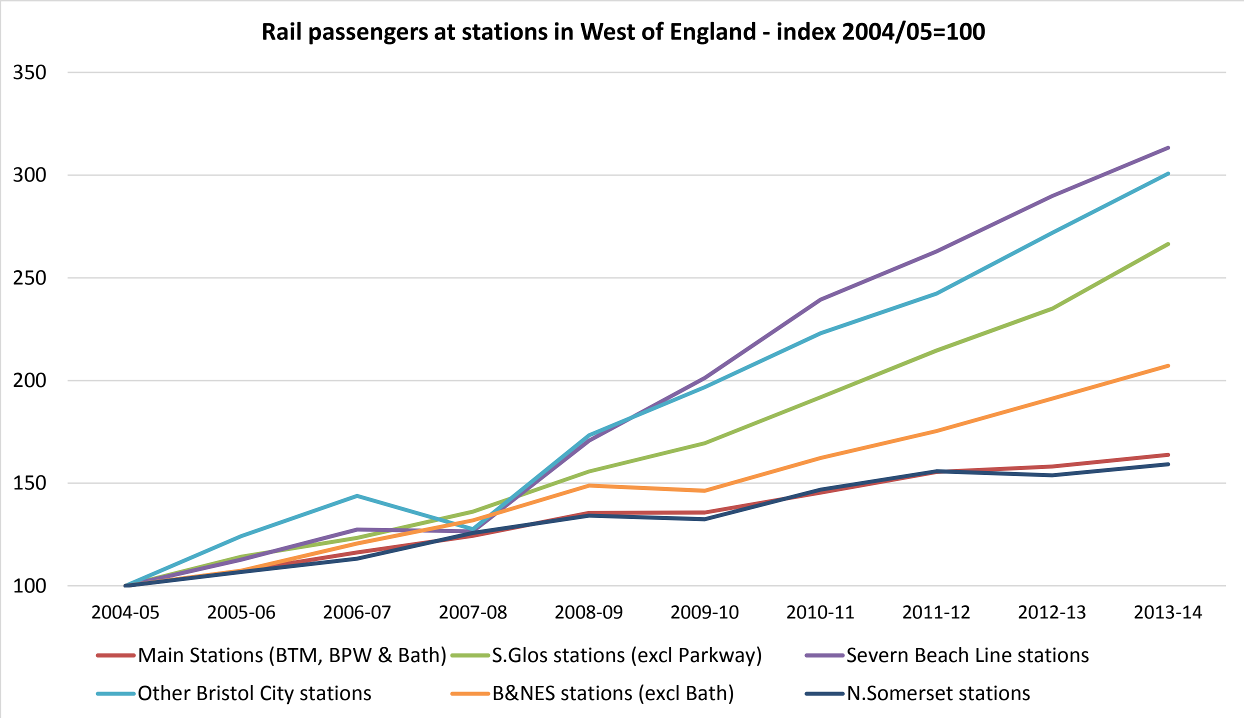

Figure 3-1: ORR historic growth in West of England area

Table 3.4: Network Rail LTPP: Regional Urban Markets Study – Bristol area forecast growth

October 2013

Economic scenario	**2013-23** total	**2013-23** per annum	**2023-2043** total	**2023-2043** per annum
'Prosperity in isolation'	14%	1.3%	33%	1.4%
'Global stability'	47%	3.9%	44%	1.8%
'Struggling in isolation'	6%	0.6%	15%	0.7%
'Global turmoil'	35%	3.0%	21%	1.0%
AVERAGE	26%	2.3%	29%	1.3%

In spite of recorded growth in recent years, it is possible that these rates would not continue unabated. As such, future year forecasts for West of England stations have been produced using a combination of decrementing historic rates, RUS and LTPP figures, as follows:

- 2014 to 2017 – taper from recent historic growth rates at West of England stations (5.6% per annum) to RUS average of peak and off peak (3.0% per annum);
- 2018 & 2019 – RUS average rate (3.0% per annum);
- 2020 to 2023 – taper from RUS average rate (3.0% per annum) to an LTPP average rate derived from the four economic scenarios (2.3% per annum); and
- 2023 to 2043 – taper from 2023 LTPP average rate (2.3% per annum) to 2043 LTPP average rate (1.3% per annum). Note that for appraisal, growth is capped to 0% per annum after 2034.

Given recent historic rates of growth of rail patronage, the forecast growth rates assumed can be considered comparatively conservative.

Early years ramp-up

It is common in the derivation of demand forecasts for new public transport services to assume that the 'full' forecast demand will not be achieved in the early years of operation as potential users adjust their trip making behaviour accordingly. As such, a series of early years' ramp up factors have also been applied to demand forecasts. Table 3.5 shows the factors used; which are based on assumptions made by CH2M in similar studies elsewhere.

Table 3.5: Early years ramp-up

Year	Ramp-up % of forecast
Opening year	80%
1	90%
2	95%
3rd year onwards	100%

Note that, in effect, the ramp-up at Henbury and North Filton is slower than indicated because of the allowance for build-out for CPNN, as it has an effect on catchment and hence demand. Table 3.5 shows the approximate build-out of CPNN anticipated for the period 2021-2024 alongside the ramp-up rates. Build-out proportions are applied to part of the demand at Henbury and North Filton in addition to ramp-up values in the early years.

Table 3.6: Early years ramp-up at Henbury and North Filton (including CPNN build-out)

Year	Ramp-up % of forecast	CPNN – approximate build % for year	
Opening year	80%	2021	65%
1	90%	2022	70%
2	95%	2023	80%
3rd year onwards	100%	2024	85%

3.4 Results of forecasts [5]

3.4.1 Demand and revenue

Headline results of demand forecasts for Henbury, North Filton, Ashley Down and Constable Road stations are shown in the tables for ‘spur’ options (1a and 1b) and ‘loop’ service options (2a and 2b). Table 3.7 has 2021 (opening year) demand figures for ‘spur’ service options (options 1a and 1b), with similar figures for ‘loop’ options in Table 3.8. Table 3.9 and Table 3.10 have results for 2031. [6] [7]

Note that revenues are based on the numbers of station-station trips from the gravity model distribution of total journeys from each new station, from which the associated passenger mileage is calculated. An overall fare of £0.20 per passenger mile average fare has been assumed (which is derived from relevant information relating to journeys in the WoE area). Up to 90% of trips are likely to be between the new stations and in the West of England area, generating over 70% of total revenue, reflecting the local nature of likely usage of the new stations.

It should also be noted that the daily forecasts represent an ‘average day’, based on an annualisation factor of 315 (in turn based on analysis of data extracted from MOIRA). These values do not directly illustrate peak time, daily or weekly fluctuations in demand or seasonal variation, and incorporate future growth assumptions described earlier. Peak time usage has been calculated for highway benefit calculations, discussed briefly in chapter 4.

The majority of trips are forecast to be new to the railway, although up to 10% of demand at Henbury could be derived from existing rail users transferring stations. [8] Trips are forecast to transfer from stations in the outer reaches of the Severn Beach line as well as Patchway and (limited numbers from) Filton Abbey Wood. However, in the urban area of Bristol with a number of relatively close stations, this

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[5] The results of the analysis of changes in demand at existing stations, using MOIRA1, are NOT discussed in the Forecasting Report, but are presented in the Network Rail Metro West Phase 2 Socio-economic appraisal report.

[6] There is no difference between new stations demand calculated for options with Yate or Gloucester as the destination for services providing the half-hourly service at Yate.

[7] Revenues are based on the numbers of station-station trips derived from the gravity model distribution of journeys, from which the associated mileage is calculated. An overall fare of £0.20 per passenger mile average fare (which is derived from relevant information relating to journeys in the WoE area).

[8] Transfer proportions do not change the demand or revenue forecast at a new station, but are used in the calculation of net revenue, when combined with demand at existing rail stations.

is considered pessimistic, because the NRTS data that these assessments are principally based on is not particularly geographically disaggregated. The proximity of North Filton to Patchway (in particular) and Filton Abbey Wood leads to greater transfer proportion, with over 25% of its demand previously using other stations.

Because Ashley Down and Constable Road are located close to a number of existing stations, derivation of catchments has already taken particular account of the locations of other stations. Transfers are therefore assessed to be lower, having been built-into the initial forecasts to a certain extent. As such, around 5% of demand at Ashley Down is assessed to have transferred from existing stations. Constable Road being such a constrained location suggests around 1% of demand is transferred.

Table 3.11 shows future year forecasts from opening in 2021 to 2034 for options 1a and 1b (with the Henbury line as a spur service), including annual and daily (average day) demand and revenue. Similar figures are given for options 2a and 2b (Henbury line as a loop service) in Table 3.12.

Growth assumptions are conservative when compared with recent actual growth in rail use, but still indicate that demand could increase substantially as time passes. Note though that the growth effect is magnified for Henbury and North Filton as a result of the gradual completion of CPNN. Hence, while Ashley Down and Constable Road see growth of around 60% between 2021 and 2034, both Henbury and North Filton almost double their throughput.

