GMCA GREATER MANCHESTER COMBINED AUTHORITY

Bus Franchising in Greater Manchester Assessment

September 2019

Economic Case Supporting Paper

Economic Case Supporting Paper

Table of Contents

1 Overview ... 3
1.2 Document purpose ... 3
1.3 Document structure ... 4
1.4 Economic Case – Key Assumptions at a Glance ... 4
2 The Forecasting Framework ... 5
2.2 The Demand and Revenue Model (DRM) ... 5
2.3 The Financial Model (FM) ... 5
2.4 The Cost Benefit Analysis Model (CBAM) ... 8
2.5 The Greater Manchester Public Transport Model (GMPTM) ... 8
3 Establishing A Baseline ... 9
3.1 The Base Year ... 9
3.2 Base Year Demand - Overview ... 9
3.3 Demand Segments (Ticket Types) ... 9
3.4 Demand by Time Periods ... 10
3.5 Demand by Geography ... 10
3.6 Base Year Demand - Metrolink and Rail ... 11
3.7 Demand Based Derivation of Revenue ... 12
3.8 Base Year Market Supply ... 12
4 Establishing The Reference Case ... 12
4.2 Demand Model Functional Form ... 13
4.3 Explaining Changes in Reference Case Demand - Exogenous Variables ... 14
4.4 Explaining Changes in Reference Case Demand - Competing Modes Explanatory Variables ... 16
4.5 Explaining Changes in Reference Case Demand – Endogenous Explanatory Variables 18
4.6 Reference Case Summary ... 20
5 Establishing the Impacts of “Do Something” Interventions ... 21
5.2 Network Redesign Interventions ... 22
5.3 Fares Unification Interventions ... 23
5.4 Interoperability Interventions ... 24
5.5 Service Quality and “Soft” Factors Interventions ... 26
5.6 Lagged Responses ... 29
6 Economic appraisal framework ... 29
6.2 Valuing Improvements to the Passenger Experience ... 30
6.3 Valuing Economic Externalities ... 30
6.4 The Detailed Economic Appraisal ... 31
6.5 Value for Money for Public Investment - Derivation of the VfM Metrics ... 32
6.6 Alternative CBR Formulations ... 32
7 Wider economic impacts (WEIs) ... 36
7.1 The wider economic impacts (WEIs) of buses ... 36
7.2 Economic benefits to key centres ... 40
7.3 Net Wider Economic Impacts (WEIs) ... 40
8 Bibliography ... 43
9 Appendix 1 – DRM Assumptions and Parameters ... 44

10 Appendix 2 - Appraising the Transition Period 57
10.2 Data used 58
10.3 Results 58
11 List of amendments 60

List of Tables

Table 1: Key Economic Appraisal Assumptions 5
Table 2: Trip Classification – OD Logic 15
Table 3: Period Ticket Price Changes under the Franchising Option 23
Table 4: Interoperability Assumptions 26
Table 5: Summary of Values used for the Franchising Scheme 29
Table 6: Appraisal Results 31
Table 7: Impact on PVB, PVC and BCR 36
Table 8: WEI's – Net Impacts to GM 41
Table 9: WEI's – Net Impacts to the UK Economy 42
Table 10: WEI Summary Table 42
Table 11: Assumed Impact 2021 - 2024 57

List of Charts

Chart 1: The Forecasting and Appraisal Framework 7
Chart 2: Core Reference Case Forecasts 13
Chart 4: Reference Case Demand, Revenue and Operated KM 21
Chart 5: Patronage by Option across the Appraisal Period 22
Chart 6: Observed versus Backcasting Modelled GM Bus Market Demand 59

List of Figures

Figure 1: DRM Zone System 11

1 Overview

1.1.1 The purpose of the bus reform economic case is to test the social cost-benefit of public investment in the bus market. The economic case answers the question; "What is the value of intervening in the bus market?". This question is answered using a combination of micro-economic tools and techniques to assess economic value as well as macro-economic approaches that are intended to assess impacts of bus reform on the economic efficiency of the GM city region.

1.1.2 Public investment resources are scarce and it is therefore important to understand who is impacted, when and by how much. Cost impacts and to whom they fall are explained, as are the actors in society who attract economic benefits, both positive and negative.

1.1.3 The objectives for the bus system are grouped in the following 4 areas;

- Network
- Simplified and integrated fares
- Customer experience
- Value for money

1.1.4 The appraisal specification matches precisely the specification of the interventions which in turn are designed to further the strategic objectives for the bus system in GM. Quantification and monetisation during option development has helped optimise the extent to which strategic objectives are met. It is these optimised intervention options that are presented in the assessment.

1.1.5 The economic case is subject to uncertainty, but appropriate account has been taken of this through a programme of sensitivity tests. These tests suggest that the economic case presented for each option is a robust one.

1.2 Document purpose

1.2.1 This document explains the Economic Case in further detail than is appropriate within the Economic Case section of the Bus Reform Assessment.

1.2.2 It is intended to inform the reader of data inputs and assumptions, the approach to forecasting of impacts, and the monetisation of impact.

1.2.3 It covers the analysis undertaken to derive the Reference Case, as well as the analysis undertaken to appraise the "Do Something" options.

1.2.4 It covers the core economic case that is based on traditional "Welfare Economics" and which uses microeconomic techniques to appraise individual well-being (welfare) at the aggregate (economy-wide) level. It also covers the analysis of Wider Economic Impacts, a branch of econometric practice that employs Macro-Economic techniques to appraise changes to the efficiency of the economy.

1.2.5 All econometric analysis undertaken in support of the Bus Reform assessment has been performed with reference to best practice, in particular the guidance contained within DfT Web based Transport Appraisal Guidance (WebTAG).

1.3 Document structure

1.3.1 This document consists of the following sections:

i. ***The Forecasting Framework*** – this section describes the main components of the forecasting framework.
ii. ***Establishing a Baseline*** – this section describes how the baseline was established.
iii. ***Establishing a Reference Case*** – this section describes the derivation of the future year "Reference Case" or "Do Minimum" scenario.
iv. ***Establishing the Impacts of "Do Something" Interventions*** – this section describes how behavioural change or other impacts associated with intervention impacts have been forecast.
v. ***Economic appraisal framework*** – this section sets out the approach to monetisation of welfare benefits and assembly of the core economic appraisal. A detailed breakdown of impact is provided.
vi. ***Wider Economic Impact appraisal framework*** - this section sets out the approach to monetisation of macro-economic impacts at the GM and the UK levels.
vii. ***Appendix 1*** - provides more details of the assumptions and parameters that underpin the economic case.
viii. ***Appendix 2*** – has a detailed description of the approach to deriving economic benefits during the transition phase of the bus reform options.

1.4 Economic Case – Key Assumptions at a Glance

1.4.1 Table 1 is a quick reference guide that sets out key inputs underpinning the economic case. A more comprehensive table of appraisal parameters is set out in Appendix 1. Notes and data tables where appropriate.

Table 1: Key Economic Appraisal Assumptions

Parameter	Detail
Population and Employment	GMFM Based forecasts
Future Year Transport Baseline	Committed schemes only
Appraisal Period	30 Years
Benefits Decay assumptions	No decay
WebTAG Databook	V1.11
Fares Growth	RPI+1.4%
£Value	£2010 prices, Discounted
Labour Costs	RPI+0%
Base Year	Financial Year 16/17
Option Implementation	18 Months during 2021 to 2023

2 The Forecasting Framework

2.1.1 Chart 1 sets out the components of the framework and how they interact.

2.2 The Demand and Revenue Model (DRM)

2.2.1 The DRM is at the core of the forecasting framework. It is a spreadsheet based tool whose purpose is to;

i. establish a reference case forecast for the GM bus market
ii. forecast the impacts of interventions in the GM bus market

2.2.2 The DRM is an elasticity based model which pivots from base patronage according to user specified changes to one or more forecasting variables. A series of elasticities define the responsiveness of bus patronage to each forecasting variable.

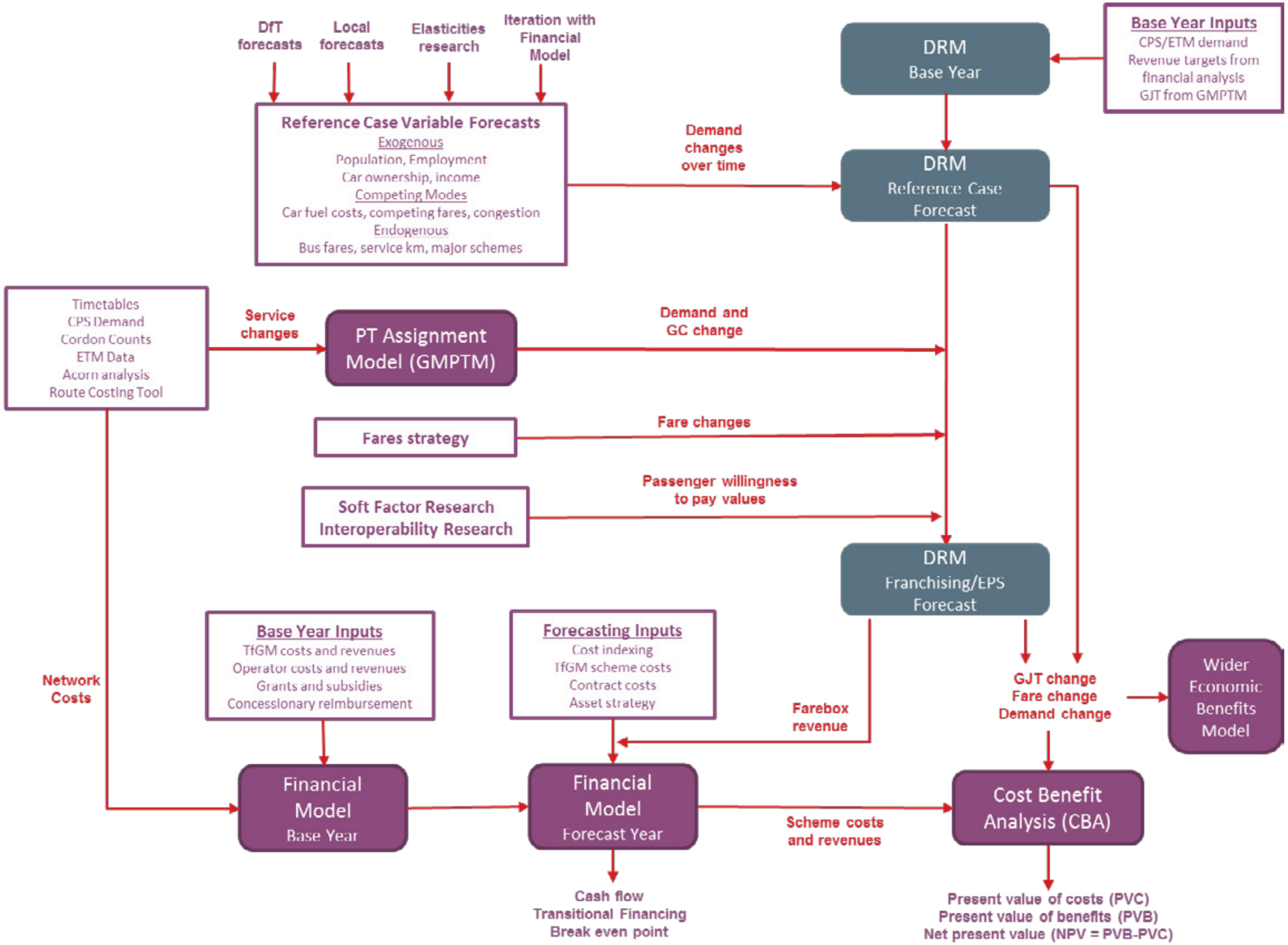
2.2.3 The Demand and Revenue Model (DRM) generates forecasts of bus demand over the full appraisal period from a base year of 2016/17. The forecasts are based on a number of user inputs including exogenous forecasts, competing mode forecasts, changes in fares, and changes to other components of the Generalised Cost of bus travel (including quality improvement measures, sometimes referred to as "soft measures"). The demand forecasts are used to generate Farebox revenue forecasts by applying average fares per trip. The model forecasts for each appraisal year individually, with the outputs from one year forming the inputs to the next.

2.3 The Financial Model (FM)

2.3.1 Outputs from the demand and revenue model are passed to the Financial Model for each forecast scenario. The Financial Model is fed ticket revenue, patronage and other supply side statistics (vehicle kilometres, hours and fleet size) from the Demand and Revenue Model.

2.3.2 The ticket revenue data is combined with other income sources such as concessionary reimbursement, tendered services etc, and the supply side statistics are used within the Financial Model to calculate operating costs. The Financial Model then creates financial forecasts in accordance with the requirements of the Financial Case, and which in turn are fed into the Economic Case Cost Benefit Analysis model.

Chart 1: The Forecasting and Appraisal Framework



2.4 The Cost Benefit Analysis Model (CBAM)

2.4.1 Cost, patronage fare and other generalised cost outputs from the DRM and FM from any two scenarios can be brought together into a separate cost benefit analysis model which calculates the incremental economic costs and benefits of a "Do Something" scenario when compared with an alternate, typically a Do Minimum or Reference Case scenario.

2.4.2 The derivation of economic costs and benefits follows standard industry practice for the appraisal of transport interventions as set out in the DfT Web Base Transport Analysis Guidance (WebTAG).

2.5 The Greater Manchester Public Transport Model (GMPTM)

2.5.1 Detailed modelling of network design changes was completed in GMPTM. GMPTM is TfGM's public transport assignment model and has been used to assess major schemes, including in support of Major Scheme business cases.

2.5.2 The GMPTM is used to assess the impact of network change scenarios. The work is based on the full Greater Manchester Area and considers potential changes to the network in terms of service design, coverage and service levels (frequency, operating periods and capacity). The modelled scenarios include restructuring to the network to address identified deficiencies. Major changes would be implemented during the course of the first franchise, but not on the commencement of franchising given that the changes take time to implement.

2.5.3 The outputs of the model are in the form of percentage changes in bus demand and Generalised Journey Time that can be transferred directly to the DRM.

