Volterra

Economic Benefits of the Metrolink extension

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Aims of the study

This report seeks to quantify the economic benefits of the Manchester Metrolink expansion that are over and above those benefits valued by conventional transport appraisal methods. Conventional appraisal shows the investment in Metrolink to be value for money, yet there remain important additional benefits which must be considered

Context

Manchester is by far the largest employment centre within the area served by Metrolink. As with most regions outside of London, the predominant mode of travel is still the car. With increasing fuel costs and the growing concern about environmental impacts, government policy is strongly geared towards improving public transport in order to facilitate more sustainable transport patterns. The most sustainable patterns of travel within the study area are trips made into Manchester. For every trip made from Bury to Oldham by public transport, 17.05 trips are made by highway. In contrast, for every trip made from Bury to Manchester by public transport, only 2.27 trips are made by highway.

The 2001 Census showed there were already significant numbers of people commuting into Manchester by tram from Bury and Trafford districts and more recent patronage data suggests this has continued to grow. The aim of the Metrolink expansion is to increase the capacity for commuting into central Manchester by public transport, and reduce congestion on highways, in order to support this dynamic labour market.

There is large forecast employment growth in Manchester with over 100,000 additional new jobs forecast to be created in the city region up to 2017. However, achieving even these reference employment growth forecasts may not be possible if the transport infrastructure is not able to cope with the increased numbers of people needing to commute and around the city region. Research undertaken by GMPTE suggests that if congestion is allowed to continue unabated up to 30,000 forecast new jobs will be at risk over the next decade.

In line with the house price boom, house prices in and around Manchester have seen reasonable growth and the highest growth has been seen in the Pathfinder designations (although from a low base). However house prices are still fairly low[1], and the North West is the second most affordable region in the country. The planned new routes for Metrolink will run through several housing market renewal pathfinder and low prices areas. Anything which can improve the growth prospects and prosperity for these areas would be a benefit to the local economy.

[1] Mean prices across Greater Manchester were £156k in 2007. This ranges from the lowest prices of just over £130k seen in Oldham, Rochdale and Wigan to the highest prices of £250k in Trafford, followed by just under £200k in Stockport.

Valuation of Additional Economic Benefits

The full expansion of the Manchester Metrolink has been evaluated using conventional transport appraisal methods as part of the TIF bid. Those transport appraisals have concluded that the investment is value for money in terms of the transport and user benefits that it will deliver. Without the additional investment in the transport infrastructure, the City Region risks crowding out one in seven potential future jobs, and losing out on over £800 million per annum in GVA by the middle of the next decade.

This report seeks to break down the additional economic benefits of the transport improvement into three types, namely:

- Move to more productive jobs
- Pure agglomeration
- House price impacts

The first two of these are part of what is known as agglomeration benefits. Agglomeration benefits occur when a high geographic concentration of economic activity leads to higher productivity. This is an important economic effect that has been recognised in Department for Transport (DfT) guidance on evaluating major transport projects.

This study values the expansion of Metrolink. It does not seek to consider any other elements contained with the TIF package. It focuses on the eight districts of Manchester, Oldham, Rochdale, Bury, Trafford, Tameside, Salford and Stockport. These districts will be directly affected by the expansion of Metrolink and their labour markets are interconnected.

Agglomeration Benefits

The 'move to more productive jobs' element values the additional output which jobs, facilitated by the increased public transport capacity into the centre, could generate by being located in central Manchester rather than elsewhere. The 'pure agglomeration' element considers the way in which the scheme improves the effective density and connectivity between businesses in the Manchester agglomeration, in turn causing them to be more productive. This element values the increased productivity triggered across all jobs in central Manchester as a result of increased co-located activity. 'Move to more productive jobs' and 'pure agglomeration' are the largest two components of Wider Economic Benefits as recognised by the DfT. They are valued using the approach as set out in DfT guidance which estimates the increased GDP created as a result of the transport improvement. In this context, these benefits can be thought of as benefits to business and their employees.

House Price Impacts

The 'house price impacts' element estimates the house price increases that might be expected with improved accessibility into an urban centre. These benefits are not wholly additional to the business benefits as the two are inextricably linked. The more productive jobs in the centre will translate into higher earnings which in turn enable workers to afford higher priced houses. Wider regeneration impacts, such as house prices impacts, of investment in transport infrastructure are hard to quantify and detailed

guidance does not yet exist in this area. The house price impacts are therefore valued using a technique which estimates the relative effect of accessibility on house prices in the study area and in this way allows estimation of the increases in house prices that may be associated with increased accessibility.

Results

Agglomeration Benefits

Results are presented for the agglomeration benefits of the Metrolink expansion under a number of scenarios (productivity, elasticity, journey purpose, rate of modal switch, capacity utilisation). The most crucial assumptions are those surrounding how many actual 'new' jobs the expansion facilitates (as opposed to people switching modes or making journeys for none-work purposes for example). In the central scenario, by 2026 (the year by which capacity is assumed to be utilised), the Metrolink expansion is facilitating just over 3,200 completely new jobs in central Manchester which are creating output of between £4k and £10k more per annum due to their location in a well connected urban core.

The 'move to more productive jobs' estimate for 2026, in 2006 prices, is £28m. In addition, the 'pure agglomeration' estimate for 2026 is £4.2m. Whilst the methodology is slightly different, this is of a similar order of magnitude to the SDG agglomeration simulation exercise for Manchester. Depending on the assumptions used about the proportion of Metrolink users who are doing 'new' trips, this estimate can approximately halve or triple. When the central scenario values are summed up (i.e. cumulative) over the years to 2026 and discounted back to 2002, they result in total values of £139m 'move to more productive jobs' and £20m 'pure agglomeration'. When they are appraised over a 60 year horizon, the values are £590m and £87m respectively.

House Price Impacts

Analysis of the impacts of accessibility on house prices suggests that travel time savings of between 1 and 15 minutes could be associated with increased house prices of 0.4 and 5.4 per cent. Clearly this could increase individual house prices by significant sums of money, the exact calculation of which depends upon house prices across the area, and the distribution of travel time savings. Results are presented for two scenarios – the first uses the available data on travel time savings as a result of the Metrolink Phase 3a extension and assumes that the zones impacted by Phase 3b receive savings equal to the average of those savings. The second uses the same data but assumes that each zone impacted by Metrolink Phase 3b receives savings equal to the closest zone to it which benefited from Phase 3a. Both scenarios suggest that house prices could increase up to £12,000 in the areas that would benefit from the Metrolink expansion. Given the house prices across the area and the fact that several of the lines will go through Housing Market Renewal areas, this could also create very real and valuable benefits for Manchester residents.