Table 3.7: New stations demand forecasts – spur service – options 1a & 1b (2021)

Demand/revenue	Henbury	North Filton	Ashley Down	Constable Rd	TOTAL
Annual demand	98,850	92,300	89,400	37,700	318,250
Daily demand (average)	314	293	284	120	1,010
Annual revenue (£)	£348,200	£290,850	£206,700	£93,250	£939,000

one-way journeys

Table 3.8: New stations demand forecasts – loop service – options 2a & 2b (2021)

Demand/revenue	Henbury	North Filton	Ashley Down	Constable Rd	TOTAL
Annual demand	100,000	93,200	89,450	37,750	320,400
Daily demand (average)	318	296	284	120	1,017
Annual revenue (£)	£350,650	£292,700	£206,750	£93,300	£943,450

one-way journeys

Table 3.9: New stations demand forecasts – spur service – options 1a & 1b (2031)

Demand/revenue	Henbury	North Filton	Ashley Down	Constable Rd	TOTAL
Annual demand	178,050	173,200	138,000	58,250	547,500
Daily demand (average)	565	550	438	185	1,738
Annual revenue (£)	£627,050	£545,850	£319,150	£144,000	£1,636,000

one-way journeys

Table 3.10: New stations demand forecasts – loop service – options 2a & 2b (2031)

Demand/revenue	Henbury	North Filton	Ashley Down	Constable Rd	TOTAL
Annual demand	180,150	174,900	138,100	58,300	551,400
Daily demand (average)	572	555	438	185	1,751
Annual revenue (£)	£631,500	£549,300	£319,250	£144,050	£1,644,100

one-way journeys

Table 3.11: New station forecasts – demand and revenue by year – options 1a & 1b

Year	Henbury			Filton North			Ashley Down			Constable Road			
	Demand		Revenue £	Demand		Revenue £	Demand		Revenue £	Demand		Revenue £	
	annual	daily	annual	annual	daily	annual	annual	daily	annual	annual	daily	annual	
2014	-	-	-	-	-	-	-	-	-	-	-	-	
2015	-	-	-	-	-	-	-	-	-	-	-	-	
2016	-	-	-	-	-	-	-	-	-	-	-	-	
2017	-	-	-	-	-	-	-	-	-	-	-	-	
2018	-	-	-	-	-	-	-	-	-	-	-	-	
2019	-	-	-	-	-	-	-	-	-	-	-	-	<< MetroWest Phase 1
2020	-	-	-	-	-	-	-	-	-	-	-	-	
2021	98,850	314	£348,200	92,300	293	£290,850	89,400	284	£206,700	37,700	120	£93,250	<< MetroWest Phase 2
2022	118,050	375	£415,700	111,300	353	£350,800	103,050	327	£238,300	43,500	138	£107,500	
2023	131,750	418	£463,950	125,350	398	£395,100	111,300	353	£257,350	46,950	149	£116,100	
2024	144,750	460	£509,700	138,450	440	£436,450	119,750	380	£276,950	50,550	160	£124,950	
2025	149,850	476	£527,650	143,850	457	£453,350	122,400	389	£283,050	51,650	164	£127,700	
2026	155,000	492	£545,900	149,300	474	£470,500	125,050	397	£289,100	52,750	167	£130,450	
2027	160,200	509	£564,150	154,750	491	£487,800	127,650	405	£295,200	53,850	171	£133,200	
2028	165,450	525	£582,700	160,350	509	£505,300	130,250	414	£301,200	54,950	174	£135,900	
2029	170,700	542	£601,050	165,850	526	£522,700	132,850	422	£307,250	56,050	178	£138,600	
2030	174,750	555	£615,400	169,950	540	£535,700	135,450	430	£313,200	57,150	181	£141,300	
2031	178,050	565	£627,050	173,200	550	£545,850	138,000	438	£319,150	58,250	185	£144,000	
2032	181,350	576	£638,600	176,400	560	£555,900	140,550	446	£325,050	59,300	188	£146,650	
2033	184,600	586	£650,100	179,550	570	£565,900	143,100	454	£330,850	60,350	192	£149,300	
2034	187,800	596	£661,400	182,700	580	£575,750	145,600	462	£336,650	61,450	195	£151,900	

Note that growth is capped at 2034 levels for appraisal purposes

Growth from 2021…

	Henbury	Filton North	Ashley Down	Constable Road
2031	80%	88%	54%	55%
2034	90%	98%	63%	63%

Table 3.12: New station forecasts – demand and revenue by year – options 2a & 2b

Year	Henbury			Filton North			Ashley Down			Constable Road			
	Demand		Revenue £	Demand		Revenue £	Demand		Revenue £	Demand		Revenue £	
	annual	daily	annual	annual	daily	annual	annual	daily	annual	annual	daily	annual	
2014	-	-	-	-	-	-	-	-	-	-	-	-	
2015	-	-	-	-	-	-	-	-	-	-	-	-	
2016	-	-	-	-	-	-	-	-	-	-	-	-	
2017	-	-	-	-	-	-	-	-	-	-	-	-	
2018	-	-	-	-	-	-	-	-	-	-	-	-	
2019	-	-	-	-	-	-	-	-	-	-	-	-	<< MetroWest Phase 1
2020	-	-	-	-	-	-	-	-	-	-	-	-	
2021	100,000	318	£350,650	93,200	295	£292,700	89,450	284	£206,750	37,750	120	£93,300	<< MetroWest Phase 2
2022	119,400	379	£418,650	112,400	355	£353,000	103,100	327	£238,400	43,500	138	£107,550	
2023	133,300	423	£467,250	126,600	400	£397,600	111,350	354	£257,400	47,000	149	£116,150	
2024	146,400	465	£513,350	139,850	445	£439,200	119,850	380	£277,050	50,550	161	£125,000	
2025	151,600	481	£531,400	145,250	460	£456,200	122,500	389	£283,150	51,700	164	£127,750	
2026	156,800	498	£549,750	150,750	480	£473,500	125,100	397	£289,200	52,800	168	£130,500	
2027	162,050	515	£568,200	156,300	495	£490,900	127,750	406	£295,300	53,900	171	£133,250	
2028	167,400	531	£586,850	161,900	515	£508,550	130,350	414	£301,300	55,000	175	£135,950	
2029	172,650	548	£605,350	167,500	530	£526,000	132,950	422	£307,350	56,100	178	£138,650	
2030	176,800	561	£619,750	171,650	545	£539,100	135,550	430	£313,300	57,200	182	£141,350	
2031	180,150	572	£631,500	174,900	555	£549,300	138,100	438	£319,250	58,300	185	£144,050	
2032	183,450	582	£643,150	178,150	565	£559,450	140,650	447	£325,150	59,350	188	£146,700	
2033	186,750	593	£654,700	181,300	575	£569,500	143,200	455	£331,000	60,400	192	£149,350	
2034	190,000	603	£666,100	184,500	585	£579,400	145,700	462	£336,750	61,450	195	£151,950	

Note that growth is capped at 2034 levels for appraisal purposes

Growth from 2021…

	Henbury	Filton North	Ashley Down	Constable Road
2031	80%	88%	54%	54%
2034	90%	98%	63%	63%

3.4.2 Catchment and access modes

The total demand forecasts have been further analysed to start to build up a picture of the locations that potential users of the potential new stations could come from, as well as the modes of transport they may use to reach the stations. NRTS data has been used to determine potential patterns of trip distance and mode of access, as this provides an indication of the true origin of trips through a station, as well as the mode of transport used to get there. This has been based on a combination of information from Filton Abbey Wood, Stapleton Road and Patchway stations, with adjustments related to possible availability of access facilities, such as car parking and bus services.

Table 3.13 shows indicative catchment distances and modes of access for Henbury station. These are preliminary figures for illustration at this stage, so are only shown for option 1a, and based on the 2021 demand forecasts. In the first instance, almost half of all one-way trips are likely to be outward and return portions of returns, many of which will be day returns, thus suggesting some 158 individuals arrive at the station in order to make 315 trips. Table 3.14 shows a similar indicative assessment for the station at North Filton (based on 147 individuals arriving at the station, to make 295 trips), with Table 3.15 and Table 3.16 showing Ashley Down (142 individuals and 285 trips) and Constable Road (60 individuals and 120 trips) respectively.

Table 3.13: Rail users accessing Henbury – illustration based on option 1a (2021 figures)

Catchment	Walk	Bus	Car parked	Car drop off	Bicycle	Taxi	ALL
Less than 1 km	28	-	-	3	-	3	34
from 1 to 2 km	51	21	7	5	4	-	87
from 2 to 3 km	19	2	3	3	2	-	29
from 3 to 4 km	-	1	1	-	-	0	2
from 4 to 5 km	-	1	3	-	1	-	5
from 5 to 10 km	-	-	1	-	-	-	1
More than 10 km	-	-	-	-	-	-	-
TOTAL	98	24	14	11	7	3	158

numbers may not add up exactly to totals due to rounding

Table 3.14: Rail users accessing North Filton– illustration based on option 1a (2021 figures)

Catchment	Walk	Bus	Car parked	Car drop off	Bicycle	Taxi	ALL
Less than 1 km	36	-	-	2	-	4	42
from 1 to 2 km	56	15	2	2	5	-	81
from 2 to 3 km	18	1	1	1	1	-	22
from 3 to 4 km	-	0	0	-	-	0	1
from 4 to 5 km	-	0	1	-	0	-	2
from 5 to 10 km	-	-	0	-	-	-	0
More than 10 km	-	-	-	-	-	-	-
TOTAL	110	16	5	5	6	4	147

numbers may not add up exactly to totals due to rounding

Table 3.15: Rail users accessing Ashley Down– illustration based on option 1a (2021 figures)