2.5.4 Of note, the GMPTM model is the public transport assignment module of a larger 4 stage GM strategic transport model, the Greater Manchester Variable Demand Model. The other components of this model have not been used to appraise bus reform. However, variable demand forecasting (as defined within *WebTAG Unit M2* (DfT, 2019)) is required for the scale and typology of intervention under consideration. Functionality to reflect the variability in bus demand over time (through changes to trip production, distribution, and mode split) are incorporated within the DRM and these work in tandem with the detailed output from GMPTM to create a bespoke "Variable Demand" forecasting system that is fit for the specific purpose of the Bus Reform assessment.

3 Establishing A Baseline

3.1 The Base Year

3.1.1 A base year of 2016/17 has been used.

3.2 Base Year Demand - Overview

3.2.1 The development of the base year position has been undertaken using a variety of data sources that describe the demand for bus as well as the broader revenue and financial position.

3.2.2 Neither Bus Reform interventions, nor the response to those interventions, will be homogenous across the entire GM market. The construction of the baseline therefore reflects what is considered to be the most appropriate disaggregation of the market to ensure a sufficient level of detail is generated to enable an accurate representation of behavioural response, while simultaneously respecting the principles of proportionate appraisal.

3.2.3 The DRM is constructed to pivot sequentially year on year from this base year position and to generate demand and revenue forecasts disaggregated by:

- Demand Segment
- Time Period
- Geography

3.2.4 The baseline is therefore established in these dimensions.

3.3 Demand Segments (Ticket Types)

3.3.1 Ticket types are used to segment demand. Response to intervention varies between different demand segments and this disaggregation of response is a component of the functionality of the DRM.

3.3.2 The ticket types in the DRM cover both ticket held and journey purpose as well as operator type (First, Stagecoach, Other and SYSTEM 1). Of note, "SYSTEM 1" is not an operator but is described as such for the purpose of disaggregating ticketing demand in the DRM. Adult period tickets are split into commute and other segments to allow different elasticities to be applied to each. All commute trips are assumed to be on adult period trips. The full list of ticket types or segments is:

- Adult single;
- Adult period commute;
- Adult period other;
- Child single;
- Child period;

- Child school;
- Youth single;
- Youth period;
- Concessions; and
- Other free.

3.3.3 Period tickets include all tickets where multiple journeys can be made, including daily, weekly and monthly tickets.

3.4 Demand by Time Periods

3.4.1 The time periods used in the model are:

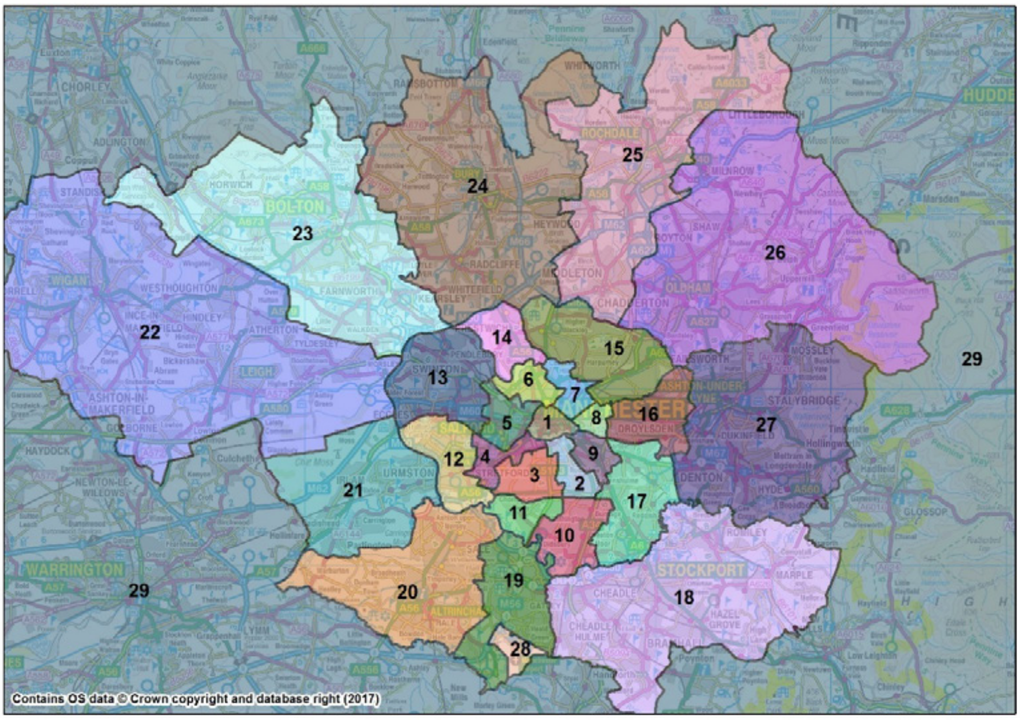
- Weekday AM peak: 0730-0930;
- Weekday Inter peak: 0930-1600;
- Weekday PM peak: 1600-1830;
- Weekday Off peak: 1830-0730;
- Saturday all day; and
- Sunday all day

3.4.2 These periods were selected to be consistent with other components of the analysis framework including both the updated network model, GM-PTM, and the network costing model used in the network planning workstream. Splitting demand by time period allows different impacts to be applied in different time periods, for example the impacts of increasing congestion will be different at different times of day, and network interventions as a result of franchising could be different, such as removing services from the peak periods to improve off peak services.

3.5 Demand by Geography

3.5.1 A 29 sector system has been used, allowing enough detail to model the different spatial impacts of interventions on different corridors. A map of the sector system is shown in the following figure.

Figure 1: DRM Zone System



3.5.2 In summary, passengers are sensitive to changes in total Generalised Journey Time (GJT) and (ceteris paribus) will make more trips if it reduces and less if it increases. GJT includes the following components:

i. In vehicle time;
ii. Wait time;
iii. Walk time; and
iv. Interchange penalty.

3.5.3 The components of GJT are extracted from the GM-PTM network model and demand weighted to the 29 zone "Origin Destination" sector system used in the model. Interoperability considerations have been reflected in the calculation of the wait time component of the GJT.

3.5.4 The GJT skim from the base year GMPTM is scaled over time in the DRM to reflect supply changes that occur in both "Do Minimum" and "Do Something" options.

3.6 Base Year Demand - Metrolink and Rail

3.6.1 The DRM includes a representation of Metrolink and rail demand. Base year Metrolink and Rail demand are disaggregated by time of day and by DRM zone pair.

3.6.2 The DRM does not itself forecast Metrolink and rail demand. A base year matrix is linked to a set of annual growth factors to enable a representation of rail and Metrolink demand to be created for the reference case. Sources are detailed in the model assumptions log.

3.6.3 This data enables demand and revenue changes in these competing modes to be calculated in response to bus reform interventions.

3.7 Demand Based Derivation of Revenue

3.7.1 Revenue is calculated by applying average fares per trip to each of the ticket, operator and person type categories.

3.8 Base Year Market Supply

3.8.1 There is an iterative relationship between supply and demand over time in this market as in all markets. Demand responds to changes in supply, but there is also a more fundamental relationship that will ensure supply and demand are somewhat in balance over the long term.

3.8.2 These supply and demand relationships are reflected in the Bus Reform assessment and require the DRM to contain supply side information.

3.8.3 For the base year, total vehicle kilometres and hours were derived from TfGM's EGIS database and converted to hours using data from the Greater Manchester Public Transport Model, GM-PTM. Fleet totals were taken from data held by TfGM on fleet submissions by operators.

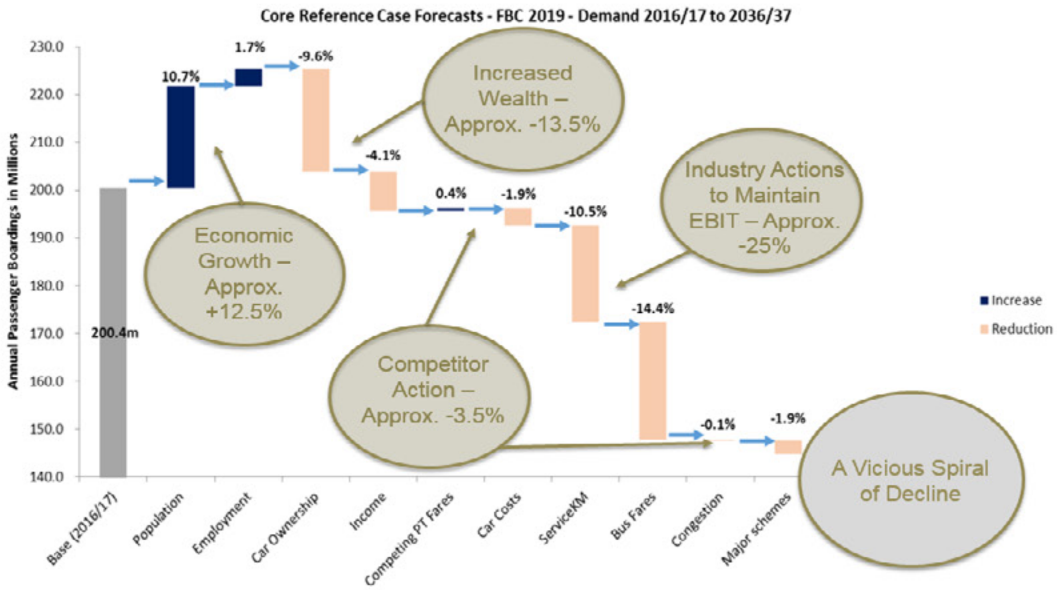
3.8.4 Total vehicle kilometres, hours and fleet size for each operator group in the DRM (First, Stagecoach and Other) are passed from the DRM to the Financial Model for the purposes of calculating operating costs.

4 Establishing The Reference Case

4.1.1 This section sets out the way in which the reference case has been established. In so doing, it describes the form of the demand forecasting model that is embedded within the DRM. This model is also used to assess the impact of bus reform interventions. As such, there is some overlap with the subsequent section which sets out how the impacts of the interventions have been established.

4.1.2 The following chart summarises the Reference Case output of the model. It shows how much impact each of the explanatory variables contained within the model is forecast to have on bus market patronage by 2036/37.

Chart 2: Core Reference Case Forecasts



4.1.3 To better understand the basis of this forecast, this section sets out;

- The mathematical form of the demand and revenue model.
- Detailed description of each of the explanatory variables and information relevant to their use in the forecasting model.

4.2 Demand Model Functional Form

4.2.1 The demand model forecasts changes in demand and resulting fare box revenue over time based on changes in a number of explanatory variables as detailed in the following sections.

4.2.2 Demand changes are driven by elasticities which explain how sensitive bus demand is to each explanatory variable. The demand in any year is forecast by pivoting from the demand in the previous year and applying any changes specified in the model. In its simplest form, the DRM has the following demand equation:

$$D_n^{ijTX} = D_{n-1}{}^{ijTX} \times \left(\frac{F_n^X}{F_{n-1}^X}\right)^{\alpha_{own}} \times \left(\frac{F_n^Y}{F_{n-1}^Y}\right)^{\alpha_{cross}} \times \left(\frac{GJT_n^{ijT}}{GJT_{n-1}^{ijT}}\right)^{\beta} \times \left(\frac{Ext^{1,2,3}{}_n}{Ext^{1,2,3}{}_{n-1}}\right)^{\gamma_1,\gamma_2,\gamma_3} \times \left(\frac{CM^{1,2,3}{}_n}{CM^{1,2,3}{}_{n-1}}\right)^{\delta_1,\delta_2,\delta_3} \times Z_n$$

Where:

D_n^{ijTX}	is the demand in the current forecast year between origin sector i, destination sector j, in time period T for ticket type X;
D_{n-1}^{ijTX}	is the demand in the previous year;
F_n^X	is the fare in the current year for ticket type X;
GJT_n^{ijT}	is the fare in the current year for competing ticket type Y;
$Ext^{1,2,3}{}_n$	is the generalised journey time by bus between origin sector i and destination sector j, in time period T;
$CM^{1,2,3}{}_n$	are a set of external, exogenous variables;
Z_n	is an explicit demand change to be applied in year n (eg the opening of the Trafford Line Extension prompts a one off demand adjustment to bus, the scale of which is forecast elsewhere) ; and
$\alpha, \beta, \gamma, \delta$	are elasticities of bus demand to each of the explanatory variables

4.2.3 The following sections describe each set of inputs to the DRM, how each input is used and key assumptions. Reference is made to the model assumptions book and supporting documentation, which include more detail.

4.3 Explaining Changes in Reference Case Demand - Exogenous Variables

4.3.1 Bus demand is sensitive to the following exogenous variables:

i. population;
ii. employment;
iii. car ownership; and
iv. income.

4.3.2 This set of exogenous explanatory variables was recommended by Professor Mark Wardman, who is an expert in the field of transport demand forecasting and appraisal. The elasticity values were tested (alongside all other variables) in a back casting exercise which suggested a good fit with observed data. The elasticities used are detailed in Appendix 1.

4.3.3 To maintain temporal consistency with all the other datasets that have been used to baseline the assessment, the population and employment forecasts pivot from observed 2016/17 data. The out turn for 2016/17 is different to that in the Greater Manchester Forecasting Model (GMFM) or National Trip Ends Model (NTEM). As such, the following approach has been used;

i. The forecasts pivot from 2016/17 out turn data.
ii. In the shorter term (to 2025) the forecasts are controlled to GMFM and use TAG "2 levels of certainty" for distribution purposes. GMFM Baseline totals are used as controls up until 2025.
iii. In the longer term, totals are controlled to NTEM Growth rates (beyond 2025).

4.3.4 In addition, population forecasts are split demographically between child, young persons (16-21), adult, and concessions so that demand in each of these categories can be driven by population changes specific to that group. The adult and concessionary population forecasts were adjusted to reflect the increasing entitlement age for concessionary travel, in effect reducing the concessionary population between 2016/17 and 2020/21.

4.3.5 The DRM includes functionality to enable the spatially and demographically disaggregated nature of the population and employment forecasts for each model zone to be reflected in the generation of the future year reference case (and subsequent "do something" options). Trip rates by demographic and geography are not uniform and therefore this disaggregation is an important component of the DRM functionality.

4.3.6 Where trips span two geographies (an origin and destination) with divergent characteristics, the following logic is applied to "assign" the trip as belonging to either the origin or destination end.

Table 2: Trip Classification – OD Logic

JOURNEY PURPOSE	FROM-HOME	TO-HOME
Commute	Destination Employment	Origin Employment
Other	Origin Population	Destination population

4.3.7 Eg - For commute trips, the employment growth is the driver of demand growth, so for from-home trips, the employment growth at the destination (work) end of the trip is used, and vice-versa.