A simplified estimation of the total of these individual house price changes across the whole study area results in central estimates of £295m and £515m across the Greater Manchester. The biggest impacts are seen in Manchester district, followed by Oldham, Rochdale and Tameside.

Conclusions

The 'move to more productive jobs' and 'pure agglomeration' estimates are entirely additional to the benefits estimated in a conventional transport appraisal. The house price impacts are less easy to define. Certainly, to some extent there is double counting as they are a way of capitalising on the increased incomes which more productive workers would earn. Some of this effect may however also be additional, the guidance here is thin and further work would be required to begin to assess the exact level of additionality in these assumptions.

The combination of estimates present a tangible way to think about transport improvement. For example, a resident of Rochdale may learn from a conventional appraisal that they will save 15 minutes on their journey to work and from the 'house price impact' analysis that they might expect the value of their house to increase by 4 per cent. From the agglomeration analysis that they might also expect their productivity to rise. These present quantifiable and tangible ways of understanding the benefits of the expansion of Metrolink to businesses, workers and residents.

2 Introduction and Background

2.1 Metrolink Overview

Manchester's Metrolink light rail network was set up in 1992 and, after a number of extensions, currently has some 23 miles (37 km) of track between Altrincham, Bury, Eccles and the Manchester urban core. On the basis that transport infrastructure plays a crucial underpinning role in the local economy, and acts as a constraint on economic growth, in 2007 AGMA (the Association of Greater Manchester Authorities) made a large bid to the Transport Innovation Fund.

The existing Metrolink is to be further extended along a number of new lines. Heavy rail will be replaced by the Metrolink on these lines, which will run more frequently than the heavy rail. The new lines will run from the urban core to:

- Rochdale via Oldham;
- Chorlton-cum-Hardy;
- Droylsden via Sportcity; and
- MediaCity: UK via a spur off the Eccles line.

Funding for these extensions, referred to throughout this document as "Phase 3a", has already been agreed with DfT. The Phase 3a expansions also include funding for 40 new trams.

Phase 3b refers to further extensions beyond this, which would be paid for with part of the Transport Innovation Fund (TIF). Phase 3b extensions would include extensions to:

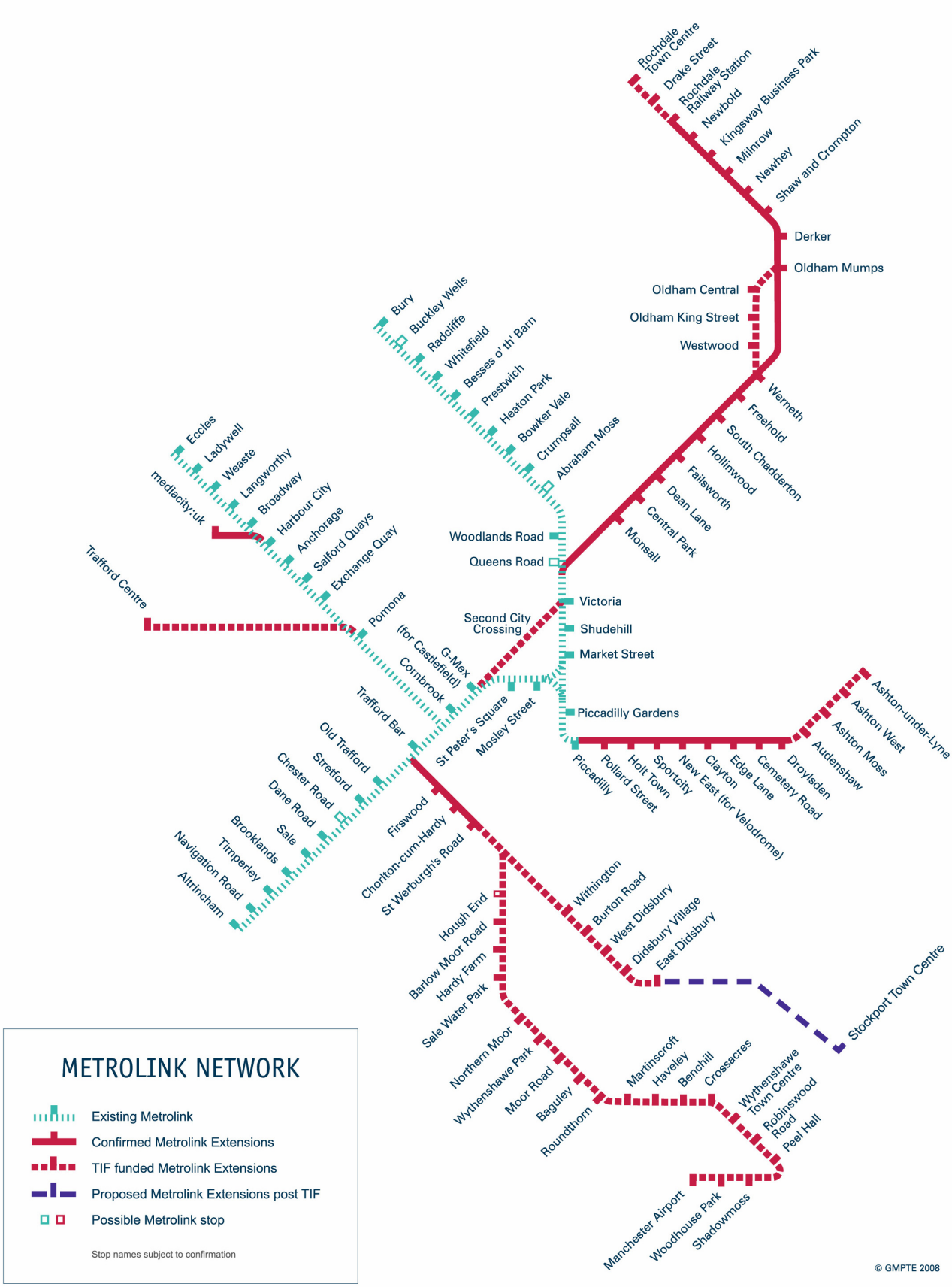
- East Didsbury;
- Manchester Airport;
- The Trafford Centre, via Trafford Park; and
- A second city crossing.

In addition to this, funding from the TIF bid will also provide 58 new trams, above the 40 currently funded as part of Phase 3a. This will increase the number of trams on the Metrolink from 32 at present to 130 when Phases 3a and 3b have been completed. The addition of Phases 3a and 3b to the existing Metrolink lines would significantly increase the length of the tram network, from 37km at present to 103km upon completion.