Catchment	Walk	Bus	Car parked	Car drop off	Bicycle	Taxi	ALL
Less than 1 km	41	-	-	1	-	4	46
from 1 to 2 km	59	12	-	1	6	-	78
from 2 to 3 km	18	1	-	-	-	-	19
from 3 to 4 km	-	-	-	-	-	-	-
from 4 to 5 km	-	-	-	-	-	-	-
from 5 to 10 km	-	-	-	-	-	-	-
More than 10 km	-	-	-	-	-	-	-
TOTAL	118	12	-	2	6	4	142

numbers may not add up exactly to totals due to rounding

Table 3.16: Rail users accessing Constable Road– illustration based on option 1a (2021 figures)

Catchment	Walk	Bus	Car parked	Car drop off	Bicycle	Taxi	ALL
Less than 1 km	17	-	-	0	-	2	20
from 1 to 2 km	25	5	-	0	3	-	33
from 2 to 3 km	8	0	-	-	-	-	8
from 3 to 4 km	-	-	-	-	-	-	-
from 4 to 5 km	-	-	-	-	-	-	-
from 5 to 10 km	-	-	-	-	-	-	-
More than 10 km	-	-	-	-	-	-	-
TOTAL	50	5	-	1	3	2	60

numbers may not add up exactly to totals due to rounding

Catchments for users of all stations are considered relatively local, more so for Filton Bank stations than those on the Henbury line, and the rail services are likely to be mostly used for local journeys. However, given the availability of connections at Bristol Temple Meads and Filton Abbey Wood, this will provide opportunities for some longer journeys on the wider rail network that previously required a trip to another railhead, if made at all. Forecasts indicate that over 75% of journeys at all stations are likely to be to and from other stations in the MetroWest area, with around 50% being to/from central Bristol (mostly Bristol Temple Meads, but also including Stapleton Road, Lawrence Hill, Bedminster and Parson Street).

Demand for parking at the stations has been assumed to be limited, because there is not anticipated to be significant parking provision at the stations, and the relationship between catchment and station has been taken from existing stations in the local area with similar levels of provision. It is likely though there will be some demand for on-street parking. However, these should not be taken as a definitive forecast of parking demand at this stage, and will be refined as development of MetroWest Phase 2 progresses.

3.5 Demand comparison

In order to understand the new stations demand forecasts in a wider context, a benchmarking exercise has been carried out. This has taken two forms:

- Direct comparison between demand forecasts for the new stations and current demand at similar stations; and
- Compound comparison the new stations with similar stations, based on the demand and catchments of each.

Direct comparison

A comparison between new stations of MetroWest Phase 2 and some local stations in the WoE area is shown in Table 3.16. Forecast demand from 2021 and 2031 are included for new stations, with the most recently available ORR station usage figures (2013-14) being shown for existing stations.

Table 3.16 also shows catchment information. Population and employment figures are taken from the 2011 Census (employment being workplaces based on Workplace Zones). Existing station population and employment is shown for basic (circular) catchments only. New stations population and employment is shown for both basic and adjusted catchments (adjustments being related to overlapping catchments used to refine demand forecasts), with CPNN build-out assumptions included for Henbury and North Filton. The table also includes an indication of the service level at each station.

The table indicates that forecasts of demand at the new stations have similarities in nature to those at other stations in the area, such as Parson Street and Bedminster both being comparable with Ashley Down. Likewise, North Filton compares well with Avonmouth, and Henbury with Patchway. Constable road demand is lower than might have been expected for its location, mostly as a result of constraining its catchment. Stations with better services but similar catchment characteristics tend to have higher demand. There are some outliers in local station comparisons, especially Clifton Down and Filton Abbey

Wood, whose locations are of particular note as key destinations (and in the case of Filton Abbey Wood also has a significantly better train service).

Table 3.17: New and existing station comparisons

Station	Demand		Population			Employment			Services
New stations									
	2021	**2031**	**<1km**	**<2km**		**<1km**	**<2km**		**/hr**
				basic	adjusted		basic	adjusted	
Henbury	98,850	178,050	8,450	18,000	18,000	2,350	6,000	6,000	1
with CPNN			10,950	23,000	23,000	2,850	7,000	7,000	
North Filton	92,300	173,200	3,700	26,950	14,300	5,600	18,800	13,550	1
with CNNN			3,700	26,950	14,300	9,600	23,800	18,550	
Ashley Down	89,400	138,000	17,050	77,550	41,950	6,250	22,550	13,100	1
Constable Road	37,700	58,250	13,950	53,350	36,100	2,800	19,700	13,850	1
Existing stations – local comparators									
	2013-14 ORR		**<1km**	**<2km**		**<1km**	**<2km**		**/hr**
Avonmouth	111,440		2,250	7,500		4,850	11,400		1.5
Bedminster	83,242		21,000	69,350		14,200	85,150		1
Lawrence Hill	136,316		24,400	69,950		11,550	64,750		2.5
Montpelier	121,294		30,350	97,750		14,000	93,150		1.5
Parson Street	102,654		17,050	55,050		6,750	28,850		1
Patchway	90,404		8,200	39,050		2,100	18,850		1
Redland	93,176		32,300	91,400		14,850	87,800		1.5
Sea Mills	58,106		3,850	19,800		2,000	4,250		1.5
Shirehampton	51,542		8,600	17,950		1,650	7,450		1.5
Stapleton Road	157,294		24,900	77,150		8,100	39,850		2.5
Existing stations – local special cases									
	2013-14 ORR		**<1km**	**<2km**		**<1km**	**<2km**		**/hr**
Clifton Down	573,770		26,250	78,900		16,800	84,750		1.5
Filton Abbey Wood	988,734		10,550	31,800		6,350	25,500		3

Notes:

Demand is one-way journeys; ORR station usage for 2013-14 for existing stations; forecast timelines for new stations.

Population and employment; 2011 Census; existing stations have basic (circular) catchments only; new stations have both basic and adjusted catchments, with CPNN build-out assumptions included for Henbury and North Filton.

Services per hour are main pattern across the day for one direction.

Compound comparison

To present a wider comparison of demand and catchment in a graphical form, a compound comparison has been carried out. This takes the demand and catchment figures (population and employment) and plots demand versus the weighted population and employment; population is weighted at 100% with employment weighted at 50%; similarly, values within the 1km-2km catchment are weighted at 50%, where the <1km catchment is weighted at 100%. This is similar to the weightings used in demand forecasting, though for consistency employs the unadjusted (circular) catchments for all stations.

The existing stations in the comparison include 10 of local the stations listed in Table 3.14 (not Clifton Down and Filton Abbey Wood, as these are considered outliers). Another 27 stations are included from around the rail network. To ensure that the plot is meaningful, these have been selected as having demand and catchment characteristics of similar magnitude (demand 20,000-160,000 and population within 1km of 2,000-25,000 and employment within 1km of 1,000-15,000). None of them would be considered main line stations, with the majority having service levels of around 1 train per hour (some slightly more, some slightly less). They are mostly located in urban areas, typically towards the edge of the area and often are a secondary or tertiary station for the area served. Figure 3.2 shows the results of the comparison, highlighting the locations of the comparator stations, with Figure 3.3 highlighting service levels at the other stations.

The plots indicate that new station demand/catchment characteristics are within the range of what would be expected from similar stations. Henbury and North Filton are the best fit, with a number of similarly served stations with similar catchment areas having demand both above and below.

It is arguable that Ashley Down and Constable Road perhaps have a lower demand than might be expected for their characteristics, though this is related to the interaction of their catchments with each other and other stations that has been specifically taken into account in the calculation of demand. As such, demand forecasts for these stations could be considered conservative. [9]

[9] It should be noted that subsequent analysis of Ashley Down as a stand-alone station (i.e. without Constable Road in the 'additional option', option 1a_x) results in a demand forecast of just over 100,000 trips per annum, an amount of demand better aligned with more of the comparator stations.