4.3.8 Since the DRM does not split demand by from-home and to-home purposes (since CPS does not record this information and the disaggregation would require some loss of detail in other areas of the model) a set of from-home proportions have been derived from the Greater Manchester Area Transportations Survey (GMATS). The factors have been calculated separately for trips to and from the city centre, and elsewhere. The figures were adjusted to account for interchanging in the city centre, since some people may be travelling to the city centre but then switching to a different bus or different mode and travelling out of the city centre again, and therefore the city centre growth rates should not apply.

4.3.9 There is large growth planned for the Regional Centre in terms of both housing and jobs and some of the people taking up the new jobs will decide to both live and work in the city centre. This is a growing trend and already accounts for about 50,000 residents/workers where 20 years ago there were almost none. People who choose to both live and work in the city centre are very likely to walk to work. To account for their lower bus usage, the model uses an adjustment factor, which works by factoring down the number of jobs and residents. This factor was derived from analysis of 2011 census journey to work data. Further detail is provided in the model assumptions book and supporting documentation.

4.3.10 The car ownership and income forecasts are specified for Greater Manchester as a whole, and are therefore applied equally to all DRM zone pairs.

4.3.11 The car ownership forecast was taken from DfT's TEMPRO software. The income forecast was purchased from the Centre for Economics and Business Research (CEBR).

4.4 Explaining Changes in Reference Case Demand - Competing Modes Explanatory Variables

4.4.1 The DRM is sensitive to the following competing mode variables:

- competing public transport fares;
- car fuel operating costs;
- car journey times;
- Congestion; and
- Major Schemes.

4.4.2 The first three variables are specified at the Greater Manchester level and are applied equally to all sector pairs. However, the responsiveness of bus patronage to these competing mode variables is clearly different depending on the nature of the journey being undertaken. For instance, a trip which is more likely to be competing with other public transport modes (for example trips to and from Manchester city centre) will be more sensitive to competing public transport fares than to car fuel operating costs and car journey times. For this reason, the elasticities of bus patronage to each of these three variables is specified using a 3x3 sector system consisting of:

- Manchester city centre;
- Inside M60; and
- Outside M60.

4.4.3 There are also a set of GM wide elasticities which are used for the segments in the DRM which do not have geographical disaggregation.

4.4.4 Of note, competing mode fares have no impact on concessionary trips since this market can also travel for free on other PT modes in Greater Manchester.

4.4.5 Metrolink fares are assumed to reduce in real terms in the first year of the forecast (2017/18) to reflect the corresponding freeze to Metrolink fares in nominal terms. A three year increase of RPI+2.33% was then assumed to reflect the most recent fares policy, followed by a long term trend of RPI+1%. Rail fares were assumed to increase in line with RPI for 3 years, in line with the current government's fares policy, and then at RPI+1% thereafter. The average of these two trends was used in the model.

4.4.6 Changes in car fuel costs were obtained from the *DfT WebTAG Databook v1.11 table A1.3.7* (DfT, 2018a), which is based on changes in fuel price forecasts published by the Department for Business, Energy & Industrial Strategy, and adjusted to reflect forecast improvements to vehicle efficiency over time.

4.4.7 Changes in car journey time are derived from forecasts from the Greater Manchester Variable Demand Model (GM-VDM). They are separate for each time period to reflect the different changes in journey times forecast at different times of day.

4.4.8 The DRM allows a separate annual trend in bus journey times for each time period, as opposed to car journey time, to reflect the impacts of congestion. Bus in-vehicle time (an element of GJT) is assumed to change in proportion to this trend. The changes are different for each time period to reflect the fact that some time periods are more congested than others, so for example in the off-peak periods it is unlikely that bus journey times will increase despite the additional traffic in the future, since the network is nowhere near capacity at this time of day. The change in GJT results in a demand response in the DRM by applying the GJT elasticity.

4.4.9 The change in journey time also has a direct impact on the total vehicle hours and fleet size, which are passed to the Financial Model to calculate operating costs. These are assumed to change in proportion to the bus journey time index, i.e. if bus journey time increases on average 5%, then PVR and vehicle hours will also increase 5%. It should be noted that this does not affect the total vehicle kilometres, which are assumed to remain fixed whilst the time increases. In other words the average bus speed reduces due to the increased congestion.

4.4.10 The trend in forecast bus journey times was obtained from outputs from GMVDM (as used for car journey times) and adjusted to be bus specific using outputs from the DfT's National Transport Model which forecasts a separate bus and car trend.

4.4.11 Finally, forecast changes to patronage of bus in response to investments in competing modes have been extracted from the business cases for two committed Metrolink investments. These schemes will abstract patronage from the bus network and as such, their impact has been reflected in the future year reference case forecasts created by the DRM;

- Impact of the Trafford Park Extension
- Impact of the purchase of additional trams through the Transforming Cities Fund

4.5 Explaining Changes in Reference Case Demand – Endogenous Explanatory Variables

4.5.1 The following endogenous explanatory variables are included in the demand model;

i. Bus Fares
ii. Bus Network Size (service km)

4.5.2 These components of the demand model reflect changes to the generalised cost of bus travel in GM.

4.5.3 Changes in bus fares are specified separately for each operator (used for operator own ticket categories) and for System One multi-operator tickets. They are also specified separately for each ticket type and for discount and non-discount corridors.

4.5.4 Changes in fares result in a demand change by applying the fare elasticities as shown in the demand function. Functionality is included in the model to allow patronage on single tickets to be sensitive to the price of period tickets (as well as the price of single tickets themselves) and vice-versa. This is achieved via the use of cross elasticities which describe how sensitive demand is to the price of a competing ticket, as well as how sensitive that demand is to the price of its own ticket. This functionality was primarily included for the purposes of modelling fares changes under franchising, when period fares change price but single fares do not. The cross elasticities were derived such that when changes in both single and period tickets are the same, the change in patronage forecast by the DRM is consistent with that forecast by the model before the cross elasticities were included. The own and cross fare elasticities are included in Appendix 1.

4.5.5 Concessionary fare passengers are not affected by fares changes in the DRM. Behavioural fares elasticities are also not applied to the "Other Free" segment of passengers, which is a combination of miscellaneous non-fare paying passengers including children under 5, holders of staff passes, and other "free rides".

4.5.6 A long-term increase in fares of 1.4% per annum above RPI was assumed for all ticket types in the Reference Case. This figure was obtained during an iterative calibration exercise between the DRM and the Financial Model seeking to balance operator revenues and costs assuming a plausible profit margin, and reflective of a realistic balance between fares revenue and operating costs (service km operated).

4.5.7 The assumptions on the scale of the network and the changes to fares in the reference case come from an heuristic, iterative, modelling process. As the initial reference case forecasts showed a decline in patronage and revenue, it was assumed that the loss of revenue would mean that operators would need to maintain profitability through a combination of increases to fares and cuts to the network. An initial assumption was made that fares would increase at 1.4%, as this was in line with the historic trend, (and increases at this level would increase revenues relative to the declining market). The first reference case showed decline in patronage of approximately 25%, but also an associated financial forecast that showed a steep decline in margin. Operators would have a choice of accepting low or negative margins long term, raising fares further above inflation or reducing the network. It is assumed that long term the network would be reduced at a 1:1 ratio with patronage, reducing their costs and increasing profitability, but also leading to a knock-on effect on patronage.

4.5.8 However, applying this still left operators with a profitability position that it is assumed they would not accept long term. A number of sensitivity tests were undertaken to determine the mostly likely trajectory that would maintain the financial health of the market while not excessively damaging patronage. The outcome was a steeper decline in the network relative to patronage in early years and then a reversion to the longer term 1:1 trend, with fares increases remaining at RPI +1.4%. While it is not possible to say with absolute certainty that this would be the optimal position, as historically operators have raised fares above inflation but not far above RPI+1.4%, and as operators have recently reduced the network more steeply than the 1:1 relationship would allow, it was concluded that this was a reasonable reference case assumption.

4.5.9 For the period up to FY 2019/20, the DRM replicates observed changes in bus fares by applying the real change in fares (net of RPI) rather than the standard 1.4%. These are calculated based on changes in actual ticket prices averaged using the shares of each ticket.

4.5.10 Changes to the network in terms of total service kilometres per annum for each operator will also affect demand and functionality is included within the DRM to model this. This functionality is designed predominantly to allow for the assessment of global network changes where the exact detail of the changes is not known.

4.5.11 There are two components to this functionality;

i. A change to the size of the overall network will have a pro-rata similar impact on service kilometres, hours and fleet size. This information is passed from the DRM to the Financial Model (FM) and used to calculate operating costs in the FM; and
ii. A change in service operated will affect patronage and revenue and this impact is calculated directly within the DRM.

4.6 Reference Case Summary

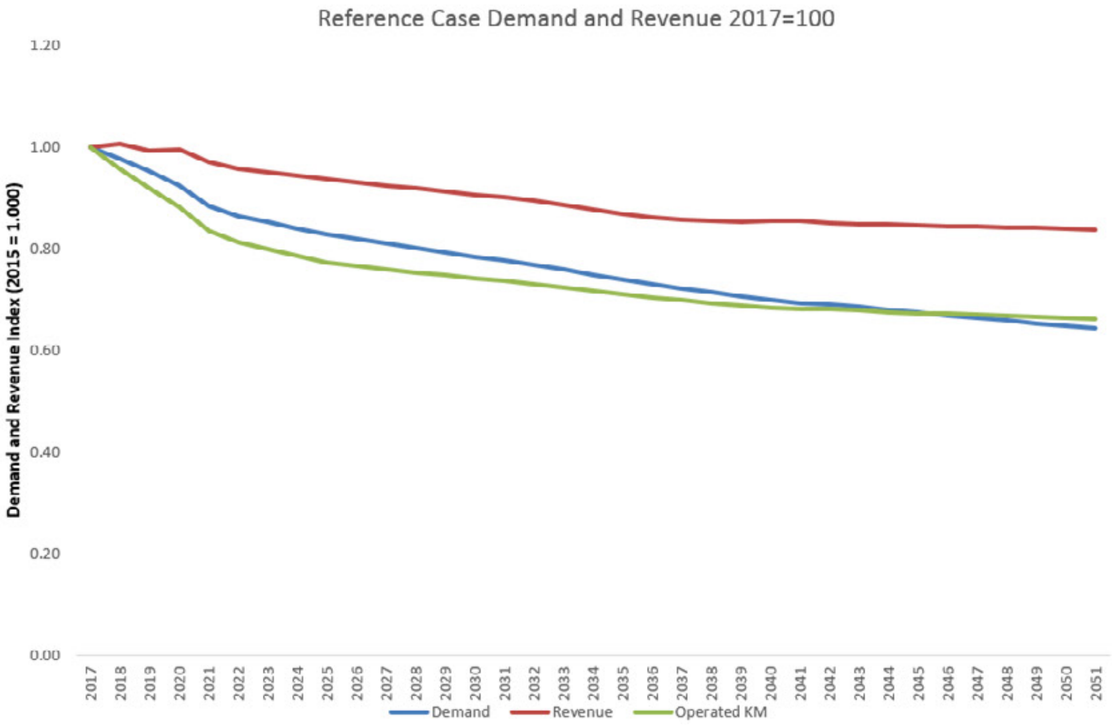
4.6.1 Despite the macro economic growth of GM, the bus market is assumed to decline in the years ahead.

4.6.2 Using economic language, the Generalised Journey Costs of bus travel will increase. In everyday language, that means the service passengers can expect to receive will get worse, providing a compelling economic reason for intervention in the bus market.

4.6.3 The quantified impact of each explanatory variable is explained at the start of this chapter.

4.6.4 The overall decline forecast throughout the appraisal period is described in the following chart.

Chart 3: Reference Case Demand, Revenue and Operated KM



4.6.5 The basis of the "Do Something" forecasts is the subject of the next section of this supporting paper.

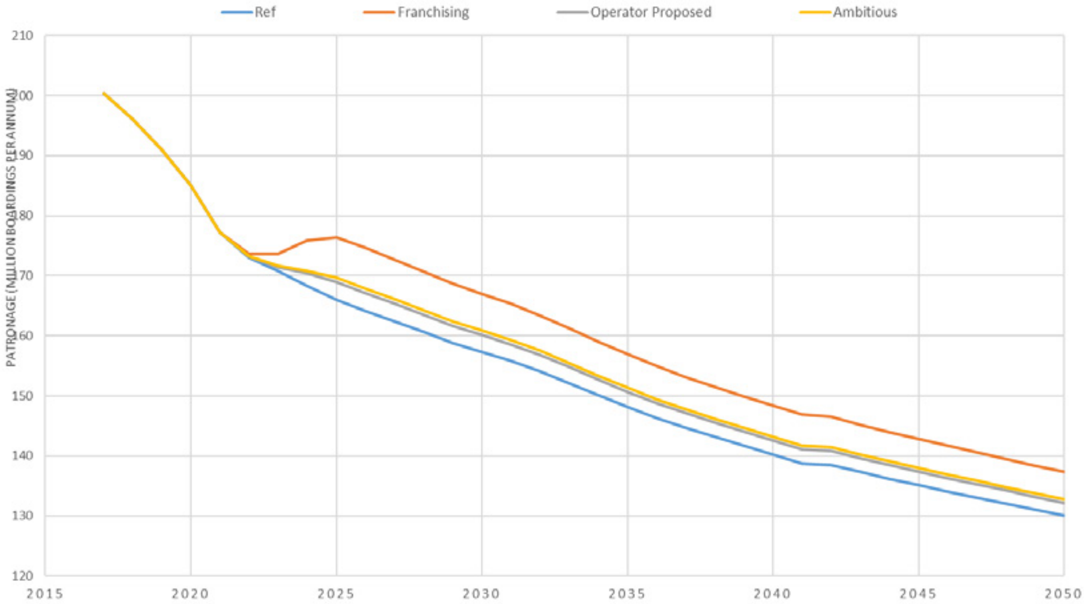
5 Establishing the Impacts of "Do Something" Interventions

5.1.1 This section sets out the way in which the "Do Something" impacts have been established.

5.1.2 The "Do Something" interventions primarily impact the Generalised Costs of travel, and it is that component of the demand model embedded within the DRM that is used to forecast behavioural response to "Do Something" interventions.