This study covers the future transport extensions of the Metrolink, which include both phases 3a and 3b. As the extensions are not currently in place, a distinction will be made between the proposed and planned lines against the existing lines to Bury, Altrincham, Eccles and the urban core.

The proposed extended route is set out in Figure 2.1.

Figure 2.1 Metrolink extended network



The 2001 Census shows that the most sustainable[2] travel to work patterns occur when commuting from the study area into Manchester[3]. 17 per cent of commuters from Bury to Manchester and 13 per cent from Trafford to Manchester travel by 'underground, metro, light rail or tram', which can be assumed to proxy for use of Metrolink. More recent patronage data suggests this has continued to grow. The aim of Metrolink is to create a better transport network, increase the capacity for commuting into central Manchester by public transport and reduce congestion on highways, in order to support this dynamic labour market.

2.2 Background, Literature Overview and Guidance

The expansion of the Manchester Metrolink as part of the TIF bid has been evaluated using conventional transport appraisal methods. Conventional transport appraisals estimate the transport and user benefits that transport improvements will deliver and set them against the capital and operational costs of delivery – a cost-benefit analysis. Those transport appraisals for Metrolink have concluded that it is a value for money investment.

The benefits of investment in transport infrastructure are valued in several ways. The full transport appraisal considers the local geography around the proposed transport link at a detailed zonal level and, via a complete analysis of the available highway and public transport networks, assesses the changes in travel times which each zone might expect to see as a result of the proposed investment. As discussed, such a transport appraisal exists for the Metrolink expansion and concludes that the scheme is value for money. Volterra were provided with (and have used) the resulting generalised travel times[4] for the Oldham-Rochdale line but not for the entire proposed extension to Metrolink as they were not available at the time of analysis. This report does not aim to provide results to a comparable level of detail as a transport appraisal.

The overall objective of this report is to set out, illustrate and analyse benefits, additional to those estimated by the conventional transport appraisal, that the proposed Metrolink extension is likely to generate. This report describes which benefits are considered, what approaches are used to value them, and then aims to quantify the benefits, and to establish ranges of sensitivity around this quantification.

The Department for Transport (DfT) now has guidance on how to value the wider economic benefits (WEBs) which investment in transport infrastructure can create. These wider economic benefits take the form of productivity increases which increased capacity into an urban centre could enable and support. This work follows the methodology set out in that guidance and uses the most appropriate assumptions for the purposes of valuing the WEBs of the Metrolink extension.

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[2] Sustainable is used in this context to refer to transport patterns which have the least impact upon the environment, and the most scope for growth. With increasing fuel costs and the growing concern about environmental impacts, government policy is strongly geared towards improving public transport in order to facilitate more sustainable transport patterns.

[3] Rather than from the study area to one of the seven other districts within the study area

[4] Generalised travel times take into consideration waiting time (for public transport), walking time at either end of a journey and cost of travel as well as the actual in-vehicle travel time.

The current guidance was heavily influenced by the proposal to build Crossrail in London. Crossrail is a new train line stretching from Maidenhead in the West through Central London and branching out to Essex and South East London. In 2002 the economic appraisal concentrated only on the direct transportation effects, in the form of changes to time and comfort for travellers, which were assumed to capture the whole of the economic benefits. Colin Buchanan and Volterra extended that analysis of economic benefits by developing an approach which quantified and valued the impact of Crossrail on central London growth and productivity by applying the theory of agglomeration.

A separate piece of work is being undertaken by the LSE as part of the Manchester Independent Economic Review[5] and will consider the concept of agglomeration more specifically focussed towards Manchester and its areas of speciality. The literature on agglomeration is large and it is not the purpose of this report to cover it in detail, but a brief overview is useful to set out the theoretical framework for the analysis.

The literature started in 1890 with Marshall's[6] conclusions that firms might favour agglomeration because it:

- Saves transport costs
- Allows for labour market pooling
- Facilitates intellectual spillover

Hotelling[7] (1929) expanded this to argue that similar firms co-locate due to the proximity of the output market. There has been a revival in the last decade of interest in economic geography which has spurred the revival of interest in cities. New economic geography research has applied modern models of profit maximising firms to a world which includes transport costs for both goods and workers. Such models show a rationale for the existence of cities in a static framework and indeed identify the scope for feedback mechanisms including knowledge spillovers and scope for learning. The literature in this area includes:

- Krugman (1997) – how economies organise themselves (self organisation, path dependence, discontinuous change)
- Krugman, Venables and Fujita (1999) – showing a rationale for the existence of large economic agglomerations
- Duranton and Puga (2001) – the role that diversified cities play in fostering innovation
- Fujita and Thisse (2002) – the economics of agglomeration
- Graham (2006) – estimates of agglomeration elasticities
- Glaeser and Gottlieb (2006) – evidence for the resurgence of cities
- Ellison, Glaeser and Kerr (2007) – measuring the relative importance of Marshall's three theories of industry agglomeration.

The result of the work incorporating the benefits of agglomeration into the valuation of Crossrail suggested that the economic impacts on business productivity valued in this

[5] More information on the Manchester Independent Economic Review and the research it has commissioned is available here: http://www.manchester-review.org.uk/
[6] A Marshall, 1890, Principles of Economics
[7] H Hotelling, 1929, Stability in Competition, The Economic Journal, Vol. 39, No. 153, pp. 41-57

way were both very large and entirely additional to the transportation impacts. In 2007, following lengthy discussions and detailed further analysis, the DfT adopted the approach, and incorporated it into their own guidance note.

In 2005 Sir Rod Eddington was commissioned to examine the long-term links between transport and the UK's economic productivity, growth and stability, within the context of the Government's broader commitment to sustainable developments. He found that transport policies offer some large economic returns and have and will continue to be crucial in sustaining productivity and competitiveness in the UK. As part of the evidence for the Eddington report, the DfT carried out a study[8] which considered the potential agglomeration benefits that could be realised by cutting transport cost by £0.01 for all journeys originating and ending in the 20 largest cities in England. The results indicate that the returns in London are vastly higher than in other cities, although the costs of delivering the time savings would also likely be higher. Manchester comes third both in terms of magnitude of agglomeration benefits and also when presented as a proportion of user benefits.

Steer Davies Gleave (SDG) carried out a simulation exercise for the Northern Way[9] to provide insight into the likely economic gains which could be delivered across the North by transport interventions. Their approach uses the methodology set out in DfT guidance – focussing only on the 'pure agglomeration' element. They simulated results based upon three broad scenarios[10] in order to give a high level view of the potential magnitude of agglomeration benefits. They found that the potential productivity gains are significant – the largest benefits were seen in Leeds and Manchester under all three scenarios. The benefits to Manchester ranged from £28m to £35m per annum, depending on the scenario.