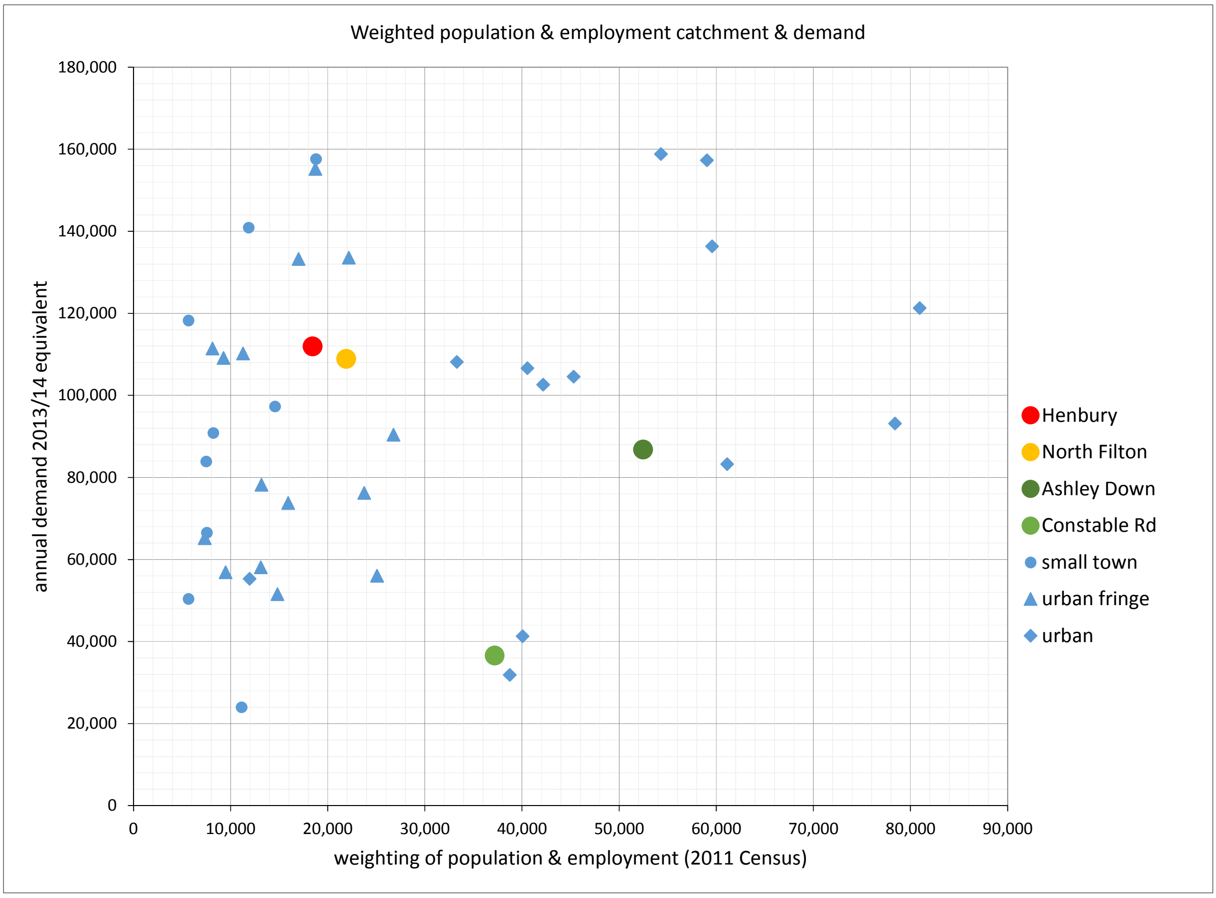

Figure 3-2: Demand and catchment comparison plot – other stations by type

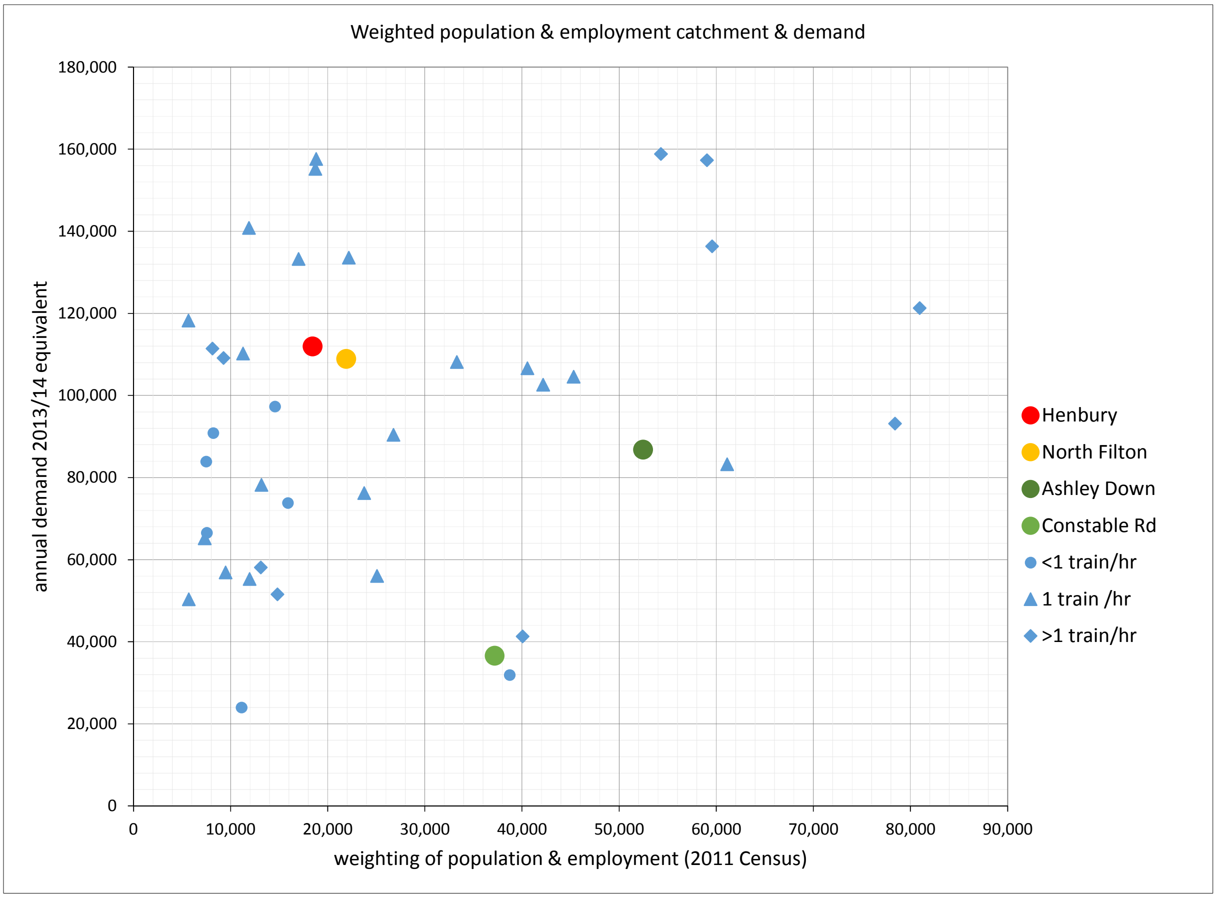

Figure 3-3: Demand and catchment comparison plot – other stations by service level

4. Highway Network Impacts

4.1 Introduction

The West of England highway networks are reaching capacity and congestion is particularly notable at:

- Bristol city centre and approaches to Bristol Temple Meads;
- The Bristol North Fringe;
- M4 and M5 junctions; and
- Corridors into Bristol city (including M32, A38, A4018 and A432).

The North Fringe suffers congestion and journey time reliability problems. This not only causes delays and lost productivity for car drivers and goods vehicle operators but also presents a major hurdle for an attractive public transport mode in the area. Table 4.1 shows free flow vs peak hour journey times on the key corridors served by MetroWest Phase 2. This shows peak hour journey times can be more than twice the corresponding free flow times.

Table 4.1: Free flow vs AM Peak journey times on key routes

Route	Observed AM Peak 2013	
	Free Flow JT (mins)	**Net Peak hour JT (mins)**
M32 Inbound (M32 J1 to Cabot Circus)	4.9	13.1
M32 Outbound (Cabot Circus to M32 J1)	3.8	5.6
A38 Inbound (M5 J16 to St James Barton Rbt)	16.3	33.6
A38 Outbound (St James Barton Rbt to M5 J16)	16.6	32.2
A4018 Inbound (M5 J17 Cribbs to Clifton Triangle)	12.3	29.7
A4018 Outbound (College Green to M5 J17 Cribbs)	12.5	18.1
A432 Inbound (A4174 Badminton Rbt to Old Market St)	15.2	35.6
A432 Outbound (West St to A4174 Badminton Rbt)	15.4	26.3

Free Flow JT = minimum journey time recorded in the period 06:00-10:00

Observed = Strategis data

4.2 Without-Intervention Case

Do Minimum infrastructure assumptions

MetroWest Phase 2 represents a major transport scheme development in the West of England area. In modelling its effects, other key infrastructure developments need to be included in the ‘Do Minimum’ assumptions prior to MetroWest Phase 2 interventions being included. It is proposed that the Do Minimum should include:

- MetroWest Phase 1;
- South Bristol Link (SBL) and other committed schemes identified in the SBL assessment;
- Ashton Vale to Temple Meads (AVTM);
- North Fringe to Hengrove Package (NFHP); and
- Cribbs Patchway New Neighbourhood (CPNN) Off-site Works Package.

The LSTF schemes and 20mph speed limits are also being implemented across the wider Bristol area and a residents parking permit scheme implemented in central Bristol. However it is not proposed to include these schemes in the Preliminary (Strategic Outline) Business Case GBATS3 modelling since they are area-wide and not expected to favour one option over another.

The proposed new station at Portway Park & Ride site has not been included in the Do Minimum situation. It is not specifically a part of MetroWest, and is envisaged as complementary to any of the options. However, its implementation timescales are not yet confirmed.

Development assumptions

Table 4.2 shows a considerable amount of development planned in the West of England area to 2029.

Table 4.2: West of England Planned Growth

Council	Homes	Jobs	Core Strategy period
Bath & North East Somerset	13,000	10,300	2011-2029
Bristol City	32,800	21,900 *	2011-2026
North Somerset	17,130	14,000 **	2006-2026
South Gloucestershire	28,355	18,600-21,870	2006-2027
All	92,285	68,070	

Source: Core Strategies and supporting documents

* Proposed figures subject to local plan examinations

** Homes figures updated February 2014, but job figures to be revised

Table 4.3 underlines this with major housing areas directly served or capable of being served by MetroWest rail stations and services.