5.1.3 The following chart summarises the "Do Something" patronage trend over the appraisal period when compared with the Reference Case.

Chart 4: Patronage by Option across the Appraisal Period



5.1.4 The following sections set out the basis of these forecasts in the following areas:

- Network Design
- Fares Unification
- Interoperability
- Service Quality and "Soft" Factors

5.2 Network Redesign Interventions

5.2.1 In addition to forecasting the impacts associated with global network changes as described in section 4, the DRM has interface functionality with the GMPTM which allows the user to test detailed network changes in the GMPTM and derive a set of Generalised Cost and Demand changes that can then be aggregated and transferred to the DRM. These are then used within the DRM to update demand and revenue.

5.2.2 This functionality has been used to model the impacts of the changes proposed under franchising or partnership. No specific network changes (other than global reductions in operated km across the network) were specified within the Reference Case and therefore this functionality has only been used to test the network redesigns proposed under the 3 options.

5.2.3 The inputs to the DRM are a percentage change in bus, Metrolink and rail GJT and users for each DRM zone pair. The percentage factors are applied to the baseline demand in the DRM. The generalised cost change is also passed to the cost benefit analysis model in order to calculate user benefits associated with the network improvements.

5.2.4 For the franchising and partnership options, network changes were specified route by route for each time period.

5.2.5 More recently, the rate of change in the GM bus market has been exceptional and the extent to which the same level of resource is now available to reallocate and improve network efficiency has reduced significantly.

5.2.6 As such, a review of the network proposals was carried out to determine whether or not the proposed changes (which were based on a 2015 network) are still possible in today's market, given the contraction of the network since 2015. The conclusion was that the scope for redesigning the network had reduced to 26% of its original potential.

5.3 Fares Unification Interventions

5.3.1 Under franchising, it is assumed that operator own period tickets will cease to exist and all passengers will buy a new "all service" period ticket (equivalent to the current System One ticket but cheaper). It would be priced at the level of the lower of the two major operators own period fares.

5.3.2 The changes in period fares used within the appraisal were derived from a review of current fares undertaken during spring 2019. The changes derived from this review are shown in the following table.

Table 3: Period Ticket Price Changes under the Franchising Option

	DAILY	WEEKLY	MONTHLY	WEIGHTED AVERAGE
First	0%	0%	0%	0.0%
Stagecoach	0%	0%	-3%	-0.4%
Other	2%	-1%	9%	1.4%
System One	-17%	-16%	-15%	-15.9%

5.3.3 System One trips have the largest fare reduction as their ticket price reduces to come into line with current First own fares. These changes are applied to standard period fares in addition to the 1.4% annual increment.

5.3.4 Fares for discount corridor trips and single ticket trips do not change (relative to the reference case) under franchising.

5.3.5 Under the two partnership options, operator own period fares are assumed to be retained with no price difference relative to the reference case. However, the operators have said they will freeze System One prices for two years following a review, and this has been appraised as a two year fare freeze from Day 1 of the Partnership option for System One tickets. This results in a reduction in fare for those tickets relative to the reference case. This freeze was modelled in the DRM by implementing a real terms fare reduction (in line with RPI) for two years at the beginning of the partnership in place of the standard assumption of RPI+1.4%. All operator own tickets remain unchanged relative to the reference case.

5.4 Interoperability Interventions

5.4.1 Many existing ticketing products tie passengers to the services of a single operator. For many passengers, this does not matter as they would only want to use the services of that operator. However, for many other passengers, it is inconvenient to be tied to a single operator in this way. They may not be able to catch the first bus that turns up on corridors where operators share freehold sections of route, and in other circumstances, passengers may have to pay additional fares.

5.4.2 The DRM has a separate input to represent the impacts of bus passengers being able to use all buses rather than those of a single operator, a component of the Franchising option specification. Currently holders of operator own period tickets can be restricted in their choice of bus as they can only use buses of the operator from whom they bought their ticket. Under franchising, all passengers will be able to use all buses and in some cases this will result in a wait time or journey time improvement, as well as a wider choice of available services and destinations.

5.4.3 Research undertaken for the Bus Reform project derived a Willingness to pay valuation for this intervention.

5.4.4 The DRM has functionality to input these willingness to pay values. Separate values can be input for each sector and these are applied based on the origin sector of the trip.

5.4.5 The DRM calculates a demand response to the willingness to pay values by deducting the willingness to pay value from the appropriate fare and applying the fare elasticity. However this “change in fare” is not deducted from the fare that is stored within the model, since that would yield a false change in revenue.

5.4.6 The willingness to pay value is then converted to units of time and deducted from the GJT stored in the DRM. This method yields a benefit value to be calculated in the cost benefit analysis model. This GJT change is not used to generate a further demand response in the DRM (since that has already been calculated using the fare elasticity).

5.4.7 The willingness to pay values are built up by combing a within route benefit and a GM wide benefit. The within route benefit represents an improvement to a passengers current service along the corridor they are current travelling within. The GM wide benefit represents the benefit associated with being able to use their ticket across a wider geographical area due to it being interoperable, i.e. being able to travel to different destinations. Separate willingness to pay values were obtained for each of these in the study.

5.4.8 In addition, it is also possible to specify for each sector pair what percentage of the benefit should be applied. This is to model two separate concepts:

i. GM wide interoperability benefit should not be applied to passengers holding a ticket which restricts them to a subset of services, e.g. within a certain corridor; and
ii. Within route interoperability benefit should not be applied to passengers making trips for which there would be no benefit of having an interoperable ticket, i.e. where there is currently no competition between operators.

5.4.9 For GM wide interoperability, these percentages were calculated by analysing ticket sales in the CPS dataset to calculate the proportion of tickets purchased at the “standard” full fare price, compared to those at discounted prices which represent corridor or service specific discount tickets. This exercise was carried out separately for adult and child tickets to avoid any confusion between full price child tickets and discount adult tickets.

5.4.10 For within route interoperability, a number of services of specific corridors were identified by TfGM experts that were deemed to have significant competition between operators, and hence are in scope for within route interoperability benefits. The proportion of trips on each DRM zone pair using these services was calculated from CPS data.

5.4.11 For the Operator Proposed partnership option, no interventions are contained in the proposal. For the Ambitious Partnership option, within route benefits are assumed to be calculated in the same way as for franchising, i.e. there would be some agreement between operators to allow use of each other’s tickets on specific corridors with competition, but it is assumed that this would be applicable to a more limited geography than is the case for the Franchising option.

5.4.12 It should be noted that the interoperability willingness to pay values are only applied to trips made using operator own period tickets, reflecting the fact that single ticket users, multi-operator ticket holders and concessionary travellers are not tied to a specific operator; they can already use any bus. The following table summarises the assumptions for franchising and partnership.

Table 4: Interoperability Assumptions

INTEROPERABILITY TYPE	FRANCHISING	PARTNERSHIP (BOTH CASES)
Within Route	Applies only to subset of passengers with operator own period tickets on corridors with sufficient competition	None for OPP option. Limited geographic coverage assumed for AP option.
Network wide	Applies to passengers purchasing full price “standard” operator own period tickets	No benefits

5.5 Service Quality and “Soft” Factors Interventions

5.5.1 Improvements to service quality (also known as soft factors) have been specified. The impact is forecast within the DRM by entering a GJT equivalent value to represent the intervention.

5.5.2 The following interventions have been assessed in this way;

i. Improved driver standards
ii. Accelerated roll out of Wi-Fi
iii. Improved security due to additional ticket inspectors
— Resource to improve Performance Management and Customer Service
iv. The value of a unified system and brand

5.5.3 Improvements can be applied globally or specified for each year and user segment within the DRM. The project specification for each intervention (in terms of scope and timing) has been broadly replicated within the DRM.

5.5.4 Improved Driver Standards are the results of investment in additional driver training and customer service awareness. This is expected to create a step change improvement in the quality of service offered. A Willingness to Pay valuation for this improvement was derived from passenger survey work. For the purpose of bus reform appraisal, it is assumed that 50% of this benefit will be realised and it is this level of improvement that has been included within all reform options.

5.5.5 Wi-Fi benefits are expected to taper from 20% of passengers benefitting to 0% after 10 years as the benefit of accelerating the roll out diminishes and the provision of Wi-Fi on the bus fleet in the “Reference Case” is assumed to “catch up” – this profile has been replicated in the DRM as 10% of passengers benefitting for 10 years.

5.5.6 Improved Security is the result of investment in additional revenue inspectors. This resource is expected to create an improvement in the level of security perceived by passengers. A Willingness to Pay valuation for this improvement was derived from passenger survey work. For the purpose of bus reform appraisal, it is assumed that this benefit will be fully realised after year 3 of franchising, but will subsequently be scaled back commensurate with the scaling of the resource planned after year 7.

5.5.7 Benefits associated with additional customer service resource and additional contract management resource reflect "Do Something" incremental budget that is intended to be used to employ staff to roles that will be directly engaged with customer service improvements and performance/contract management duties. It is reasonable to assume that the resource deployed will yield at least equal and opposite economic value to their cost. In the event that they do not, they would be redeployed or curtailed during the early years of the appraisal period. As such, this approach to deriving a value estimate for this type of small scale but none the less important service quality increment is considered appropriate and proportionate in appraisal terms.

5.5.8 Branding is an important differentiator between the Franchising option and other options. A simplified bus product under the control of the GMCA and which offers a single unified identity will emerge under the franchising option. This means that the GM bus industry will present a very different face to the travelling public when compared with the current GM bus product (or that which would exist under the Partnership option) which is reflective of a fragmented industry, an industry that often competes with itself, an industry whose product offer is complex and inconsistent across GM, an industry that is not accountable to any elected officials, and an industry that by necessity places commercial survival and profit ahead of passenger interest. In normal commercial circumstances, an organisation with a higher brand value can monetise that value by charging a higher price for an otherwise identical product. In the case of Franchising, fares will not increase and the brand value will directly increase the consumer surplus for passengers. However, a unified public transport brand also generates non-user economic value. The most successful example is that of London Transport whose iconic brand motifs (the tube, the roundel, the red London bus) are known globally. This brand gives users confidence but also supports the London economy in many other tangible ways. It gives individuals and business alike confidence that transport is not a barrier to visiting, living, working and/or doing business in London. The Franchising option will result in GM becoming known (over time) for a unified bus product with a specific brand and therefore it is reasonable to expect some elements of the success of the London Transport brand to be capable of replication. Work is ongoing to understand the precise nature by which GM can create and use the bus brand for the greater benefit of GM bus passengers and GM as a whole. A Willingness to Pay valuation has been sourced from *TRL593*, *The Demand for Public Transport: a practical guide* (TRL, 2004), which brought together evidence on factors affecting the demand for public transport from a range of sources into a practical user guide. The value of branding contained in this guide has more recently been re-issued by the DfT and is considered the best available industry wide evidence for the halo effects associated with delivering a joined up and integrated public service through a single competent authority. No monetised valuation of the non-user benefits has been attempted and for that reason, the overall benefit assigned to branding impacts is considered to be conservative.

5.5.9 The DRM input sheet has an interface to convert values of improvements in units of pence into units of minutes. This involves applying a value of time to convert from pence to minutes.

5.5.10 The values in minutes are then deducted from the GJT in the model and a demand response is calculated by applying the GJT elasticity.

5.5.11 The willingness to pay values associated with Wi-Fi, ticket inspectors and driver training were estimated in a separate piece of research carried out on behalf of TfGM.

5.5.12 The costs of all these interventions are contained within the Financial Model and the delivery mechanisms described in the Commercial and Management cases are considered to be robust.

5.5.13 The following table summarises the values used for the Franchising Scheme, their source and the factor applied. It also indicates which of these interventions were also included for the partnership option. Values for children and students / young adults were assumed to be half of the adult values as is a normal convention to reflect the lower values of time applicable to these groups.

Table 5: Summary of Values used for the Franchising Scheme

QUALITY IMPROVEMENT	VALUE (2017 prices)	SOURCE	FACTOR	INCLUDED IN PARTNERSHIP
Wi-Fi	2.6p	TfGM research	10% for 10 years, then 0% (as a proxy for 20% in Year 1 tapering to 0% in year 11.	Yes
Ticket inspectors	0.4p	TfGM research	Taper up to 100% by year 3, then 43% by Year 7 to reflect planned resource scaling.	No
Driver training	5.0p	TfGM research	50% for the entire period.	Yes
Customer service and Contract Management	n/a (0.06 minutes)	Calculation based on cost of implementation	100% all years	No
Branding	4.1p	TRL593	100% all years	No

5.6 Lagged Responses

5.6.1 Changes in patronage due to changes in fares and GJT are calculated in the DRM using long run elasticities in the year at which the change in fare or GJT occurs. However the increase or reduction in patronage that this change implies is lagged over a three year period, with 50% of the impact assumed to occur in year 1, 75% by year 2 and 100% by year 3. These lag factors can be changed via the DRM Parameters sheet. Other impacts, e.g. due to exogenous or competing mode variables, are not lagged.

6 Economic appraisal framework

6.1.1 A welfare economics approach to assessing the economic value of bus reform has been chosen as appropriate for the type of interventions under consideration. All values are discounted and quoted in £2010 prices and values, reflective of the guidance contained in DfT WebTAG and the associated WebTAG databook (DfT, 2018a). This is also aligned with national convention, where maintaining a consistent price year allows for comparison of diverse projects over time.

6.1.2 The over-arching intention of bus reform intervention is to improve the passenger experience of the bus system. There is a wealth of empirical data and a long track record in the UK of reliably using micro-economic tools and techniques to assess behavioural response to the type of interventions envisaged. The same professional “Book of Knowledge” used to assess behavioural change is also used to appraise economic value and the use of this approach is therefore considered entirely appropriate and consistent with best practice.

6.1.3 However, the workplan for the economic appraisal of the bus reform options has also included work to appraise the Wider Economic Impacts of bus reform options using macro-economic tools and techniques that seek to establish the impacts of changes in transport provision on macro-economic efficiency. The WEI analysis is described in a subsequent section of this supporting paper.

6.2 Valuing Improvements to the Passenger Experience

6.2.1 Most economic benefits are derived from changes to the user experience in terms of:

i. the fare paid;
ii. the speed of the journey; and
iii. the quality of the journey.