The aim of the SDG work was to provide an understanding of the broad orders of magnitude rather than forecasting the impact of any particular scheme. As a result, too much weight should not be placed on the actual magnitude of these agglomeration effects. But the results by location give a reasonable indication of the relative impacts of various interventions and the results imply, unsurprisingly, that agglomeration benefits accrue more heavily to denser employment centres. The exact industrial make up of employment affects the degree to which the economies benefit from agglomeration – the activities located in the North West, for example, benefit more from agglomeration than those which dominate the economy in the North East (primary and public sectors).

SDG's South & West Yorkshire Dynamic Model[11] is more narrowly focussed than their simulation exercise, covering districts around Leeds and Sheffield. Again it tests the impacts of some broad transport improvement scenarios[12] rather than testing the effects

[8] DfT, December 2006, Agglomerations in the UK and the role of transport policy
[9] Steer Davies Gleave, November 2006, Northern Way: Agglomeration Simulation Exercise
[10] The three scenarios were a (i) 5% reduction in generalised cost of travel across the North, (ii) a focussed 10% reduction in travel costs within City Regions and (iii) a combination of intra and inter City Regions transport improvements.
[11] Steer Davies Gleave, December 2006, Model Development and Results for Northern Way using the South & West Yorkshire Dynamic Model.
[12] These scenarios include (i) an Urban Intervention defined as a 10% reduction in generalised travel time between zones which form a contiguous urban area around either Leeds or Sheffield and (ii) an Inter

of a particular transport scheme. It finds that there is potentially a conflict between overall growth in productivity and distributional impacts – while one intervention may lead to more balanced growth across cities, there is larger potential for productivity gains overall by the other intervention.

Another piece of research commissioned by the DfT as part of the Eddington study is the MVA analysis of wider economic impacts[13]. Using the technical capabilities of the South & West Yorkshire Strategic model, it considered the likely impacts of a range of transport interventions. Again the interventions were illustrative and did not reach specific conclusions. A key message from this work is that *"transport interventions in conurbations and major cities are able to make significant contributions to welfare and the economy, returning benefit to cost ratios generally in excess of 2.5"*.

In brief summary, the implications of these and significant other research across a wide range of disciplines and geographic areas on the role of transport in the economy are that the UK has been under-investing, in urban rail infrastructure in particular, by ignoring these wider economic benefits.

2.3 How to Value Metrolink

This report seeks to quantify the additional economic benefits of the Metrolink expansion. It seeks to value three types of benefit attributable to the transport improvement, namely:

- Move to more productive jobs
- Pure agglomeration
- House price impacts

The first two elements listed above, 'move to more productive jobs' and 'pure agglomeration' are the largest components of Wider Economic Benefits (WEBs). The other components of WEBs are derived directly from the conventional transport appraisal. The third element of this work, 'house price impacts' is less well defined and our approach, whilst considering and benchmarking against existing research, has focussed on the generation of new evidence in this area. Each element is now described in more detail in turn.

Move to More Productive Jobs

The 'move to more productive jobs' element is about the impact of the scheme in relieving capacity constraints into the city and thus enabling people to take jobs in the city where they will be more productive. For conservatism, this is valued as if a job created in the city centre would have been located elsewhere had capacity constraints prevented its central location. It answers the questions "how many workers could access jobs in central Manchester if the scheme were in place?" and "how much more productive will these jobs be than if they were located elsewhere in the region?".

Urban Intervention defined by three levels of generalised travel time reduction – 15% city centre to city centre, 10% urban area to city centre and 5% urban area to urban area.

[13] MVA, in association with David Simmonds Consultancy and Mouchel Parkman, for the DfT, October 2006. Wider Economic Impacts of Transport Interventions.

Capacity on the existing Metrolink lines will be increased and new capacity on the extra lines will be created. Mean output per worker in Manchester is estimated to be just under £45k (in 2006)[14]. In comparison output per worker in the other districts in the study area ranges from £32k to £41k. This implies that workers in Manchester are more productive. If the Metrolink expansion enables more workers to access jobs in central Manchester then this uplift in productivity can be realised.

Pure Agglomeration

The Pure Agglomeration element considers the way in which the scheme improves the effective density and connectivity between businesses in the Manchester agglomeration, in turn causing them to be more productive. The 'pure agglomeration' benefits therefore capture the increase in productivity of all workers as the total number of workers increases and these benefits accrue to both existing and new jobs.

In order to estimate this, the impact that increased employment density in Manchester will have upon the productivity of its workers must be understood – this is known as the agglomeration elasticity (the ratio of change in productivity with respect to changes in density). Work for the DfT by Dan Graham estimates the agglomeration elasticity by district. This allows us to value the changes in productivity brought about by changes in employment density.

House Price Impacts

As well as these wider economic benefits to businesses, it is important to understand how these benefits of increased productivity at work might both filter through to the residents of an area and catalyse additional regeneration.

The DfT guidance on valuing regeneration as a result of transport improvements mainly considers how many currently unemployed people will get jobs as a result of the investment. This is a narrow interpretation, specifically because it does not consider the wider regeneration benefits of increased development leading to new and increased population or higher wealth and prosperity for the current population.

Previous research (e.g. on the expansion of the Jubilee line in London[15]) has highlighted the wider welfare benefits of such transport infrastructure upgrades, such as the rise in property prices along the routes. The nature of these sorts of effects is that they are very local – the Jubilee line extension analysis for example, found significantly different sized impacts (ranging between 0 and 5.4 per cent) upon house prices in locations 250m, 500m or 750m from a station and these impacts were different again for the same distances from different stations (Canary Wharf and Southwark for instance).

There is no standard methodology for estimating how large this impact might be, and the results of existing post hoc appraisals, such as those for the Jubilee line extension, are not directly applicable in this context. Our approach therefore focuses on the generation of new evidence on the relationship between accessibility and house prices.

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[14] This is estimated from ASHE and ABI data and is explained in more detail in Section 4.1.6 and Appendix F.

[15] AtisReal & Geofutures, May 2006, for Transport for London: Property Value Study – Assessing the change in values attributable to the Jubilee Line Extension

Analysis at a very local level is fraught with difficulties from a data perspective. The data available to us is discussed in more detail later in the report. In summary however, the analysis set out in this report has considered a cross-sectional relationship between house prices, accessibility and other factors in order to attempt to estimate the impacts increases in accessibility may have on house prices along the Metrolink route.