Table 4.3: Development sites served by MetroWest

Housing area	Homes	Rail schemes
Cribbs Patchway New Neighbourhood (CPNN)	5,700 (50Ha employment)	MetroWest Phase 2 (Henbury line)
North Yate	3,000	MetroWest Phase 2
Somerdale (former Cadbury site, Keynsham)	700	MetroWest Phase 1
Weston-super-Mare	11,000	MetroWest Phase 1 & 2

Source: Core Strategies and supporting documents

A significant number of jobs are planned, to be delivered through Enterprise Zones/Areas that will benefit from MetroWest Phase 2, including Bristol Temple Quarter Enterprise Zone and Avonmouth Severnside Enterprise Area. Further details of modelled development assumptions are provided in South Bristol Link Forecasting Report, April 2013.

Network operation

Table 4.4 shows highway network operation for the 2012 model base year and the forecast years for the Do Minimum scenario. This shows a considerable worsening of network operation in future years resulting in marked increases in queues, associated travel times and reductions in average speed relative to the current levels of congestion.

4.3 With-Intervention Case

The highway network operation has been assessed in the With Intervention 'Do Something' scenario using the methodology set out in section 2.

The change in rail and highway trips are shown in Table 4.5, which take into account increased rail demand at both new and existing stations. This takes the results of demand forecasts set out for new stations in Chapter 3 and existing stations (set out in the Network Rail Socio-economic appraisal report) and illustrates demand by GBATS3 model period (AM peak, inter-peak and PM peak), noting that the initial forecasts are all annual figures.

To calculate period demands consistent with the inputs and outputs for GBATS3 model periods, MOIRA hourly usage profiles have been used. There are several different sets of profiles for different types of journeys, providing individual 24 hour demand based on station origin and destination type and journey time (for instance, very long distance journeys of greater than 6 hours duration tend to begin between 10:00 and 12:00, whereas local journeys up to 1 hour duration are more likely to take place in the peak hour of 08:00-09:00). Annual demand forecasts have been converted to daily figures, also using a MOIRA derived factor, and split into time period, using the gravity model distribution to allocate trip journey time, which alongside allocating stations to categories, subsequently determines the MOIRA profile to use for a particular movement.

The proportion of additional rail trips that are forecast to switch from highway have been identified from the GBATS3 multi-modal assessment results, which vary by time period. These have been applied to the AM peak, inter-peak and PM peak rail demand figures (the resulting changes in highway trips are also shown in Table 4.5).

Table 4.6 and Table 4.7 show the highway network operation for 2016 and 2031 respectively, including all four options considered in the Preliminary Business Case.

The highway assignment results indicate improvements in network operating conditions as a result of the MetroWest scheme. Whilst there are highway benefits the results indicate the differences between options are limited in terms of highway network impacts.

Table 4.4: Do Minimum highway network operation

	2012 base year			**2016**			**2031**		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)	6140	3768	5932	7338	4498	7025	9999	6278	9483
Total Travel Time (pcu. hrs./hr.)	22690	15743	22176	26409	18173	25918	35635	23855	34845
Travel Distance (pcu. kms./hr.)	1030834	783188	1006413	1114346	856032	1091845	1332452	1076024	1310273
Overall Average Speed (kph)	45	50	45	42	47	42	37	45	38
Total Trips Loaded (pcu/hr)	120133	97165	112211	128148	105253	120262	151773	128979	142065
				2016 vs 2012			**2031 vs 2012**		
				AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)				20%	19%	18%	53%	56%	51%
Total Travel Time (pcu. hrs./hr.)				16%	15%	17%	49%	45%	49%
Travel Distance (pcu. kms./hr.)				8%	9%	8%	27%	34%	28%
Overall Average Speed (kph)				-7%	-5%	-7%	-19%	-10%	-19%
Total Trips Loaded (pcu/hr)				7%	8%	7%	25%	30%	25%

Source: GBATS3

Table 4.5: Change in rail and highway trips

Change in rail/car demand (from do minimum)		**2016**				**2031**			
		Annual	**Average day**			**Annual**	**Average day**		
			AM	IP	PM		AM	IP	PM
	Existing stations	98,050	39	22	44	151,350	105	60	122
	Henbury	98,850	20	12	36	178,050	55	32	99
	North Filton	92,300	13	8	24	173,200	36	21	66
1a	Ashley Down	89,400	40	17	42	138,000	107	47	116
	Constable Road	37,700	17	8	18	58,250	46	21	51
	TOTAL	416,300	129	66	163	698,850	349	180	453
	reduction in car trips		58	54	73		107	156	186
	Existing stations	122,050	48	27	54	188,450	130	74	149
	Henbury	98,850	20	12	36	178,050	55	32	98
	North Filton	92,300	13	8	24	173,200	36	21	65
1b	Ashley Down	89,400	39	17	42	138,000	106	46	115
	Constable Road	37,700	17	8	18	58,250	46	20	50
	TOTAL	440,300	138	71	174	735,950	372	194	478
	reduction in car trips		62	59	77		114	168	197
	Existing stations	101,050	40	23	45	156,050	108	62	126
	Henbury	100,000	21	12	36	180,150	56	33	100
	North Filton	93,200	14	8	24	174,900	37	21	66
2a	Ashley Down	89,450	40	17	42	138,100	107	47	116
	Constable Road	37,750	17	8	18	58,300	46	21	51
	TOTAL	421,450	131	67	165	707,450	354	183	458
	reduction in car trips		59	55	74		109	158	189
	Existing stations	125,050	49	28	56	193,100	133	76	153
	Henbury	100,000	21	12	36	180,150	55	32	99
	North Filton	93,200	14	8	24	174,900	37	21	66
2b	Ashley Down	89,450	39	17	42	138,100	106	46	115
	Constable Road	37,750	17	8	18	58,300	46	20	50
	TOTAL	445,500	140	72	176	744,500	377	196	484
	reduction in car trips		63	59	78		116	170	199

Source: RDM & GBATS3

Table 4.6: Do Something highway network operation – 2016

	Do minimum			**Option 1a**			**Option 1b**		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)	7338	4498	7025	7324	4492	7009	7321	4493	7009
Total Travel Time (pcu. hrs./hr.)	26409	18173	25918	26377	18160	25870	26378	18163	25869
Travel Distance (pcu. kms./hr.)	1114346	856032	1091845	1113748	855402	1091298	1113838	855324	1091268
Overall Average Speed (kph)	42	47	42	42	47	42	42	47	42
Total Trips Loaded (pcu/hr)	128148	105253	120262	128104	105216	120208	128101	105213	120205

	1a vs do min			**1b vs do min**		
	AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)	-0.2%	-0.1%	-0.2%	-0.2%	-0.1%	-0.2%
Total Travel Time (pcu. hrs./hr.)	-0.1%	-0.1%	-0.2%	-0.1%	-0.1%	-0.2%
Travel Distance (pcu. kms./hr.)	-0.1%	-0.1%	-0.1%	-0.0%	-0.1%	-0.1%
Overall Average Speed (kph)	-	-	0.2%	-	-	0.2%
Total Trips Loaded (pcu/hr)	-0.0%	-0.0%	-0.0%	-0.0%	-0.0%	-0.0%

	Do minimum			**Option 2a**			**Option 2b**		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)	7338	4498	7025	7328	4493	7007	7329	4493	7014
Total Travel Time (pcu. hrs./hr.)	26409	18173	25918	26393	18162	25864	26393	18162	25879
Travel Distance (pcu. kms./hr.)	1114346	856032	1091845	1113674	855375	1091384	1113773	855402	1091409
Overall Average Speed (kph)	42	47	42	42	47	42	42	47	42
Total Trips Loaded (pcu/hr)	128148	105253	120262	128103	105216	120207	128100	105212	120204

	2a vs do min			**2b vs do min**		
	AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)	-0.1%	-0.1%	-0.2%	-0.1%	-0.1%	-0.2%
Total Travel Time (pcu. hrs./hr.)	-0.1%	-0.1%	-0.2%	-0.1%	-0.1%	-0.1%
Travel Distance (pcu. kms./hr.)	-0.1%	-0.1%	-0.0%	-0.1%	-0.1%	-0.0%
Overall Average Speed (kph)	-	-	0.2%	-	-	0.2%
Total Trips Loaded (pcu/hr)	-0.0%	-0.0%	-0.0%	-0.0%	-0.0%	-0.0%

Source: GBATS3

Table 4.7: Do Something highway network operation – 2031

	Do minimum			Option 1a			Option 1b		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)	9999	6278	9483	9979	6250	9475	9974	6259	9457
Total Travel Time (pcu. hrs./hr.)	35635	23855	34845	35562	23805	34745	35540	23814	34725
Travel Distance (pcu. kms./hr.)	1332452	1076024	1310273	1331496	1074421	1308993	1331387	1074707	1308770
Overall Average Speed (kph)	37	45	38	37	45	38	38	45	38
Total Trips Loaded (pcu/hr)	151773	128979	142065	151694	128879	141937	151689	128872	141930

	1a vs do min			1b vs do min		
	AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)	-0.2%	-0.4%	-0.1%	-0.3%	-0.3%	-0.3%
Total Travel Time (pcu. hrs./hr.)	-0.2%	-0.2%	-0.3%	-0.3%	-0.2%	-0.3%
Travel Distance (pcu. kms./hr.)	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
Overall Average Speed (kph)	-	-	0.3%	0.3%	-	0.3%
Total Trips Loaded (pcu/hr)	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%

	Do minimum			Option 2a			Option 2b		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)	9999	6278	9483	9978	6268	9467	9984	6247	9449
Total Travel Time (pcu. hrs./hr.)	35635	23855	34845	35557	23825	34726	35566	23801	34715
Travel Distance (pcu. kms./hr.)	1332452	1076024	1310273	1331675	1074365	1308926	1331486	1074218	1308699
Overall Average Speed (kph)	37	45	38	38	45	38	37	45	38
Total Trips Loaded (pcu/hr)	151773	128979	142065	151693	128877	141936	151687	128870	141929

	2a vs do min			2b vs do min		
	AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)	-0.2%	-0.2%	-0.2%	-0.1%	-0.5%	-0.4%
Total Travel Time (pcu. hrs./hr.)	-0.2%	-0.1%	-0.3%	-0.2%	-0.2%	-0.4%
Travel Distance (pcu. kms./hr.)	-0.1%	-0.2%	-0.1%	-0.1%	-0.2%	-0.1%
Overall Average Speed (kph)	0.3%	-	0.3%	-	-	0.3%
Total Trips Loaded (pcu/hr)	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%

Source: GBATS3

4.4 Highway Benefits Analysis

Highway benefits have been identified through TUBA based on results of the highway modelling reported above. TUBA version 1.9.5 has been used.