6.2.2 The methods by which these have been calculated are described in earlier sections of this note.

6.3 Valuing Economic Externalities

6.3.1 An economic externality is the cost or benefit associated with a transaction (or aggregate group of transactions) within the economy that affects a party who did not choose to incur that cost or benefit. For example, pollution from the use of transport systems will have impacts on individuals in the population who are not directly involved in either providing or consuming the transportation "product".

6.3.2 Externalities can be both positive and negative.

6.3.3 The following economic externalities have been captured within the bus reform appraisal;

i. Congestion impacts
ii. Accident impacts
iii. Carbon emissions impacts
iv. Air pollution and noise impacts
v. Highway infrastructure and maintenance cost impacts

6.3.4 The appraisal of impacts pivots from a change in vehicle km operated where changes to the demand for bus imply changes in the demand for other modes.

6.3.5 As aggregate "Vehicle Km Travelled" (or VKT) reduces, the impacts in the above 5 areas reduce. The method for deriving an economic value associated with this reduction is based on unit rates of impact per VKT. The full method followed is set out in *TAG Unit A5.4 "Marginal External Costs"* (DfT, 2018b).

6.4 The Detailed Economic Appraisal

6.4.1 The following tables provides greater details of the breakdown of costs and benefits that are summarised in the assessment document.

Table 6: Appraisal Results

ECONOMIC APPRAISAL - 2010 PRICES and VALUES REVENUE	Franchising £m 2010 PV	OP Partnership £m 2010 PV	Ambitious Partnership £m 2010 PV
TfGM - Bus			
Bus (TfGM) ticket sales (including advertising)	£1,889.5	-£0.2	-£0.2
Bus (TfGM) Levies and Grants	£94.7	£0.2	£0.2
Tenders & Concessions	£899.2	-£6.7	-£8.2
TfGM Franchise Payment	-£2,747.5	£0.0	£0.0
TfGM Total	**£136.0**	**-£6.7**	**-£8.2**
Bus Operators			
Bus (Private Operators) ticket sales (including advertising	-£1,831.9	-£0.8	£6.8
Bus (Private Op) Levies and Grants	-£994.0	£6.7	£8.2
Bus (Private Op) Franchise Payment	£2,747.5	£0.0	£0.0
Depot Sale	£31.9	£0.0	£0.0
Operating Cost	-£2.1	-£0.7	-£0.7
Operators Total	**-£48.6**	**£5.1**	**£14.2**
Total Bus Revenues	**£87.5**	**-£1.5**	**£6.1**
Other Public Transport Modes			
Metrolink	-£27.7	-£6.1	-£8.1
Train	-£23.5	-£6.0	-£7.3
Other Public Transport Revenues	**-£51.2**	**-£12.1**	**-£15.4**
Total Bus Farebox Revenues	**£57.6**	**-£1.0**	**£6.5**
Total Public Transport Farebox Revenues	**£6.4**	**-£13.1**	**-£8.9**
Total Revenue Changes	**£36.3**	**-£13.6**	**-£9.3**

BENEFITS	Franchising	OP Partnership	Ambitious Partnership
Time Savings	£299.1	£68.2	£85.3
User Charges - Fare Paid	£56.0	£28.6	£28.6
Decongestion	£61.4	£14.9	£19.1
Accident reduction	£4.0	£1.0	£1.3
Carbon emissions	£1.4	£0.3	£0.4
Air pollution & noise	£0.3	£0.1	£0.1
Infrastructure	£0.2	£0.1	£0.1
Total Benefits	**£422.5**	**£113.2**	**£134.9**
Indirect Tax			
Fuel	-£4.6	-£1.1	-£1.4
Public Transport Fares	-£1.0	£2.1	£1.4
Total Indirect Taxes	**-£5.7**	**£1.0**	**£0.0**
Total Benefits	**£416.8**	**£114.2**	**£134.9**

COSTS	Franchising	OP Partnership	Ambitious Partnership
Capital including QRA and OB	£95.4	£4.1	£4.6
Maintenance including QRA and OB	£42.7	£12.7	£14.1
Renewals including QRA and OB	£81.1	£3.1	£3.7
Total Costs	**£219.1**	**£20.0**	**£22.4**
QRA and OB - Capital	£10.5	£0.0	£0.0
QRA and OB - On-Going Costs	£66.0	£3.1	£3.7
Total On-Going Costs	£123.7	£15.8	£17.8

ECONOMIC INDICATORS	Franchising	OP Partnership	Ambitious Partnership
Benefits + Revenues = Present Value of Benefits (PVB)	£344.7	£113.3	£141.8
Scheme Costs - Present Value of Costs (PVC)	£110.8	£32.7	£38.7
Net Present Value = PVB - PVC	£234.0	£80.6	£103.1

ECONOMIC APPRAISAL - 2010 PRICES and VALUES	Franchising £m 2010 PV	OP Partnership £m 2010 PV	Ambitious Partnership £m 2010 PV
PVB - User / Non-User Benefits	£416.8	£114.2	£134.9
PVB - Revenues	-£70.0	-£0.2	£7.7
PVB - Operating Costs	-£2.1	-£0.7	-£0.7
PVC	£110.8	£32.7	£38.7
NPV	£234.0	£80.6	£103.1
Time Savings	£299.1	£68.2	£85.3
User Charges	£56.0	£28.6	£28.6
Decongestion	£67.3	£16.4	£20.9
Total	**£422.5**	**£113.2**	**£134.9**
Network	£50.4	£0.0	£12.3
Fares	£56.1	£28.6	£28.6
Interoperability	£54.7	£0.0	£4.6
Soft Factors	£193.9	£68.3	£68.5
Total User Benefits	**£355.2**	**£96.8**	**£113.9**
Network	14.2%	0.0%	10.8%
Fares	15.8%	29.5%	25.1%
Interoperability	15.4%	0.0%	4.0%
Soft Factors	54.6%	70.5%	60.1%

6.5 Value for Money for Public Investment - Derivation of the VfM Metrics

6.5.1 Achieving VfM is an important objective as set out in the Strategic Case.

6.5.2 In circumstances where there is a mixture of funding sources between the fares paid by the user of the service and taxpayer funding (for concessions, subsidised services and direct subsidy), it is important that the spending of public money gains the best value for taxpayers investment.

6.5.3 There are alternate approaches to appraising VfM. The metrics outlined in the strategic case are as follows;

i. NPV
ii. BCR
iii. Total KM operated and quality of km operated

6.5.4 These metrics are reported in the Economic Case.

6.5.5 Of note, there are alternative approaches to deriving the BCR metric. These reflect alternative definitions of the “constrained” resource.

6.6 Alternative CBR Formulations

6.6.1 Economic Analysis is often undertaken to help ration scarce funds.

6.6.2 When used for this purpose, the BCR metric (value per pound spent) is often considered to be of equal or greater use than the NPV (total value created) metric.

6.6.3 Creating a measure of value per pound spent is applicable to bus reform. The intention of a BCR is to understand how much value is created per pound spent.

6.6.4 It is desirable to include a BCR metric within the Bus Reform assessment because;

- People expect to see it
- It is a useful and relevant metric to support decision making
- It helps to focus attention on the whole life economic cost of the intervention

6.6.5 However, alternative BCR formulations are routinely used - in summary, there are different approaches when deciding what to put "above the line" in the PVB and what to put "below the line" in the PVC. (Of note, for any given project option, the formulation of PVC and PVB will not affect the NPV (which equals PVB minus PVC).)

6.6.6 When describing the "value per pound spent", it is important to define the budget from which the pounds are taken. This budget is known as the "constrained resource". There are many alternative definitions and this is the reason why alternative BCR formulations exist. Some definitions of "the constrained resource" include that include;

- The Broad Transport Budget (DfT WebTAG)
- The Public Sector Finances (HM Treasury)
- The TfGM/GMCA Capital Budget for Bus Reform
- The GMCA Public Finances (recommended)
- The economic costs to society as a whole

6.6.7 There is no "correct" or "incorrect" economic definition of the constrained resource. Instead, it is simply necessary to conform with applicable guidance and precedent; and to apply common sense to the definition of the constrained resource. It is normal practice however to link the definition with a known constrained financial resource (eg a budget).

6.6.8 Three alternative formulations are described in further detail;

- The Capital Budget for Bus Reform
- DfT WebTAG formulation
- The "GMCA Budget as a constrained resource" formulation

6.6.9 The following list sets out the component parts of the BCR.

i. TfGM/GMCA Capital Costs (inc. maintenance and renewal of assets)
ii. TfGM/GMCA Net Financial Effect as a "Bus Operator"
iii. TfGM/GMCA Net Financial Effect as "Metrolink Operator"
iv. Private Sector Bus Operators "Net Financial Effect"
v. Rail Industry "Net Financial Effect"
vi. Indirect Tax (impacts to the national exchequer)
vii. User Benefits
viii. Non-User Benefits (economic externalities)

6.6.10 Using "The Capital Budget for Bus Reform" as the constrained resource;

- PVC = 1
- PVB = 2+3+4+5+6+7+8

6.6.11 Under this formulation, the constrained resource is "The Capital, maintenance and renewal budget available to TfGM/GMCA"

6.6.12 Using the "WebTAG Formulation";

- PVC = 1+2+3+5
- PVB = 4+6+7+8

6.6.13 WebTAG guidance explicitly states the following;

- "As the BCR is used to inform value for money assessments of transport schemes, the PVC should reflect the public budget available to fund transport schemes, referred to as the 'Broad Transport Budget'. The PVC should only comprise Public Accounts impacts (i.e. costs borne by public bodies) that directly affect the budget available for transport." (A1-1, 2.8.6).

6.6.14 This suggests that all costs (both operating and revenue) should be included in the PVC. However, WebTAG also states;

- "Public Accounts impacts that do not directly affect the transport budget, such as Indirect Tax Revenues which accrue to the Treasury, and impacts on transport users and providers that might commonly be referred to as costs, such as fuel costs or public transport operating costs, should be included in the PVB. Where a scheme leads to changes in public sector revenues (for example tolling options) careful consideration should be given to whether they will accrue to the Broad Transport Budget and all assumptions, and their justifications, should be clearly reported." *WebTAG A1-1* 2.8.7 (DfT, 2018c)

6.6.15 This suggests that “public transport operating costs” should accrue to the PVB unless they are borne by the public sector and impact the transport budget, in which case some careful consideration (and explanation of assumptions) is required.

6.6.16 It is assumed that the guidance is primarily written to be reflective of the fact that most of the UK public transport operating costs are the responsibility of the private sector and that operator impacts would not normally impact the public purse directly. Where public transport fareboxes are the responsibility of the public sector (for example, TfL, or Metrolink), whole life financial impacts of the farebox ought to be considered within the PVC as these impacts will affect the public purse and available transport budgets (as per TAG 1-1, 2.8.6). This is indeed the case for TfL (the *TfL Business Case Development Manual* (TfL, 2017) sections 2.5 to 2.7 – Definition of “Net Financial Effect” refers).

6.6.17 To operationalise these considerations, it is appropriate to sub-divide the “operator” group into public and private sector actors, and assume that public sector impacts would be reported within the PVC.

6.6.18 Rail industry operating costs are assumed to be an impact on the public purse in the long term as the industry is reliant (overall) on public subsidy. This is certainly the case for local rail in GM.

6.6.19 Using the “TfGM Finances as the Constrained Resource” formulation (the recommended formulation);

- PVC = 1+2+3
- PVB = 4+5+6+7+8

6.6.20 This is almost identical to the WebTAG formulation but assumes that GMCA/TfGM transport budgets will not be affected by impacts to the rail industry associated with the abstraction of passengers from rail to bus as a result of bus market reforms.

6.6.21 In general, the decision regarding the most appropriate form of BCR is dependent on funding source. This in turn will inform decisions regarding the applicable definition of “constrained resource”.

6.6.22 For this reason, it is recommended that a switch is made to the definition of “the constrained resource” for the reasons set out above.

6.6.23 The impact on PVB, PVC and BCR metrics is shown in the following table. No impacts occur to the NPV.

Table 7: Impact on PVB, PVC and BCR

	Franchising	OPP	AP
1. TfGM/GMCA Capital Costs (Inc. maintenance and renewal of assets)	-219.1	-20	-22.4
2. TfGM/GMCA Net Financial Effect as a "Bus Operator"	136	-6.7	-8.2
3. TfGM/GMCA Net Financial Effect as "Metrolink Operator"	-27.7	-6.1	-8.1
4. Private Sector Bus Operators "Net Financial Effect"	-48.6	5.1	14.2
5. Rail Industry "Net Financial Effect"	-23.5	-6	-7.3
6. Indirect Tax (impacts to the national exchequer)	-5.7	1	0
7. User Benefits	355.1	96.8	113.9
8. Non-User Benefits (economic externalities)	67.4	16.4	21
NPV	233.9	80.5	103.1
PVB – TfGM Capital Budget	453	100.5	125.5
PVC - TfGM Capital Budget	-219.1	-20	-22.4
BCR - TfGM Capital Budget	2.07	5.03	5.60
PVB - WebTAG Formulation	368.2	119.3	149.1
PVC - WebTAG Formulation	-134.3	-38.8	-46
BCR - WebTAG Formulation	2.74	3.07	3.24
PVB - Recommended Formulation	344.7	113.3	141.8
PVC - Recommended Formulation	-110.8	-32.8	-38.7
BCR - Recommended Formulation	3.11	3.45	3.66

7 Wider economic impacts (WEIs)

7.1 The wider economic impacts (WEIs) of buses

7.1.1 The core Economic Case explains how bus reform will deliver core transport impacts (termed 'user impacts') which will influence the economy and contribute directly to achieving jobs and GVA growth through improved transport efficiency. Each option will also generate social and environmental impacts through changes in travel behaviour. These will occur under each of the options or reform to different extents. These impacts are termed 'Level 1' or 'established' impacts.

7.1.2 The Level 1 impacts, by proxy, capture a large proportion of the expected economic impacts. However, where the economy is not functioning efficiently, e.g. due to 'market failures' or 'distortions' an additional set of impacts are likely to be generated from significant interventions in transport supply. These are termed Wider Economic Impacts (WEIs).