The Metrolink Impact Study in 1994[16] used a hedonic pricing method to relate house prices to a variety of structural and locational characteristics. It should be noted that it found no evidence to suggest that Metrolink had a perceptible influence on the structure of house prices. Volterra does not have access to the detailed data used in their modelling and this report does not replicate the analysis previously undertaken. It is feasible however that relationships have changed over the past decade.

The Wider Economic Benefits elements of 'move to more productive jobs' and 'pure agglomeration' are entirely additional to the benefits estimated in a conventional transport appraisal. The house price impacts are less easy to define. Certainly, to some extent there is double counting as they are a way of capitalising the increased incomes which more productive workers would earn. Some of this effect may however also be additional. The guidance here is thin and further work would be required to begin to assess the exact level of additionality in these assumptions. The combination of estimates present a tangible way to think about transport improvement. For example, a resident of Rochdale may learn from a conventional appraisal that they will save 15 minutes on their journey to work and from the 'house price impact' analysis that they might expect the value of their house to increase by 4 per cent. From the agglomeration analysis that they might also expect their productivity to rise. These present quantifiable and tangible ways of understanding the benefits of the expansion of Metrolink to businesses, workers and residents.

[16] Metrolink Impact Study, 1994. University of Salford: Department of Geography

3 Context

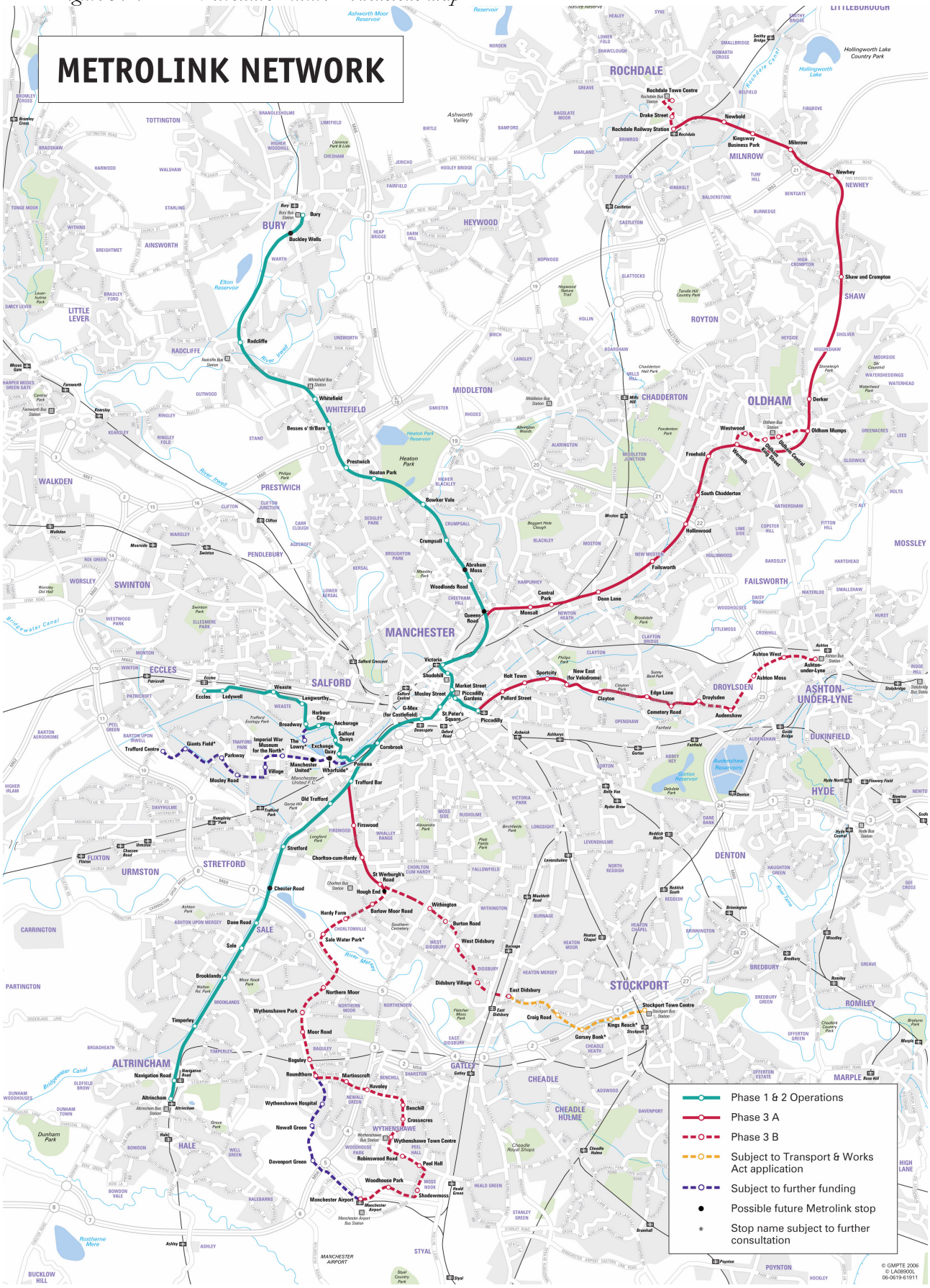
The Metrolink Extension will greatly benefit businesses and workers in Manchester by increasing their accessibility to one another and to the large labour market in the study area. This section defines the study area and then considers its dynamics and economic characteristics in more detail.

3.1 The Study Area

The map below shows the Metrolink extension in the context of the area within which it falls. The existing and new Metrolink lines fall within the districts of Manchester, Bury, Rochdale, Oldham, Salford, Trafford and Tameside. Stockport is also included within the analysis as it borders the central Manchester district, neighbours the Metrolink line ending at East Didsbury and, as Figure 3.1 shows, in the future Metrolink may be further extended into Stockport Town centre. Stockport is also part of the combined labour market in this area and is therefore relevant.

The other districts within Greater Manchester are excluded from the analysis as they do not benefit directly from the expansion of Metrolink and it is therefore appropriate not to consider them. Throughout this report, when the 'study area' is referred to, it encompasses the eight districts of Bury, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside and Trafford.