Table 4.8 shows annualisation factors employed, which take into account relative congestion levels in peak and 'shoulder' hours rather than purely on traffic counts. These are set out in the NFHP DfT Engagement Annualisation Factors Review, August 2011 supplementary document. This document is available upon request.

Table 4.8: TUBA annualisation factors

Time Period	Modelled Hour to Period Conversion Factor	Number of Occurrences per Year	Annualisation Factors	Comments
AM	2.55	253	645.15	Conversion based on AM peak hour
IP	6	253	1518	Conversion based on IP average hour
PM	2.56	253	647.68	Conversion based on PM peak hour
OP	0.69	253	174.57	Conversion based on IP average hour
WE	6.07	56	339.92	Conversion based on IP average hour

Table 4.9 gives the TUBA highway benefits identified. Appendix A presents the decongestion-related inputs in TEE format.

Table 4.9: TUBA highway benefits

Highway benefits (£'000s)	1a	1b	2a	2b
Commuting / Other user benefit	£20,467	£21,309	£24,746	£25,422
Business user benefit	£11,826	£13,923	£10,393	£13,992
Wider public finances (Indirect taxation revenues)	-£4,037	-£4,098	-£5,784	-£5,336
Greenhouse gases	£417	£567	£428	£578

Figure 4-1 presents the spatial distribution of highway benefits from the scheme based on trip origins. This is based on option 1a, and shows the spatial distribution of benefits is consistent with the areas expected to benefit from MetroWest Phase 2. Other options are not plotted as they have similar distributions at this aggregation of benefits.

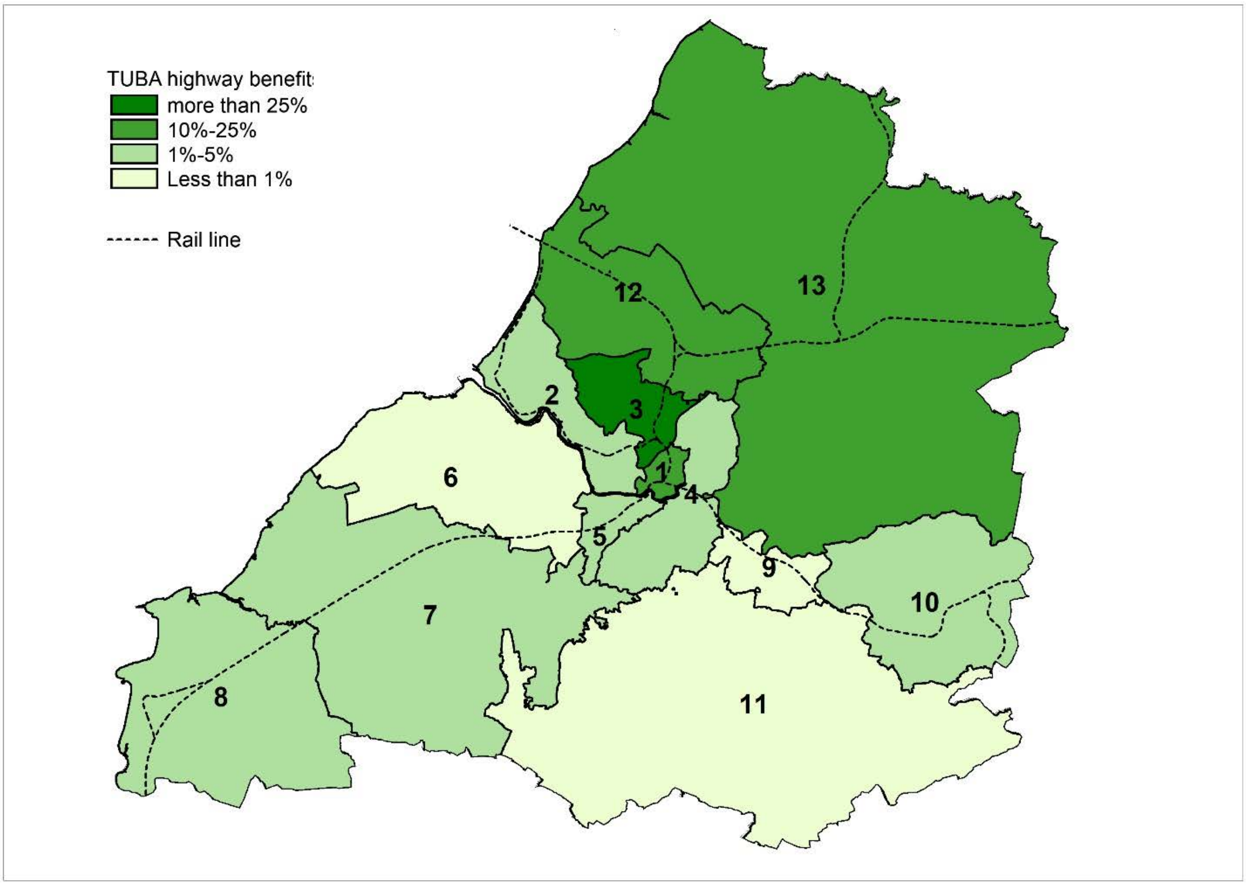

Figure 4-1: Spatial distribution of benefits – based on origin sector

5. Additional Option

5.1 Introduction

Analysis of the costs and benefits of the four scheme options considered through the Preliminary Business Case (PBC) indicated a need to consider alternatives, principally to understand whether the benefits of MetroWest Phase 2 could be achieved with an option that would cost less to deliver.

To this end, an additional option has been devised, based on option 1a. This option is very similar to option 1a, but with only one station on the Filton Bank between Stapleton Road and Filton Abbey Wood, instead of two. Constable Road is by far the most expensive station and it generates the fewest trips, therefore it was removed, so this new option (Option '1a_x') can be briefly described as follows:

Option 1a_x – additional option

- Re-opened Henbury line with hourly service operating as a spur from Bristol Temple Meads;
- New stations at Henbury, North Filton and Ashley Down; and
- Extension of existing service terminating at Bristol Parkway to Yate (providing a service of 2 trains per hour at Yate).

This chapter draws together the results of assessing this option, including new station demand forecasts and highway network impacts.

5.2 Demand forecasts

5.2.1 New stations

Methodology

The same forecasting methodology has been followed in assessing demand for new stations in this option as previously described (and followed) for assessment of the other four options. In outline, this includes consideration of catchments, distribution of trips, diversion of trips to the new stations, potential suppression of demand and future growth.

No differences are forecast between demand at Henbury and North Filton stations in option 1a, but changes have been made at Ashley Down. Apart from catchments though, which are discussed further below, all other elements have been treated in exactly the same way for Ashley Down in option 1a_x as the other options.

A key element of new station demand forecasts is the assessment of the potential station catchment population and employment, which is applied to the relationships between catchment and demand derived from other stations. Because of the close proximity of Ashley Down and Constable Road stations, allowance was made in the derivation of catchments for the interaction between the two stations (as well existing stations), as the four main options of the PBC all include both station operating together. However, in the additional option, Ashley Down would operate without Constable Road and, as such, revised forecasts for Ashley Down are required for operation as a single new station on the Filton Bank.

Demand and revenue

Headline results of demand forecasts for Henbury, North Filton and Ashley Down stations are shown in the tables for the additional option (1a_x). Table 5.1has 2021 (opening year) demand figures with 2031 figures in Table 5.2. [10] [11] [12]

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[10] Figures for Henbury and North Filton are included for completeness, but are the same as option 1a.

[11] Revenues are based on the mileage of distributed trips, assuming an overall £0.20 per mile average fare (which is derived from relevant information relating to journeys in the WoE area).

[12] Daily forecasts represent an 'average day', based on an annualisation factor of 315 (in turn based on analysis of data extracted from MOIRA). These values do not directly illustrate peak time, daily or weekly fluctuations in demand or seasonal variation, and incorporate future growth assumptions described earlier in the report.