7.1.3 All the resulting impacts will be felt at different spatial levels. The Economic Case focuses on the net additionality at the UK level, accounting for displacement of activity between areas using standard DfT approaches. The local, e.g. district level, and regional, e.g. Greater Manchester, impacts will differ as interventions are likely to stimulate changes in the location of activity.

These impacts are also described in this supporting paper, but it is only the net UK impacts which must be considered in conjunction with the standard user impacts and associated value for money assessment.

7.1.4 WEIs can occur directly due to changes in transport supply and also indirectly by stimulating changes in land use (through changes in transport supply). These are termed Level 2 and 3 impacts respectively, or 'evolving' and 'indicative'.

7.1.5 Nine quantifiable WEIs have been identified which are relevant to bus provision in Greater Manchester. These impacts will vary spatially across the city region, depending on the scheme interventions, and will also encourage the displacement of activity both within the city region, to/from adjacent areas, as well as net changes at a UK level. The latter impacts are considered in this case with reference to the CBA.

7.1.6 The impacts reflect new development activity at key economic nodes across Greater Manchester, including the regional centre (Manchester city centre, Oxford Road, Salford Quays and Trafford Wharfside), Manchester Airport and the Western Gateway (including Port Salford and Carrington). These inputs are consistent with the land use assumptions used for Bus Reform.

7.1.7 For the assessment of the Phase 1 bus reform proposals and the partnership schemes, static land uses (i.e. Level 2 impacts) are, given the scale of the expected impacts on transport supply, assumed. Under Phase 2 proposals we would expect interactions between transport supply and land use to be generated. Put simply, this will help support development and activity in those areas which receive the largest reductions in travel times and costs, and/or greatest increases in transport supply.

7.1.8 The nine WEI indicators fall into four categories, namely:

i. Labour market impacts
   - *WEI1 – Changes in labour supply by type and location*: Changes in bus service provision can help to address existing market failures in labour supply, and encourage displacement of activity and also changes in employment at a Greater Manchester level. Access to diverse types of labour is, either directly or indirectly, fundamental to the operation of most businesses.
   - *WEI2 – Reduction in spatial inequalities*: Residents of more deprived areas may not have the flexibility to change locations or jobs to the same extent as those in less deprived areas,

meaning that public transport enhancements have a greater impact on connectivity to jobs and key facilities for that group.

- *WEI3 – Reduction in structural unemployment*: Economic growth aspirations for Greater Manchester rely, as well as on population growth, on reductions in long-term unemployment. Areas with high levels of structural unemployment are typically characterised by low levels of residential mobility, and improvements in public transport supply can have a higher impact all else being equal (e.g. due to lower levels of car availability). Bus service improvements would allow residents to access new opportunities which, in turn, would free up local opportunities for others.

ii. Move to more productive jobs

- *WEI4 – Move to more productive jobs (direct)*: In addition to overall changes in labour supply (jobs), changes in transport provision allow residents to access more opportunities, and allow businesses to locate in places with higher productivity. Where these opportunities are in locations with higher productivity, there is then a net benefit at the UK level. There is also, depending on average GDP per worker, the potential for disbenefits if the scheme displaces activity from a more to less productive area.
- *WEI5 – Move to more productive jobs (indirect)*: It is likely that those able to access more productive work (in WEI4) will already be in employment locally, and the impact is then to free up these local opportunities for those residents at the margin of the labour market (such as those referred to in WEI2 and WEI3). There is a risk of double counting in an indirect impact such as this so this WEI is not quantified. The important recognition is that changes in the labour market which the options help support will have more beneficiaries than just the direct users of the system.
- *WEI6 – Move to more productive jobs (upskilling of labour force)*: Buses play an important role in access to further and higher education opportunities for Greater Manchester residents. This is likely to increase should current proposals for merger or amalgamation of Further Education (FE) campuses occur. These education opportunities help to equip residents with the skills and training needed to fulfil more productive work on

graduation, in turn supporting greater confidence from businesses in inward investment decisions that support more, and potentially more productive, jobs in Greater Manchester.

- *WEI7 – Economic activity at key nodes*: As noted under WEI1, public transport provision has an important role to play in supporting densification at key economic nodes with higher levels of productivity. There are risks that this activity will be displaced to areas with lower productivity within Greater Manchester, or outside of the conurbation altogether, if transport supply cannot readily adapt and support positive inward investment decisions. This is principally a Level 3 impact linked to the Phase 2 proposals, and has strong interactions with delivery of GMSF.

iii. Agglomeration

- *WEI8 – Agglomeration*: Reductions in travel times and costs help to make Greater Manchester a 'smaller place', leading to higher effective density and greater productivity as businesses and workers gain benefits from proximity. This is particularly true where the impacts are felt in areas with higher existing or planned job density, where gross domestic product (GDP) per worker is greater. Large scale changes in travel times and costs can promote dynamic land use effects and spatial clustering which may have a larger impact than the first order transport supply impacts themselves. At this Stage we have assumed that the Phase 1 Franchising, Operator proposed Partnership, and Ambitious Partnership do not have a dynamic effect.

iv. Local centres

- *WEI9 – Vitality of commercial centres*: Buses are disproportionately important for economic activity and vitality in the regional centre, the district centres, and more local neighbourhood centres, with a mode share of 20%. Any increase in bus use suggests a displacement of activity internally within Greater Manchester to such localities, but no net changes at the Greater Manchester level. In practice, some gains might be expected as activity is attracted from adjoining authorities outside of Greater Manchester. We assume no net change at the UK level though and therefore no additional impact to be included in the adjusted PVBs.

7.1.9 Analysis was undertaken for both the partnership options and Phase 1 Franchising scheme. For the reasons discussed above, monetised impacts were estimated at the UK level for six of these indicators.

7.2 Economic benefits to key centres

7.2.1 Although not considered as part of the net UK impact, bus reform will contribute towards the development of town centres (WEI 9), particularly in terms of supporting access to employment opportunities, allowing employment to grow at these nodes, and the retail, leisure, and visitor offer. The primary driver for travel to the key centres is retail, leisure, and personal business, accounting for over 45% of trips and bus, as a mode of travel, accounts for 20% of these trips at these locations (more than it accounts for in commuting trips). Enhancements to bus supply, assuming they continue to have a strong role in serving key centres, will therefore have a disproportionate effect on their vitality relative to other locations.

7.2.2 Additional local demand from bus franchising is estimated to generate an increase of approximately £10.0 million per annum (undiscounted 2010 prices) in total retail and leisure spend across the regional centre, the district centres, and neighbourhood centres. Clearly, a large proportion of this spending will be displaced from elsewhere in Greater Manchester (particularly major shopping centres) or regionally, however, this retail impact does demonstrate the contribution that improved bus services can make to the vibrancy and attractiveness of town centres. The operator proposed and ambitious partnerships are forecast to add £3.1 and £1.6 million respectively per annum (undiscounted 2010 prices) in total retail spend across the regional centre, the district centres, and neighbourhood centres.

7.3 Net Wider Economic Impacts (WEIs)

7.3.1 The net UK and GM impacts have been estimated in line with DfT Transport Analysis Guidance (WebTAG), and are presented in 2010 values and prices, discounted to 2010. The GM level WEIs should be considered in the context of the Strategic Case, and their contribution towards GM wide policy objectives and desired strategic outcomes. All the UK level monetary values can be considered as additional to the standard Present Value of Benefits (PVB) reported in the "core" Economic Case.

7.3.2 The WEI impacts from Phase 1 Franchising total £168 million at the UK level accounting for any displacement, with the total benefits at Greater Manchester level being £507 million, the main difference between the two values being the labour supply impacts, i.e. the scheme will support increased local employment but TAG estimates suggest that a much smaller proportion will be net additional to the UK and not displaced from elsewhere. The Operator Proposed and Ambitious Partnership WEIs are smaller than the Phase 1 Franchising impact: for the UK £51 to £78 million, and for Greater Manchester £262 to £288 million. An important distinction between the two is that the non-welfare metrics at the UK level are GDP, i.e. inclusive of indirect taxation, and those at the Greater Manchester level are GVA (and therefore a factor lower).

7.3.3 Agglomeration impacts are the largest difference between the two schemes, reflective of the fact that better linking people with opportunity is a significant reason for reforming the bus market, and that Phase 1 Franchising does this better than the partnership alternatives tested. While some of that benefit to GM will come at the expense of other parts of the UK, the net overall impact on the UK is very positive.

Table 8: WEI's – Net Impacts to GM

WEI	DESCRIPTION	GREATER MANCHESTER IMPACTS (GVA & Welfare) – PRESENT VALUE OF BENEFITS (£ millions) 30 YEARS		
		PHASE 1 FRANCHISING	OPERATOR PROPORSALS PARTNERSHIP	AMBITIOUS PARTNERSHIP
1	**Labour supply**	304	211.7	213.2
2	**Reduction in spatial inequalities**	9.5	6.5	6.6
3	**Reduction in structural unemployment**	0.1	0.1	0.1
4	**Move to more productive jobs (direct)**	-5.9	-1.2	-1.7
6	**Move to more productive jobs (upskilling of labour force)**	59.9	14.7	18.3
8	**Agglomeration**	139.3	30.0	51.5
Total WEI impacts (2010 prices and values for 30 years)		**507.5**	**261.9**	**288.0**

Table 9: WEI's – Net Impacts to the UK Economy

WEI	DESCRIPTION	UK IMPACTS (GDP & Welfare) – PRESENT VALUE OF BENEFITS (£ millions) 30 YEARS		
		PHASE 1 FRANCHISING	OPERATOR PROPORSALS PARTNERSHIP	AMBITIOUS PARTNERSHIP
1	**Labour supply**	13.2	3.2	4.4
2	**Reduction in spatial inequalities**	9.5	6.5	6.6
3	**Reduction in structural unemployment**	0.1	0.1	0.1
4	**Move to more productive jobs (direct)**	-2.1	-0.4	-0.6
6	**Move to more productive jobs (upskilling of labour force)**	21.4	5.3	6.5
8	**Agglomeration**	165.8	35.8	61.3
Total WEI impacts (2010 prices and values for 30 years)		**207.9**	**50.5**	**78.3**

Table 10: WEI Summary Table

SCHEME DESCRIPTION	PRESENT VALUE OF BENEFITS (£M) 30 YEARS		
	TOTAL WEI UK BENEFITS	TOTAL WEI GREATER MANCHESTER BENEFITS	PERCENTAGE UK TO GREATER MANCHESTER CHANGE
Phase 1 Franchising	207.9	506.5	41%
Operators' proposals partnership	50.5	261.9	19%
Ambitious Partnership	78.3	288.0	27%

8 Bibliography

TfL (2017). Business Case Development Manual.

DfT (2018a). DfT WebTAG Databook v1.11. https://www.gov.uk/government/publications/tag-data-book.

DfT (2018b). WebTag Unit A5.4. https://www.gov.uk/government/publications/webtag-tag-unit-a5-4-marginal-external-costs-may-2018.

DfT (2018c). WebTag Unit A1.1. https://www.gov.uk/government/publications/webtag-tag-unit-a1-1-cost-benefit-analysis-may-2018.

DfT (2019). WebTAG Unit M2. https://www.gov.uk/government/publications/tag-unit-m2-variable-demand-modelling.

TRL (2004). TRL593, The Demand for Public Transport: a practical guide. https://trl.co.uk/reports/TRL593.

9 Appendix 1 – DRM Assumptions and Parameters

Item	Description	Default Value DM	Default Value DF (if different from DM)	Comments e.g. Source, Rationale
Fare Elasticities	Used to drive the bus demand response to bus fare changes year on year	Commute: -0.65 Child school: -0.85 Leisure singles: -2.08 for own elasticity, 1.20 for cross elasticity Leisure periods: -0.98 for own elasticity, 0.21 for cross elasticity		Mark Wardman (SYSTRA) carried out a review of available evidence and recommended a set of elasticities to use. The elasticities used are long run elasticities. The demand response is lagged in the model to spread the full response to a fare change over a 3 year period. Concessionary demand has a fare elasticity of 0 since concessions do not pay a fare. For the 2018 update we also added in a cross-elasticity between single and period leisure tickets for each person type (adult, youth and child).
Generalised Journey Time Elasticities	Used to drive the bus demand response to changes in Generalised Journey Time (excluding Fare) year on year	Commute: -1.15 Leisure: -1.05		
Population Elasticities	Used to drive the bus demand response to change in population year on year	Commute: 0 Leisure: 1		
Employment Elasticities	Used to drive the bus demand response to change in employment year on year	Commute: 1 Leisure: 0		
Car ownership Elasticities	Used to drive the bus demand response to change in car ownership year on year	Vary by ticket type - see Parameters sheet		Derived from NTS analysis
Income Elasticities	Used to drive the bus demand response to change in income	Vary by ticket type		Derived from NTS analysis
PT Fare Elasticities	Used to drive the bus demand response to change in PT fares	Vary by geography -		Derived based on diversion factors
Car Operating Cost Elasticities	Used to drive the bus demand response to change in car operating costs	Vary by geography -		Derived based on diversion factors
Car journey time elasticities	Used to drive the bus demand response to change car journey time (due to changes in congestion)	Vary by geography		Derived based on diversion factors
Competing mode elasticity override for ticket types	Used to set the competing mode PT fare elasticity to zero for ticket types 8:concession and 10: other free	0 for 8:concession and 10: other free; 1 for everything else		Reasonable to assume that passengers who travel for free on bus will likely travel for free on other modes in GM and hence their behaviour should not be influenced by changes in competing mode fares.