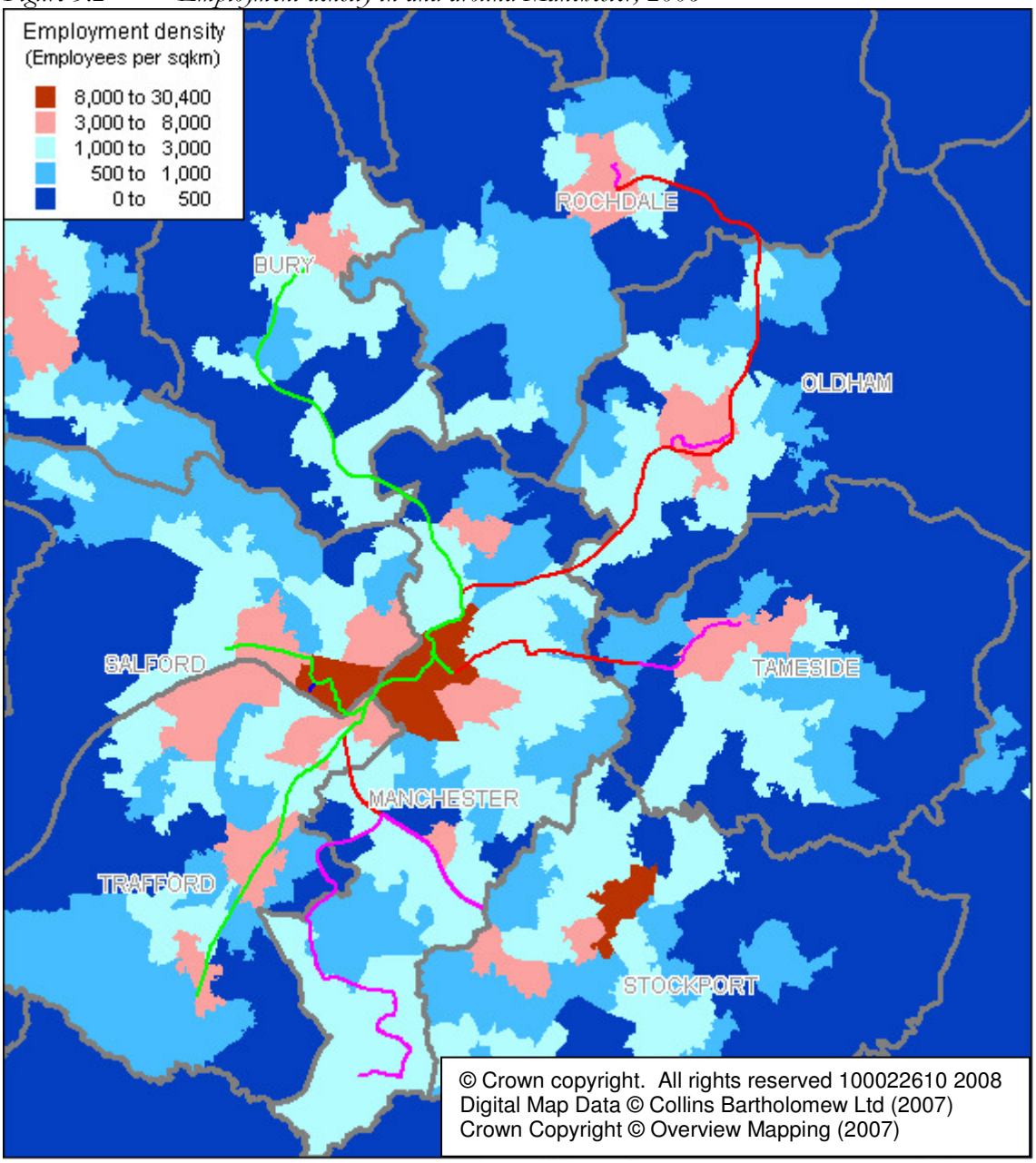
Figure 3.1: Metrolink Future Extensions map



3.2 Labour Market

The map in Figure 3.2 shows the density of employment in and around Manchester. There is a clear cluster of employment in central Manchester near to Victoria and Piccadilly stations and around the universities of Salford and Manchester. Other pockets of less dense employment are also evident along and at the ends of the existing and proposed Metrolink lines. These are the employment centres of Rochdale, Bury, Oldham, Ashton, Eccles, Altrincham, Cheadle and Stockport. Bolton is also evident in the North West of the map.

Figure 3.2 Employment density in and around Manchester, 2006



Data Source: ABI, 2006

3.2.1 Commuting by district

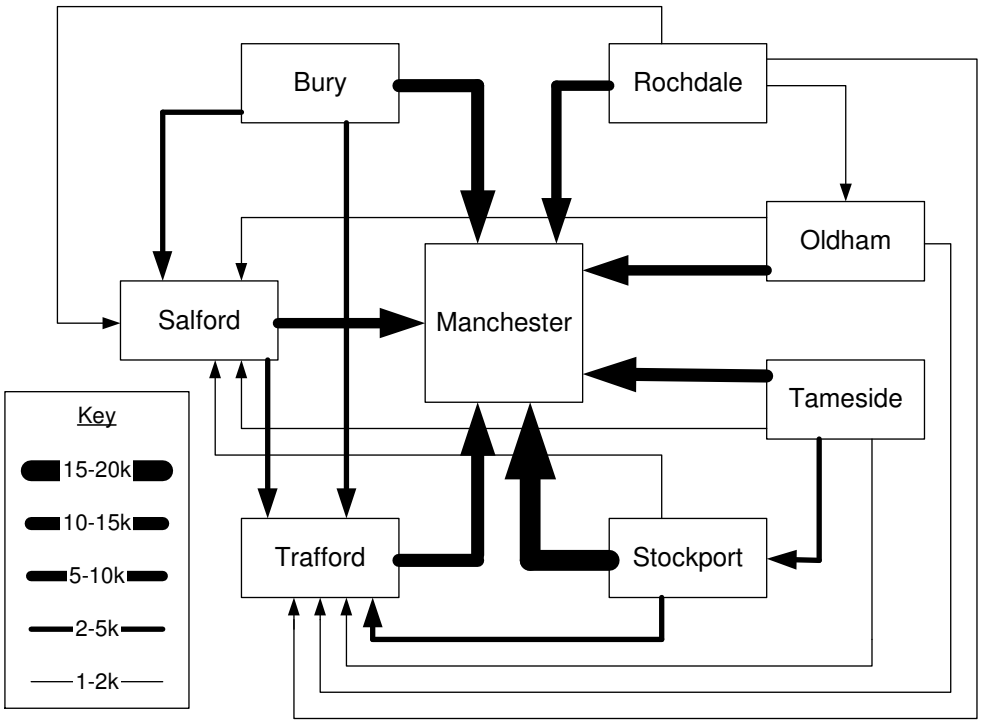
The 2001 Census provides us with an interesting picture of commuting patterns within the study area. The net pattern of commuting is summarised in Figure 3.3 below. More detailed tables can be found in Appendix A.