Table 5.1: New stations demand forecasts – additional option – option 1a_x (2021)

Demand/revenue	Henbury	North Filton	Ashley Down	Constable Rd	TOTAL
Annual demand	98,850	92,300	100,850	-	292,050
Option 1a	98,850	92,300	89,400	37,700	318,250
Daily demand (average)	314	293	320	-	927
Annual revenue (£)	£348,200	£290,850	£235,000	-	£874,050

one-way journeys

Table 5.2: New stations demand forecasts – additional option – option 1a_x (2031)

Demand/revenue	Henbury	North Filton	Ashley Down	Constable Rd	TOTAL
Annual demand	178,050	173,200	155,750	-	507,000
Option 1a	178,050	173,200	138,000	58,250	547,500
Daily demand (average)	565	550	494	-	1,610
Annual revenue (£)	£627,050	£545,850	£362,850	-	£1,535,750

one-way journeys

Because Ashley Down is located close to a number of existing stations, derivation of its catchments has already taken account of the locations of other stations. Most trips are therefore forecast to be new to the railway, having been built-into the initial forecasts to a certain extent. As such, around 5% of demand at Ashley Down is assessed to have transferred from existing stations.

Table 5.3 shows future year forecasts from opening in 2021 to 2034 for option 1a_x, including annual and daily (average day) demand and revenue.

It is notable that Ashley Down as a stand-alone station (on the Filton Bank) attracts a greater usage than when operating in conjunction with Constable Road. Indeed, some 30% of the demand forecast for Constable Road with option 1a (11,500 of the forecast 37,750 trips per annum in 2021) is forecast to continue to use the railway, albeit via Ashley Down station instead. This is unsurprising given the proximity of the stations and overlapping nature of the catchments.

Catchment and access modes

Catchment and access mode of users of Ashley Down in the additional option are considered to be very similar to the figures outlined in Table 3.15 for option 1a (preliminary figures for illustration at this stage based on the 2021 demand forecasts). Although the quantum will be slightly higher as demand forecasts are larger, this indicates station users are relatively local to the station, and the rail services are likely to be mostly used for local journeys. However, these should not be taken as a definitive forecast of parking demand at this stage, and will be refined as development of MetroWest Phase 2 progresses.

5.2.2 Existing stations

Forecast increases in demand at existing stations are assumed to be the same for the additional option as for option 1a. There could be a marginal change to the timetable for Henbury line trains operating along the Filton Bank as a result of no longer stopping at Constable Road, but this has not been assessed for operational feasibility. As such, the analyses carried out tacitly assumes that the timetable would remain the same for option 1a as for option 1a_x.

Table 5.3: New station forecasts – demand and revenue by year – option 1a_x

Year	Henbury			Filton North			Ashley Down			Constable Road			
	Demand		Revenue £	Demand		Revenue £	Demand		Revenue £	Demand		Revenue £	
	annual	daily	annual	annual	daily	annual	annual	daily	annual	annual	daily	annual	
2014	-	-	-	-	-	-	-	-	-	-	-	-	
2015	-	-	-	-	-	-	-	-	-	-	-	-	
2016	-	-	-	-	-	-	-	-	-	-	-	-	
2017	-	-	-	-	-	-	-	-	-	-	-	-	
2018	-	-	-	-	-	-	-	-	-	-	-	-	
2019	-	-	-	-	-	-	-	-	-	-	-	-	<< MetroWest Phase 1
2020	-	-	-	-	-	-	-	-	-	-	-	-	
2021	98,850	314	£348,200	92,300	293	£290,850	100,850	320	£235,000	-	-	-	<< MetroWest Phase 2
2022	118,050	375	£415,700	111,300	353	£350,800	116,300	369	£270,950	-	-	-	
2023	131,750	418	£463,950	125,350	398	£395,100	125,600	399	£292,550	-	-	-	
2024	144,750	460	£509,700	138,450	440	£436,450	135,150	429	£314,900	-	-	-	
2025	149,850	476	£527,650	143,850	457	£453,350	138,150	439	£321,800	-	-	-	
2026	155,000	492	£545,900	149,300	474	£470,500	141,100	448	£328,700	-	-	-	
2027	160,200	509	£564,150	154,750	491	£487,800	144,050	457	£335,600	-	-	-	
2028	165,450	525	£582,700	160,350	509	£505,300	147,000	467	£342,450	-	-	-	
2029	170,700	542	£601,050	165,850	526	£522,700	149,950	476	£349,300	-	-	-	
2030	174,750	555	£615,400	169,950	540	£535,700	152,850	485	£356,100	-	-	-	
2031	178,050	565	£627,050	173,200	550	£545,850	155,750	494	£362,850	-	-	-	
2032	181,350	576	£638,600	176,400	560	£555,900	158,600	504	£369,550	-	-	-	
2033	184,600	586	£650,100	179,550	570	£565,900	161,450	513	£376,200	-	-	-	
2034	187,800	596	£661,400	182,700	580	£575,750	164,300	522	£382,750	-	-	-	

Note that growth is capped at 2034 levels for appraisal purposes

Growth from 2021…

	Henbury	Filton North	Ashley Down
2031	80%	88%	54%
2034	90%	98%	63%

5.3 Highway Network Impacts

The GBATS3 model has been used to assess the impact of the additional option (1a_x) on the highway network, using the same methodology as described in chapter 4 to assess the other options.

The change in rail and highway trips are shown in Table 5.4, which take into account increased rail demand at both new and existing stations. The proportion of additional rail trips that are forecast to switch from highway have been identified from the GBATS3 multi-modal assessment results, which vary by time period. Table 5.5 and Table 5.6 show the highway network operation for 2016 and 2031 respectively.

Table 5.4: Change in rail and highway trips

Change in rail/car demand (from do minimum)	2016				2031			
	Annual	Average day			Annual	Average day		
		AM	IP	PM		AM	IP	PM
Existing stations	98,050	39	22	44	151,350	105	60	122
Henbury	98,850	20	12	36	178,050	55	32	99
North Filton	92,300	13	8	24	173,200	36	21	66
Ashley Down	100,850	45	19	47	155,750	122	53	132
Constable Road	-	-	-	-	-	-	-	-
TOTAL	390,050	118	61	151	658,350	320	167	421
Option 1a	416,300	129	66	163	698,850	349	180	453
reduction in car trips		54	50	67		99	145	174
Option 1a		58	54	73		107	156	186

Source: RDM & GBATS3

Table 5.5: Do Something highway network operation – 2016

	Do minimum			Option 1a			Option 1a_x		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)	7338	4498	7025	7324	4492	7009	7323	4493.4	7014.7
Total Travel Time (pcu. hrs./hr.)	26409	18173	25918	26377	18160	25870	26403	18161	25880
Travel Distance (pcu. kms./hr.)	1114346	856032	1091845	1113748	855402	1091298	1113850	855594	1091404
Overall Average Speed (kph)	42	47	42	42	47	42	42	47.1	42
Total Trips Loaded (pcu/hr)	128148	105253	120262	128104	105216	120208	128108	105219	120212

	1a vs do min			1a_x vs do min		
	AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)	-0.2%	-0.1%	-0.2%	-0.2%	-0.1%	-0.1%
Total Travel Time (pcu. hrs./hr.)	-0.1%	-0.1%	-0.2%	0.0%	-0.1%	-0.1%
Travel Distance (pcu. kms./hr.)	-0.1%	-0.1%	-0.1%	0.0%	-0.1%	0.0%
Overall Average Speed (kph)	-	-	0.2%	-	-	0.2%
Total Trips Loaded (pcu/hr)	-0.0%	-0.0%	-0.0%	0.0%	0.0%	0.0%

Table 5.6: Do Something highway network operation – 2031

	Do minimum			**Option 1a**			**Option 1a_x**		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)	9999	6278	9483	9979	6250	9475	9981	6252	9472
Total Travel Time (pcu. hrs./hr.)	35635	23855	34845	35562	23805	34745	35595	23806	34759
Travel Distance (pcu. kms./hr.)	1332452	1076024	1310273	1331496	1074421	1308993	1331106	1074645	1308991
Overall Average Speed (kph)	37	45	38	37	45	38	37	45	38
Total Trips Loaded (pcu/hr)	151773	128979	142065	151694	128879	141937	151701	128887	141948
				1a vs do min			**1a_x vs do min**		
				AM	IP	PM	AM	IP	PM
Queues (pcu. hrs./hr.)				-0.2%	-0.4%	-0.1%	-0.2%	-0.4%	-0.1%
Total Travel Time (pcu. hrs./hr.)				-0.2%	-0.2%	-0.3%	-0.1%	-0.2%	-0.2%
Travel Distance (pcu. kms./hr.)				-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
Overall Average Speed (kph)				-	-	0.3%	-	-	0.3%
Total Trips Loaded (pcu/hr)				-0.1%	-0.1%	-0.1%	-0.0%	-0.1%	-0.1%

5.3.1 Highway benefits analysis

Similar to the other options, highway benefits have been identified using TUBA, based on results of the highway modelling reported above. Table 5.7 gives the TUBA highway benefits identified for the additional option (also including results for option 1a for reference). Spatial distribution of highway benefits is similar to option 1a. Appendix A presents the decongestion-related inputs in TEE format.

Table 5.7: TUBA highway benefits

Highway benefits (£'000s)	**1a**	**1a_x**
Commuting / Other user benefit	£20,467	£15,354
Business user benefit	£11,826	£8,335
Wider public finances (Indirect taxation revenues)	-£4,037	-£3,393
Greenhouse gases	£417	£417

6. Summary

6.1 Results

A methodology has been employed that makes best use of approaches accepted by the rail industry, in the form of a rail demand model, and the GBATS3 multi-modal model. The methodology is in accordance with both WebTAG and Guide to Railway Investment Projects (GRIP) demand forecasting requirements.