Walk time weight factor	Used to weight the walk time element of bus generalised journey time to reflect the fact that passengers generally dislike the walking element of a public transport journey more than the part of the journey spent on the bus	2		WebTAG Unit M3.2, TUBA General Guidance and Advice. Unlike wait time, a separate value for appraisal and demand modelling purposes is not recommended. Value of 2 means that for example a 5 minute walk time is equivalent to 10 minutes of in vehicle time.
Wait time weight factors	Used to weight the wait time element of bus generalised journey time to reflect the fact that passengers generally dislike the waiting element of a public transport journey more than the part of the journey spent on the bus	2		In the FBC May 2018, for demand modelling purposes, a figure of 1.9 was used as recommended in WebTAG unit M3.2. However for appraisal purposes (i.e. calculating user benefits) a factor of 2.5 is recommended in the DfT's TUBA General Guidance. This was corrected to 2 for both values following guidance from Oxera.
In vehicle time weight factor	Used to weight the in vehicle time element of bus generalised journey time	1		Walk time and wait time factors are relative to in vehicle time, e.g. walk time is valued at 2 x IVT, hence IVT weight should simply be 1.
Revenue calibration factors	Factors applied to modelled Farebox revenue (before calibration) to ensure that the total revenue in the base year for First, Stagecoach and System One tickets match observed figures calculated from annual reports. For the "Other" operators, for whom annual reports are not available, a revenue target was calculated based on the average yield per trip of First and Stagecoach.	Very close to 1 (range from 0.966 to 1)		Farebox revenue is calculated by multiplying the number of trips by a base year fare per trip (calculated using CPS data). These factors were calculated during the calibration stage of the model build to ensure the total revenue matched observed data for each operator. The factors are very close to 1 since the average yields are calculated using the target revenues.
Lagged response factors - fares	Factors used to lag the demand response due to changes in fares	Year 1 (Year of change): 50% Year 2: 25% Year 3: 25%		Values selected following review of available evidence. Percentages are the proportion of the full demand response applied in each year. The lag factors are applied to any change in fare in any year, either due to franchising or otherwise.
Lagged response factors - GJT	Factors used to lag the demand response due to changes in GJT	Year 1 (Year of change): 50% Year 2: 25% Year 3: 25%		Values selected following review of available evidence. Percentages are the proportion of the full demand response applied in each year. The lag factors are applied to demand impacts in the model due to a change in GJT. This includes service quality improvements but does not include interoperability or network impacts.

Lagged response factors - competing modes	Factors used to lag the demand response due to changes in competing mode prices	Year 1 (Year of change): 50% Year 2: 25% Year 3: 25%		Values selected following review of available evidence. Percentages are the proportion of the full demand response applied in each year. The lag factors are applied to the wait time changes due to franchising and any service level changes but not the GJT changes introduced as a result of any quality or infrastructure improvements.
Proportion of trips from home	The proportion of trips which should be considered to be From Home trips (as opposed to trips returning home) and therefore should be given population growth based on the origin of the trip, or employment growth based on the destination of the trip. Split by CC/Non-CC area combinations, time periods, and commute/other.	Depends on category		Obtained from survey data from GMATS by calculating the proportion of trips travelling from-home and to-home at different times of day, both into and out of the city centre. The figures were adjusted to account for interchanging in the city centre, since some people may be travelling to the city centre but then switching to a different bus or different mode and travelling out of the city centre.
Bus km reduction to trips relationship	The relationship of trips lost to global service km adjustment, to determine how many trips are lost when generic annual service kilometre changes are made.	Form: y = a*x^3 + b*x^2 + c*x a -2.1423 b 1.8477 c 0.0233		Calculated by combining patronage data from CPS with mileage data from EGIS for each service and ordering by the number of passengers per mile to give an indication of service popularity, and the level of trips that would be at risk if less popular services were removed. Now higher than the values for 2015 because the network has been reduced since then.
Values of Time	Used to convert interoperability, soft factor values and infrastructure values into GJT changes to allow calculation of demand response and benefits.	Varies by year - see worksheet		WebTAG databook 1.11.1 A1.10.1, December 2018
Base Demand Matrix	Representation of bus demand across Greater Manchester in the base year 2014/15, split by sector pair, ticket type and operator.	Large dataset - see worksheet		Obtained from CPS data for the three years from 2014/15 to 2016/17, adjusted to match 2016/17 totals.
Base Year Fares	Used to calculate revenue generated from ticket sales in the base year 2014/15 by multiplying by base demand	Large dataset - see worksheet		Single fares calculated using a boarding fare plus a fare per stage multiplied by the average number of stages for that sector pair. The number of stages for each sector pair was calculated from CPS. Period fares calculated by splitting the observed ticket revenue (calculated by analysing operator financial statements) between ticket types using revenue data from CPS and deriving an average yield by dividing by the patronage from CPS for each ticket type. Period fares and different for the Oxford Road corridor to reflect

				cheaper tickets on that corridor. Ratio of discount to standard corridor fares derived from CPS data - supporting document 50. Further detail on method provided in the base model development notes
Base Year Demand Targets	Total annual patronage by ticket type and operator used as control totals during the base matrix building process	-		In the previous version of the model when the base matrix was derived from GM-PTM factors were applied to ensure the total matched patronage figures from CPS. In the current version the base matrix has been derived from CPS directly so these are no longer required. The base model development note explains what is included and not included in the base matrices.
Base Year Revenue Targets	Total annual revenue by ticket type and operator used as control totals during the base matrix building process	See sheet for total and breakdown by ticket type and operator		Total Farebox revenue for each operator obtained from assessment of financial accounts by financial workstream. Totals split between ticket types using CPS revenue data.
Base Year Generalised Journey Time	Separate elements of journey time (in vehicle time, wait time, walk time, interchange penalty, number of boarding's). Used as the pivot point for any changes in generalised journey time brought about through changes to service provision, quality etc.	Large dataset - see worksheet		Obtained directly from the Greater Manchester Public Transport Model (GM-PTM), part of the suite of models known as GM-VDM. Demand weighted to sector system.
Total vehicle kilometres, hours and fleet size	Annual total network statistics passed to the financial model and used to calculate operating costs.	Total km: 97,981,828 Total hrs: 6,065,958 Total fleet: 2002 for breakdown by time period and commercial/subsidised see worksheet		Vehicle kilometres derived from EGIS database. Vehicle hours obtained from TfGM. Time period variations obtained from GM-PTM. Fleet size derived from operator fleet lists held by TfGM. Full process documented in the base model development and validation note.
Annual real fare change - up to 2019/20	Percentage change in fares from one year to the next, net of RPI, up to financial year 2019/20	Actual real terms change in fares calculated based on observed ticket prices where available.		Observed ticket prices obtained from TfGM compilation of historic fares and updated with most recent fare changes in financial year 2019/20.

Annual real fare change - post 2019/20	Percentage change in fares from one year to the next, net of RPI, financial year 2017/18 onwards	RPI+1.4%	Franchising: Adult and child period tickets harmonised - small change for operator own but reduction for System One. Partnership: 2 year fare freeze for System One tickets	Standard annual fares assumptions is RPI+1.4%. Derived during the reference case calibration exercise between DRM and Financial Model to balance operator costs and revenues in forecast years. Period tickets assumed to be harmonised at the lowest major operator level for franchising - % changes calculated in supporting doc 21,22 System One fares frozen for 2 years in partnership option but operator own fares retained and kept as per reference case. There used to be a mechanism to remove discount corridor tickets as part of franchising but this was discontinued. The calculations for this are still at the bottom of the Fares sheet, but these are not used in the model.
Definition of "discount" corridors	Corridors (model sector pairs) between which discount fares are applied in the model rather than full price fares.	N/A	N/A	Discount fares only apply to demand along the Wilmslow Road corridor (between DRM zones 1, 2 and 10) Agreed following consultation with TfGM. Flexibility built into model to change which corridors (sector pairs) are classed as "discount" and are driven by the discount fares.
Single tickets under franchising	Fares for single tickets under franchising	RPI+1.4%	-	Fare tables for each service to remain as they are in the Reference Case.
Concessionary fares	Fares for concessions and non fare paying passengers	No fare	-	Concessionary passengers and other free travellers (staff passes, children under 5, etc.) assumed to continue travelling for free. Agreed following consultation with TfGM. Concessionary passengers include ENCTS pass holders (elderly and disabled) travelling off-peak as well as disabled passengers travelling for free in the peak under the local concession.
Global service km changes	Annual percentage change in total service kilometres (not service specific) - used as a proxy for network cuts when specific details (i.e. which services) are not known	Observed 4.1% reduction in year 17/18, then linked to *initial** patronage decline in the ratio: 2.25:1 until 2024/25 1:1 until 2039/40 0.5:1 until 2050	-	Reductions derived based on patronage decline from an *initial* DRM forecast*. Changes designed to achieve a target EBIT in Financial Model. *the term *initial* here refers to a ref case forecast that includes no additional mileage cuts beyond the observed cut in 18/19. Once the longer term cuts are included, there is a knock on impact on patronage so the ratio of patronage: mileage decline reduces.

Changes due to interoperability on introduction of franchising	Benefit in pence per trip to passengers when period tickets become interoperable and can be used on all operators' buses under franchising.	None	GM wide benefit: Low competition area - 9.8p/tripHigh competition area - 11.4p/tripWithin route benefit:10.4p/trip	Willingness to pay values obtained from Interoperability research, 2016. Separate values for low and high competition areas and for within route and network wide benefit. Demand impact calculated using fare elasticity. DRM then converts the willingness to pay into units of minutes using a value of time. The value in minutes is used to adjust the GJT which is used in cost benefit analysis to calculate the benefits.Applied only to operator own period ticket holders.
Proportion of operator own trips benefitting from interoperability	Proportion of operator own period trips given interoperability benefit. Specified separately for each sector pair.	None	Franchising GM wide: varies by zone pair linked to the proportion of trips using standard (non discount) tickets Franchising within route: varies by zone pair depending on level of competition. Partnership GM wide: zero Partnership within route: varies by zone pair depending on level of competition.	GM wide only valid under franchising where passengers will be able to use all buses. However passengers using discount tickets which restrict them to a specific corridor are not in scope for GM wide benefit. So benefit is only applied to proportion of trips using standard tickets. Proportions calculated from CPS based on fares paid. Within route only valid on zone pairs where competition exists. This was calculated based on inputs from TfGM showing level of overlap between competing services.

Demand impacts of franchising network changes	Percentage change in bus demand due to network changes expected as a result of franchising.	None	Large dataset - see worksheet	Obtained from the Greater Manchester Public Transport Model (GM-PTM), part of the suite of models known as GM-VDM, by coding network changes into the model and extracting the implied changes in demand. Impacts reduced by a global factor for the 2018/19 assessment based on the reduction in PVR available to redistribute. The changes are separate for each sector pair and time period and vary depending on the extent to which network changes were specified and whether these had a positive or negative impact on bus service provision for journeys between each sector pair at each time of day. Note that for rail and Metrolink we initially planned to use inputs split by origin sector, destination sector and time period but found that due to small values in some cells that we were getting unrealistic percentage changes, and also the total change in demand when the spatially disaggregate factors were applied was different to the total change in demand from the GMPTM. We therefore switched to using time period level factors for Metrolink and rail.
Generalised cost change due to franchising network changes	Absolute change in public transport generalised cost in minutes due to franchising network changes - used in cost benefit analysis to calculate network benefits.	None	Large dataset - see worksheet	Obtained from GMPTM - see above comments
Population forecast	Change in population for each ticket group (child, adults and concessions) over time used to drive change in demand. Separate for each sector.	Varies by year, person type and sector - see worksheet		A mixed forecast from ONS, GMFM and NTEM data - higher concessions in later years than previous versions. Growth distributed to DRM sectors/zones using data from Greater Manchester Spatial Framework on location of future developments. Total population split between age bands using forecasts from DfT's TEMPRO software. The change in concessionary entitlement age is accounted for by adjusting the age group splits as the entitlement age increases. The forecasts are applied with a 1 year offset due to the model representing financial years, e.g. 2019 population forecast used for model year 2020 (financial year 2019/20).

Employment forecast	Change in employment over time used to drive change in demand for commute trips. Separate for each sector.	Varies by year and sector - see worksheet		A mixed forecast from ONS, GMFM and NTEM data - higher concessions in later years than previous versions. Growth distributed to DRM sectors/zones using data from Greater Manchester Spatial Framework on location of future developments. The forecasts are applied with a 1 year offset due to the model representing financial years, e.g. 2019 population forecast used for model year 2020 (financial year 2019/20).
Proportion of additional city centre jobs assumed to not generate trips	Proportion of additional city centre jobs assumed to not generate additional trips due to jobs being taken by new city centre residents. Factor applied to city centre employment growth to reduce growth rates used for trips.	12.0%		Derived based on growth in city centre population and percentage of new residents likely to take up city centre jobs based on census journey to work data.
Car ownership forecast	Change in car ownership over time used to drive change in demand. Specified as the proportion of households with 0, 1 or 2+ cars.	Varies by year and by car ownership category - see worksheet		DfT National Trip End Model (NTEM) forecasts from TEMPRO software. The forecasts are applied with a 1 year offset due to the model representing financial years, e.g. 2019 population forecast used for model year 2020 (financial year 2019/20).
Income forecast	Change in income over time used to drive change in demand.	Varies by year - see worksheet		UK average earnings per working age adult calculated from CEBR forecasts, up to 2036. Forecast extrapolated beyond 2036.
Competing PT fares	Change in competing PT fares net of RPI over time used to drive change in bus demand. GM wide.	Metrolink:Real terms reduction in 2017/18 RPI+2.33% to 2020/21RPI+1% from 2021/22Rail:RPI+0% to 2019/20RPI+1% from 2020/21		Metrolink - From TfGM. In 17/18 Metrolink fares were frozen, hence a real terms reduction. For 18/19 to 20/21 Metrolink fares are increasing at RPI+2.33% to make up freezes in recent years whilst lines have been upgraded disrupting services. Beyond this period fares are assumed to rise in line with historic policy of RPI+1%. Rail - from TfGM. Current government commitment to increase in line with RPI. Assumed to revert back to historic policy of RPI+1% after 3 years. The trend used in the model is the average of Metrolink and rail fares. Only one trend in fares is included rather than having Metrolink and Rail fares separately which would have exaggerated the impact on demand since each would be applied to all demand in the model. Investigations concluded that mapping each sector to either rail or Metrolink would be difficult because many of the sectors are served by both modes.
Car operating (fuel) costs	Trend in car fuel cost used to drive change in bus demand. GM wide	Varies by year - see worksheet		WebTAG Databook 1.11.1 Dec 2018 Table A1.3.11. Standard DfT assumption on car fuel costs. Accounts for forecast changes in fuel price and changes to vehicle efficiency.