By way of example, 13,600 residents of Bury commute to Manchester but only 1,400 commute in the opposite direction from Manchester to Bury. In terms of distribution, the 13,600 people commuting from Bury to Manchester represent 16 per cent of the working residents of Bury but only account for 5 per cent of the people who work in Manchester. This relationship with Manchester is similar across all other districts. The largest volumes of out-commuting from Manchester are to the districts in the south of the study area – Trafford, Stockport and Salford.

Bury, Oldham, Rochdale, Stockport and Tameside are net out exporters of workers – i.e. they have fewer jobs than working residents, whereas Manchester, Salford and Trafford are net importers, having more jobs than working residents. Manchester has by far the largest difference, with almost double the number of jobs than working residents.

This large concentration of employment in Manchester, with large net inflows of workers coming from the neighbouring districts is shown in Figure 3.3. This pattern of commuting supports the case that Manchester is the central hub of employment activity within the study area.

Figure 3.3 Net commuting flows within the study area



Data Source: Census 2001 Origin-Destination Commuting tables, by district

3.2.2 Commuting by mode

Detailed tables of commuting by mode can also be found in Appendix A. As with most regions outside London, the predominant transport mode is the car. With increasing fuel costs and the growing concern about environmental impacts, government policy is strongly geared towards improving public transport in order to facilitate more sustainable transport patterns. Of the districts considered, Manchester has the lowest reliance upon car trips and the highest use of buses. This reflects its city status and more comprehensive provision of public transport. The aim of the Metrolink Extension is to increase the capacity for commuting into central Manchester, improving accessibility within the study area as a whole and supporting this dynamic and interconnected labour market.

Interestingly, when considering the modal split of commuting from these districts in more detail it is evident that of those commuting into Manchester, a larger proportion use public transport than of those commuting to one of the other seven districts within the study area. There are also significant percentages commuting by tram from Bury and Trafford districts (17 and 13 per cent respectively) representing the existing Metrolink lines to Bury and Altrincham.

It is interesting to note that the percentage which commutes by bus is significantly lower in Bury and Trafford than in the other districts (with the exception of Stockport which has higher levels of train commuting). This suggests that commuters switched from bus to tram when Phase 1 Metrolink lines were introduced. This theory is supported by the findings of the Metrolink Monitoring Study[17] produced in 1996 which found evidence that suggested larger numbers switched from bus to tram than from car to tram.

Table 3.1 compares the ratio of highway trips to public transport trips[18] by origin and destination of trip. This shows that for every trip made from Bury to Oldham by public transport there are 17.05 trips made by highway, whereas for every trip made by public transport from Bury to Manchester there are only 2.27 trips made by highway. This table shows that trips into Manchester have by far the most sustainable patterns, having the lowest ratios of highway to public transport trips. The objective will be to further reduce these ratios and promote increased use of public transport.

[17] Metrolink Monitoring Study, December 1996. An independent report by Oscar Faber. Volume One: Impacts on Travel Patterns and Behaviour

[18] Where Highway trips are defined to include car drivers and passengers and motorcycles, and Public Transport trips are defined to include underground, train and bus.

Table 3.1 Ratio of highway trips to public transport trips, by origin and destination

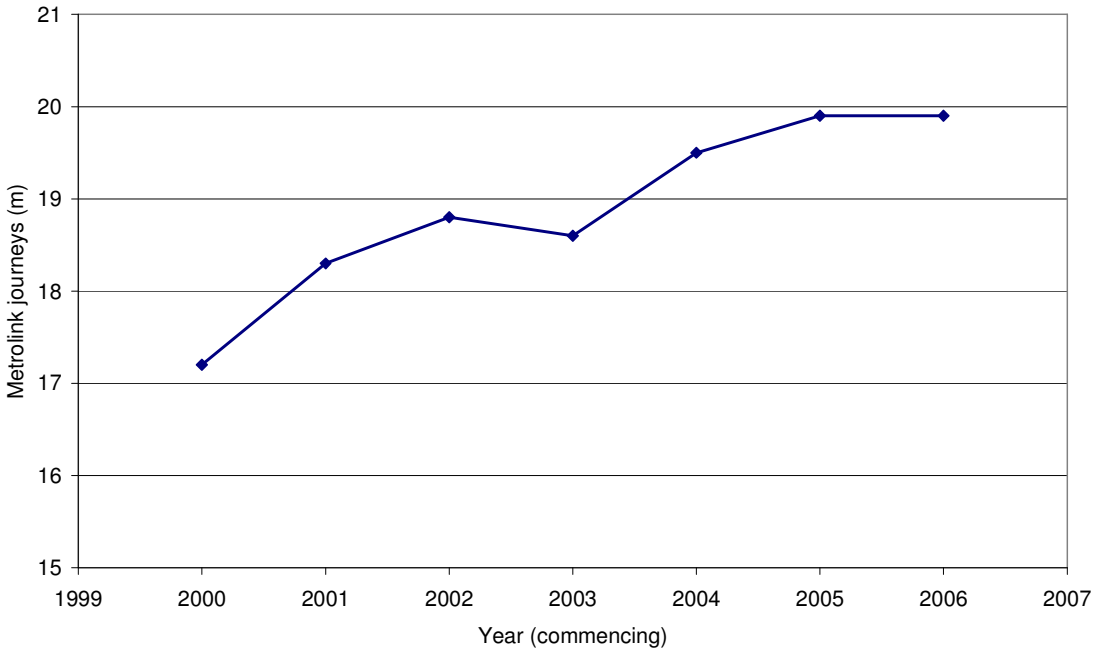
To → From ↓	Bury	Manchester	Oldham	Rochdale	Salford	Stockport	Tameside	Trafford
Bury	6.43	2.27	17.05	13.58	7.82	13.59	8.34	7.90
Manchester	3.79	1.59	4.33	4.05	2.80	3.18	3.28	2.89
Oldham	14.65	2.75	4.90	9.16	5.68	15.87	9.66	8.54
Rochdale	6.46	2.77	6.99	7.08	8.34	18.11	20.34	8.22
Salford	7.74	1.99	10.83	13.20	5.08	10.81	5.46	5.97
Stockport	17.35	3.27	23.74	23.94	6.19	5.68	12.58	12.25
Tameside	8.87	2.09	6.45	13.07	4.52	5.96	5.55	7.76
Trafford	7.60	2.78	13.53	15.27	6.60	16.60	11.39	5.68

Data Source: Census 2001 Origin-Destination Commuting tables, by district and mode

3.2.3 Metrolink Patronage

Figure 3.4 shows the total journeys on Metrolink from 2000/2001 to 2006/2007. This shows that journeys have grown steadily over the seven year period. For this study it is necessary to understand the patronage in the peak period, for commuting reasons. More detailed information is available for the peak period, but not by journey purpose.