This report has presented:

- Rail demand forecasts for new stations;
- Highway network impacts; and
- Highway user benefits.

Demand forecasts indicate that around 320,000 passengers would use the proposed new stations at Henbury (99,000), North Filton (92,000), Ashley Down (89,000) and Constable Road (38,000) in the opening year. Slightly more trips would be generated with a loop service on the Henbury line than a spur service (less than 1% more).These values are forecast to rise significantly over time, both with general expected growth in rail use at all stations and the effects of the build-out of the CPNN on Henbury and North Filton.

Highway network impacts show a net present value of highway user benefits of between £28.6m for option 1a and £34.6m for option 2b. A net reduction in tax revenues, and consequent impact on fuel duty paid to the exchequer, of around £4m is expected due to reduced fuel consumption for options 1a and 1b, rising to over £5m for options 2a and 2b.

The rail forecasts for existing stations and rail user benefits are presented in the Network Rail Metro West Phase One Economic Appraisal Report.

The final combined economic appraisal results are presented in the Preliminary Business Case Report.

Additional option

Further analysis of an additional option based on option 1a (option 1a_x) indicate that opening year demand for an Ashley Down station would be higher without Constable Road station, at around 101,000 trips per annum.

Overall highway network impacts indicate slightly lower benefits than option 1a, with a commensurate reduction in the effect on tax revenues.

The final combined economic appraisal results for the additional option are presented in the Preliminary Business Case Report.

6.2 Further forecasts

Analysis of MetroWest Phase 2 in the Preliminary Business Case has focused on the key options, whether the Henbury line operates as a spur from Bristol Temple Meads or a loop via the Severn Beach line, and whether the Yate extension should include running services to Gloucester. Forecasting has followed suit. It is clear though from results of the forecasting, and subsequent economic analysis, that there will be a need to understand the forecasts in the context of issues that could drive demand as MetroWest Phase 2 is developed through the Outline Business Case.

As such, it is anticipated that sensitivity testing will form a key part of the demand forecasting and analysis of the option taken forward. This is likely to consider decremental testing of scheme options, as well as elemental drivers of demand such as fares, frequencies, journey times and catchments, but also future growth uncertainty and usage of the services and the ability of the trains to cope with demand.

Appendix A
TEE Table TUBA Highway Benefits

Option 1a

Economic Efficiency of the Transport System (TEE)
Highways only (£'000s)

Consumer - Commuting user benefits	All Modes	Road	
Travel Time	15,619	15,619	
Vehicle operating costs	4,857	4,857	
User charges	-10	-10	
During Construction & Maintenance	0	0	
NET CONSUMER - COMMUTING BENEFITS	**20,467**	**20,467**	
Consumer - Other user benefits	**All Modes**	**Road**	
Travel Time	0	0	
Vehicle operating costs	0	0	
User charges	0	0	
During Construction & Maintenance	0	0	
NET CONSUMER - OTHER BENEFITS	**0**	**0**	
Business	All Modes	Personal	Freight
Travel Time	10,484	6,510	3,973
Vehicle operating costs	1,332	338	994
User charges	11	8	2
During Construction & Maintenance	0	0	0
Subtotal	**11,826**	**6,857**	**4,970**
Private Sector Provider Impacts			
Revenue	0	0	
Operating costs	0	0	
Investment costs	0	0	
Grant/subsidy	0	0	
Subtotal	**0**	**0**	
Other business Impacts			
Developer contributions	0	0	
NET BUSINESS IMPACT	**11,826**		
TOTAL			
Present Value of Transport Economic **Efficiency Benefits (TEE)**	**32,293**		

Note: Benefits appear as positive numbers, while costs appear as negative numbers.
Note: All entries are present values discounted to 2010, in 2010 prices

Option 1b

Economic Efficiency of the Transport System (TEE)
Highways only (£'000s)

Consumer - Commuting user benefits	All Modes	Road	
Travel Time	15,886	15,886	
Vehicle operating costs	5,441	5,441	
User charges	-19	-19	
During Construction & Maintenance	0	0	
NET CONSUMER - COMMUTING BENEFITS	**21,309**	**21,309**	
Consumer - Other user benefits	**All Modes**	**Road**	
Travel Time	0	0	
Vehicle operating costs	0	0	
User charges	0	0	
During Construction & Maintenance	0	0	
NET CONSUMER - OTHER BENEFITS	**0**	**0**	
Business	All Modes	Personal	Freight
Travel Time	12,732	6,340	6,392
Vehicle operating costs	1,179	297	882
User charges	11	5	6
During Construction & Maintenance	0	0	0
Subtotal	**13,923**	**6,643**	**7,280**
Private Sector Provider Impacts			
Revenue	0	0	
Operating costs	0	0	
Investment costs	0	0	
Grant/subsidy	0	0	
Subtotal	**0**	**0**	
Other business Impacts			
Developer contributions	0	0	
NET BUSINESS IMPACT	**13,923**		
TOTAL			
Present Value of Transport Economic **Efficiency Benefits (TEE)**	**35,232**		

Note: Benefits appear as positive numbers, while costs appear as negative numbers.
Note: All entries are present values discounted to 2010, in 2010 prices

Option 2a

Economic Efficiency of the Transport System (TEE)
Highways only (£'000s)

Consumer - Commuting user benefits	**All Modes**	**Road**	
Travel Time	17,773	17,773	
Vehicle operating costs	6,961	6,961	
User charges	13	13	
During Construction & Maintenance	0	0	
NET CONSUMER - COMMUTING BENEFITS	**24,746**	**24,746**	
Consumer - Other user benefits	**All Modes**	**Road**	
Travel Time	0	0	
Vehicle operating costs	0	0	
User charges	0	0	
During Construction & Maintenance	0	0	
NET CONSUMER - OTHER BENEFITS	**0**	**0**	
Business	All Modes	Personal	Freight
Travel Time	8,751	4,890	3,861
Vehicle operating costs	1,638	321	1,316
User charges	4	18	-14
During Construction & Maintenance	0	0	0
Subtotal	**10,393**	**5,229**	**5,164**
Private Sector Provider Impacts			
Revenue	0	0	
Operating costs	0	0	
Investment costs	0	0	
Grant/subsidy	0	0	
Subtotal	**0**	**0**	
Other business Impacts			
Developer contributions	0	0	
NET BUSINESS IMPACT	**10,393**		
TOTAL			
Present Value of Transport Economic **Efficiency Benefits (TEE)**	**35,139**		

Note: Benefits appear as positive numbers, while costs appear as negative numbers.
Note: All entries are present values discounted to 2010, in 2010 prices

Option 2b

Economic Efficiency of the Transport System (TEE)
Highways only (£'000s)

Consumer - Commuting user benefits	All Modes	Road	
Travel Time	18,907	18,907	
Vehicle operating costs	6,506	6,506	
User charges	9	9	
During Construction & Maintenance	0	0	
NET CONSUMER - COMMUTING BENEFITS	**25,422**	**25,422**	
Consumer - Other user benefits	**All Modes**	**Road**	
Travel Time	0	0	
Vehicle operating costs	0	0	
User charges	0	0	
During Construction & Maintenance	0	0	
NET CONSUMER - OTHER BENEFITS	**0**	**0**	
Business	All Modes	Personal	Freight
Travel Time	12,412	8,508	3,904
Vehicle operating costs	1,575	398	1,177
User charges	5	8	-3
During Construction & Maintenance	0	0	0
Subtotal	**13,992**	**8,914**	**5,078**
Private Sector Provider Impacts			
Revenue	0	0	
Operating costs	0	0	
Investment costs	0	0	
Grant/subsidy	0	0	
Subtotal	**0**	**0**	
Other business Impacts			
Developer contributions	0	0	
NET BUSINESS IMPACT	**13,992**		
TOTAL			
Present Value of Transport Economic **Efficiency Benefits (TEE)**	**39,414**		

Note: Benefits appear as positive numbers, while costs appear as negative numbers.
Note: All entries are present values discounted to 2010, in 2010 prices

Option 1a_x (additional option)

Economic Efficiency of the Transport System (TEE)
Highways only (£'000s)

Consumer - Commuting user benefits	**All Modes**	**Road**	
Travel Time	10,970	10,970	
Vehicle operating costs	4,403	4,403	
User charges	-18	-18	
During Construction & Maintenance	0	0	
NET CONSUMER - COMMUTING BENEFITS	**15,354**	**15,354**	
Consumer - Other user benefits	**All Modes**	**Road**	
Travel Time	0	0	
Vehicle operating costs	0	0	
User charges	0	0	
During Construction & Maintenance	0	0	
NET CONSUMER - OTHER BENEFITS	**0**	**0**	
Business	All Modes	Personal	Freight
Travel Time	7,636	5,011	2,625
Vehicle operating costs	680	244	436
User charges	19	9	10
During Construction & Maintenance	0	0	0
Subtotal	**8,335**	**5,264**	**3,071**
Private Sector Provider Impacts			
Revenue	0	0	
Operating costs	0	0	
Investment costs	0	0	
Grant/subsidy	0	0	
Subtotal	**0**	**0**	
Other business Impacts			
Developer contributions	0	0	
NET BUSINESS IMPACT	**8,335**		
TOTAL			
Present Value of Transport Economic **Efficiency Benefits (TEE)**	**23,689**		

Note: Benefits appear as positive numbers, while costs appear as negative numbers.
Note: All entries are present values discounted to 2010, in 2010 prices