Bus and car journey time forecast due to congestion	Trend in average bus and car journey times reflecting the impacts of congestion. GM wide but separate by time of day.	Varies by year and time of day- see worksheet		Average car speeds from GMVDM used for 2014, 2020 and 2035 and interpolated for intermediate years. These are separate for each time period and therefore reflect the fact that AM peak speeds reduce more than off peak speeds. The car trend is adjusted for buses using data from DfT Road Traffic Forecasts. The journey time trend is linked to both passenger in vehicle time (an element of the total bus GJT), total bus hours and total bus PVR. All of these change in proportion to the forecast trend. Assumed to remain constant after 2040.
Service Quality / Soft Factors values per trip	Values of soft factor interventions in pence / trip	None	Varies by year and person type - see worksheet	Values for Wi-Fi, ticket inspectors and improved drivers are obtained from research carried out on behalf of TfGM to gain values for a range of attributes (supporting doc 50, table 4.1) Values for branding from TRL593 (supporting doc 51, table 8.4). Values combined and converted to correct units in supporting doc 47. Values for management/customer service calculated based on the investment cost and an assumed equal and opposite benefit (supporting doc 46) Monetary values for ticket payers are converted to minutes using the value of time (item 1.22) and deducted from the GJT in order to calculate a demand response and benefits.
Infrastructure investment	Investment specified in millions of pounds to be spent on bus infrastructure. Converted to GJT improvement per trip based on parameters specified under "Infrastructure Factors" above.	None		Not used in current forecasts. Recent scheme impacts (LSM busway and LSTF initiatives modelled via Direct Demand functionality described in item 8.3)
Direct demand inputs due to major bus schemes	Change in bus patronage per annum input explicitly to account for major bus schemes	Varies by year - see worksheet		Extracted from existing TfGM work to reflect the impact on bus demand of the LSM busway scheme. LSTF impacts removed for 2018 update. The forecasts are applied with a 1 year offset due to the model representing financial years, e.g. 2019 population forecast used for model year 2020 (financial year 2019/20).

Direct demand inputs due to Metrolink network improvements	Change in bus patronage per annum input explicitly to account for major Metrolink schemes	Varies by year - see worksheet		Forecasts of additional Metrolink patronage taken from Metrolink modelling work for planned timetable improvements. Metrolink patronage factored by bus abstraction rate to estimate the reduction in bus patronage.
Application of interoperability improvement to ticket types	Only operator own period ticket demand receives benefit	N/A		Single ticket holders and concessions already board any bus (since they are not tied to any single operator) and therefore do not benefit from ticketing interoperability. Similarly current System One ticket holders can already use any bus and will not benefit.
Ticket type choice	Ticket type choice is modelled indirectly via the use of fare cross elasticities described in item 1.1. So single ticket demand is influenced by both single fare changes but also by period fare changes (via use of the cross elasticity).	N/A		This functionality was introduced during the 2018 model update primarily for use when the fare changes due to franchising are introduced, but the functionality is present for regular year on year fare changes as well.
Destination choice	The model does not switch demand between different sector pairs due to any change in the relative fare or GJT, i.e. there is no destination choice	N/A		Not modelled, i.e. passengers do not change their destination in the model based on a change in cost. Not considered important for modelling of bus franchising at this stage
Revenue calculation	Revenue is calculated by multiplying demand by the average yield per trip for each ticket type and operator in each year and then applying the revenue calibration factors estimated during the base calibration stage.	N/A		Best method of calculating revenue since the alternative of using ticket sales multiplied by actual ticket prices is not reliable in this case since complete base year ticket sales data is not available.
Transition - network	Changes for each sector pair spread over 5 years from the start year. Changes spread over 3 years for Partnership.	N/A		Impacts spread over 5 years to reflect steady introduction of changes to services. Impacts for all model zones are introduced at the same time, and do not attempt to reflect the 3 tranche roll out assumed for franchising. Instead, this roll out period is modelled separately (items 9.9-9.10)
Transition - fares and ticketing	Fare changes introduced in a single year for each sector pair, i.e. not spread over 5 years like the network changes.	N/A		Impacts not spread over multiple years because fares changes would be immediate and not phased in. Impacts for all model zones are introduced at the same time, and do not attempt to reflect the 3 tranche roll out assumed for franchising. Instead, this roll out period is modelled separately (items 9.9-9.10)

Transition - interoperability	Interoperability improvements introduced in a single year, like fare changes.	N/A		Like fare changes, interoperability will happen immediately once revised tickets are introduced. Impacts for all model zones are introduced at the same time, and do not attempt to reflect the 3 tranche roll out assumed for franchising. Instead, this roll out period is modelled separately (items 9.9-9.10)
Adjustment to franchising and Partnership revenue to reflect additional trips on existing tickets	Reduction factors applied post-DRM to the revenue in the franchising and Partnership cases to reflect the fact that some of the additional trips generated due to franchising/Partnership interventions will be made by passengers who already hold period tickets and make additional trips on that ticket, thus not generating any additional revenue. By default, the DRM does not account for this because it applies an average yield to all trips.	N/A	Singles: no reduction Period Commute: no reduction Period Leisure: 50%	Prudent assumption based on assessment of impacts for different tickets and intervention types. See supporting email/spreadsheet.
Adjustment to demand to reflect tranche timings	Adjustment factors applied to additional demand to reflect a) tranche roll out over 3 years b) that planned tranche implementations are part-way through a financial year	N/A	2022: 9% 2023: 33% 2024: 74%	Based on tranche opening dates provided by TfGM. Proportions calculated based on the number of months in the financial year for which each tranche is franchised, multiplied by the proportion of the network considered to be franchised in that year.
Adjustment to revenue to reflect tranche timings	Adjustment factors applied to additional revenue to reflect a) tranche roll out over 3 years b) that planned tranche implementations are part-way through a financial year	N/A	2022: 9% 2023: 33% 2024: 74%	Based on tranche opening dates provided by TfGM. Proportions calculated based on the number of months in the financial year for which each tranche is franchised, multiplied by the proportion of the network considered to be franchised in that year.
Tranche opening dates	Assumed Go Live dates for each tranche to determine the proportion of the year that demand/revenue/benefits should be claimed	N/A	Tranche 1 - 31/10/21 Tranche 2 - 23/10/22 Tranche 3 - 08/10/23	provided by TfGM
Base year Metrolink demand	Representation of Metrolink demand in the DRM in base year 2016/17 - by sector pair	Large dataset - see worksheet		Distribution by zone pair taken from Metrolink Ticket Vending Machine (TVM) data by Metrolink zone pair and mapped to DRM zones. Total controlled to 2016/17 patronage figure from Metrolink Revenue Forecasting Model v3.14
Base year rail demand	Representation of rail demand in the DRM in base year 2016/17- by sector pair	Large dataset - see worksheet		From GM-PTM base year matrices. Split into time periods using proportions from NTEM/TEMPRO (item 10.6).
Metrolink growth rates over time	Reference case growth in Metrolink demand	Varies by year - see worksheet		From Metrolink Revenue Forecasting Model v3.14

Rail growth rates over time	Reference case growth in rail demand	3.8% p.a. to 2026/27 2.9% p.a. to 2039/40 1.0% to 2049/50		Agreed with TfGM from internal 2040 Strategy city centre forecasts modelling work
Metrolink and rail abstraction factors	The factors applied to changes in bus demand to calculate a corresponding change in other mode demand.	Rail: 8%; Metrolink: 7%		Taken from diversion factor study
Percentage of rail trips in each time period	Used to split the rail base year demand by time period	AM 23.0% IP 27.2% PM 20.2% OP 10.1% Sat 13.2% Sun 6.2%		Derived from TEMPRO
Change in Metrolink and rail demand due to network changes	Metrolink and Rail demand changes due to forecast changes in network under franchising	Varies by mode and time period - see worksheet		Obtained from the Greater Manchester Public Transport Model (GM-PTM). Process documented in Model Specification note. The changes are applied by time period only (not by sector pair). See explanation on item 5.4

10 Appendix 2 - Appraising the Transition Period

10.1.1 The management case currently assumes the franchising scheme would be rolled out in three tranches.

10.1.2 Changes are introduced within the DRM simultaneously at the beginning of the first tranche. Post modelling adjustments are then made to the impacts (revenue, ridership, benefits, etc) based on the rate of franchising set out in the commercial and management cases.

10.1.3 The go live dates are assumed to be:

- Tranche 1 – 31/10/21
- Tranche 2 – 23/10/22
- Tranche 3 – 08/10/23

10.1.4 The proportions of the market in each tranche were calculated from operator data provided to TfGM and were:

- Tranche 1 – 21.4%
- Tranche 2 – 27.7%
- Tranche 3 – 50.9%

10.1.5 A set of factors were calculated based on the go live dates to determine what proportion of impact should be assumed in each year of transition.

Table 11: Assumed Impact 2021 - 2024

TRANCHE	2021/22	2022/23	2023/24
T1	41%	100%	100%
T2	0%	44%	100%
T3	0%	0%	48%

10.1.6 In addition to the adjustments described above to model the transition period, it is assumed that the network changes proposed under franchising would be spread over 5 years, to minimise disruption to the network on day 1. This is modelled within the DRM by simply spreading the response over 5 years rather than implementing in the first year. For all other interventions (fares changes, interoperability and quality improvements), the impacts are assumed to occur from day 1.

10.1.7 The standard lag factors, which describe the rate of behavioural change in response to an intervention, are also applicable and overlaid on the above schedule of phasing.

10.1.8 A backcasting exercise was undertaken to test how well the suite of variables and elasticities selected for the DRM performed in describing of the DRM which aggregated patronage to the ticket type level and pivoted from a base position of 2001 to a final forecast year of 2015, using historic trends in each of the explanatory variables. The resulting patronage forecasts were compared to observed patronage figures from CPS records.

10.2 Data used

10.2.1 Datasets were compiled from historic sources for each of the DRM explanatory variables.

10.2.2 There were have been two significant one-off changes during the backcasting period which cannot be modelled in the DRM;

- The introduction of free concessionary travel for the elderly in 2006, leading to a significant increase in patronage for that segment; and
- The introduction of the IGO card for children which changed the fare structure for child tickets.

10.2.3 Both of these impacts have been accounted for via a direct intervention in the appropriate year which was estimated based on the observed patronage changes in the period immediately after the changes were introduced. This is an approximation since it is not possible with the data available to confirm if the observed changes were entirely due to the one-off change or in part due to more general ongoing changes such as demographics.

10.3 Results

10.3.1 The child and concessionary markets match well to the observed totals.

10.3.2 The adult modelled trend shows a reasonable match although out turn patronage was consistently higher than the backcast suggested. This was due to the lack of available evidence in the following areas;

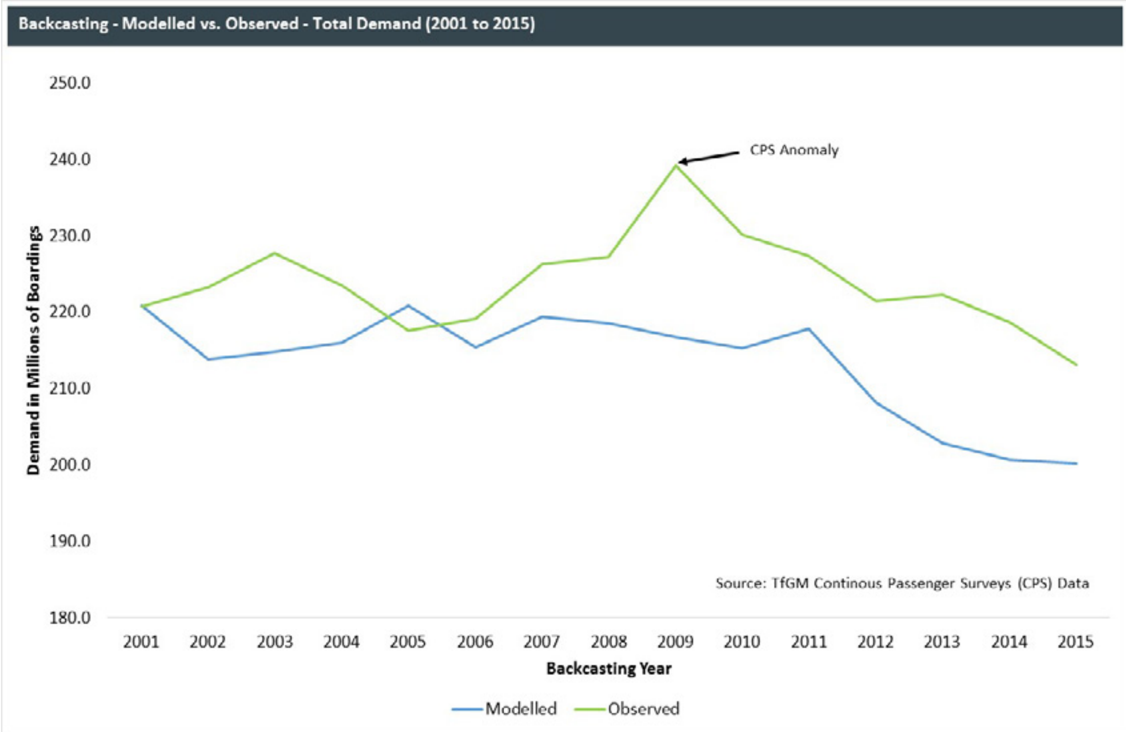
- Quality improvements, e.g. improvements to vehicle fleet, Wi-Fi etc.
- Impacts of specific bus schemes, e.g. cross city bus package

10.3.3 If the quality value of these changes (in the form of a WTP value) had been included in the specification of the backcasting exercise, it is expected that the DRM would have created backcast results that were close to actual out turn.

10.3.4 As such, the forecasting system is considered to be well calibrated and the results of the backcasting exercise suggest good validation. Of note, the observed data for 2009 is considered to be an anomaly of the CPS reporting system rather than an actual out tur result.

10.3.5 In summary, the exercise demonstrated that the DRM is fit for purpose.

Chart 5: Observed versus Backcasting Modelled GM Bus Market Demand



11 List of amendments

On 28 June 2019 and upon completion of TfGM's assessment of a proposed bus franchising scheme, the Greater Manchester Combined Authority decided to proceed to the next step under the Transport Act 2000 (as amended by the Bus Services Act 2017) ("the Act") by obtaining a report from an independent audit organisation on the assessment in accordance with section 123D of the Act.

The purpose of this section is to document the minor changes that have been made to the Economic Case Supporting Paper and which are now included in the version of the supporting paper which has been published in undertaking a consultation on the same in accordance with section 123E of the Act.

List of Amendments

Change No.	**Supporting Paper Reference**	**Page**	**Description of Change**
1	Table 6	31	Corrected values in table