Figure 3.4 Metrolink Journeys 2000/2001 to 2006/2007



Data Source: Greater Manchester Passenger Transport Authority & Executive Business and Performance Plan and Annual Environmental Report 2007-2008, page 11.

A review of the detailed boarding counts[19] of Inbound passengers on the Bury, Altrincham and Eccles lines in the peak period shows that after the initial opening of the Bury and Altrincham lines, the patronage appears to have remained fairly steady,

[19] GMTU Report 1289, pages 131-141

although both lines saw an increase between 2005 and 2006. Patronage on the Eccles line has been rising steadily since it opened fully in 2000.

The peak period runs from 7:30-9:30am. The boarding counts suggest that, depending upon the exact distribution of passengers across the two hour peak period, the Altrincham line is currently operating at around capacity and the Bury line is just under. The Eccles line could accommodate more passengers during the peak period but the patronage has almost doubled during the six years since opening.

3.3 Prosperity and Deprivation

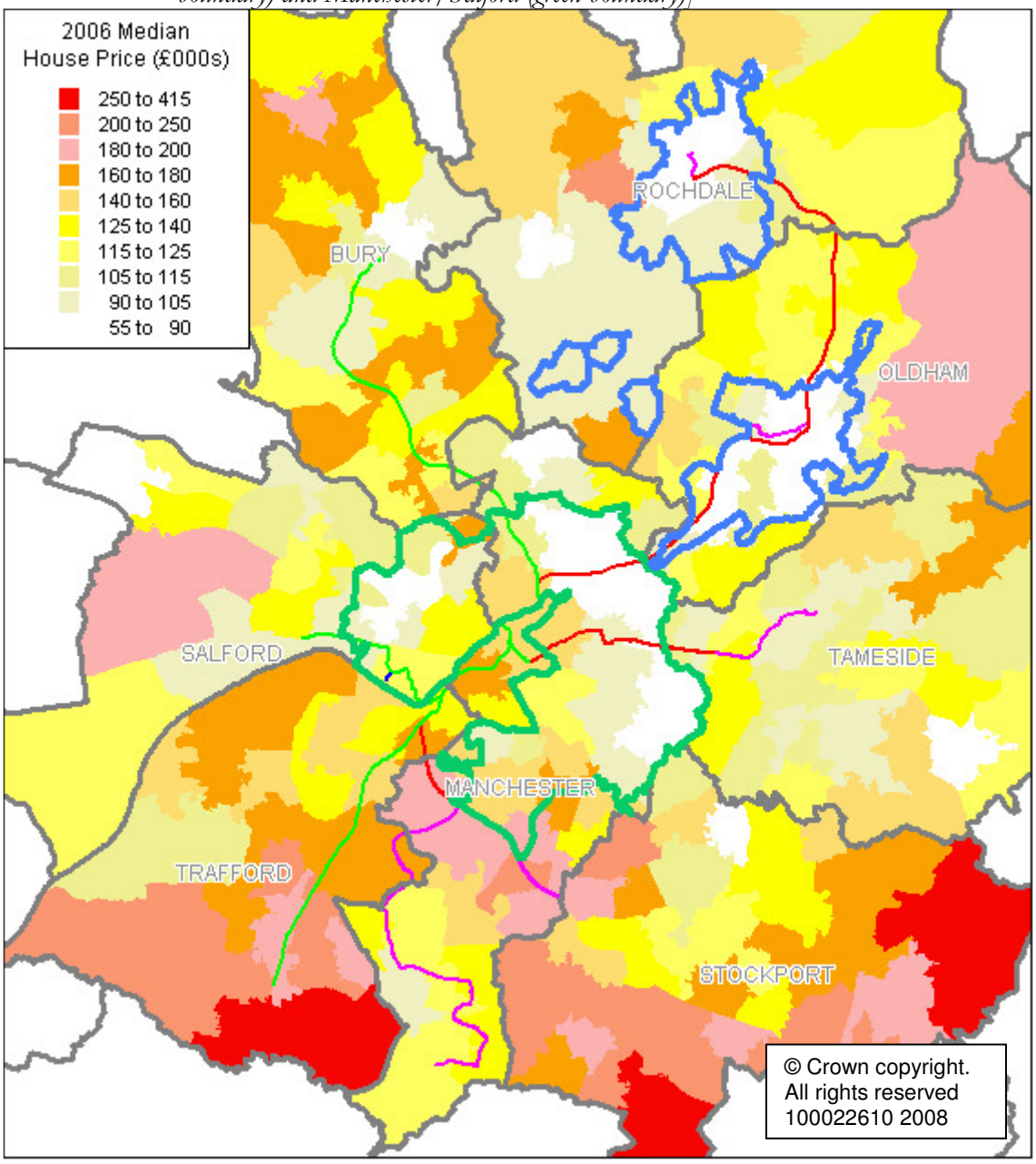
As discussed in the previous section, the study area is currently heavily reliant on highway modes of transport. The extension of Metrolink will therefore offer more public transport choice to residents. Not only will this benefit businesses and workers in Manchester by improving their interconnectivity, it may also impact upon house prices as public transport accessibility affects the desirability of residential locations. This section examines indicators of prosperity and deprivation, namely house prices, affordability, deprivation and accessibility.

3.3.1 House prices

Over the last decade house prices have grown rapidly across the whole country. Land Registry data shows that at a district level, within the study area, Manchester district has experienced the largest growth, followed by Trafford. Rochdale has seen the poorest performance although nearly all of the eight districts have matched the average North West growth rates. More detailed tables and charts of the average district house prices can be found in Appendix B.

District level statistics disguise wide ranges of house prices at a more local level. House prices can vary significantly from street to street. House prices are available at a smaller level of geography from Neighbourhood statistics (via the Office of National Statistics). This shows the higher prices reached in Macclesfield district which contains the wealthy towns of Wilmslow and Knutsford. The low prices in Rochdale, north Manchester and, in fact, much of the study area, are evident. Figure 3.5 shows house prices at this level of geography within the study area.

Figure 3.5 *House prices in the eight districts at Middle Super Output Area level [Housing Market Renewal Pathfinders highlighted: Oldham/Rochdale (blue boundary) and Manchester/Salford (green boundary)]*



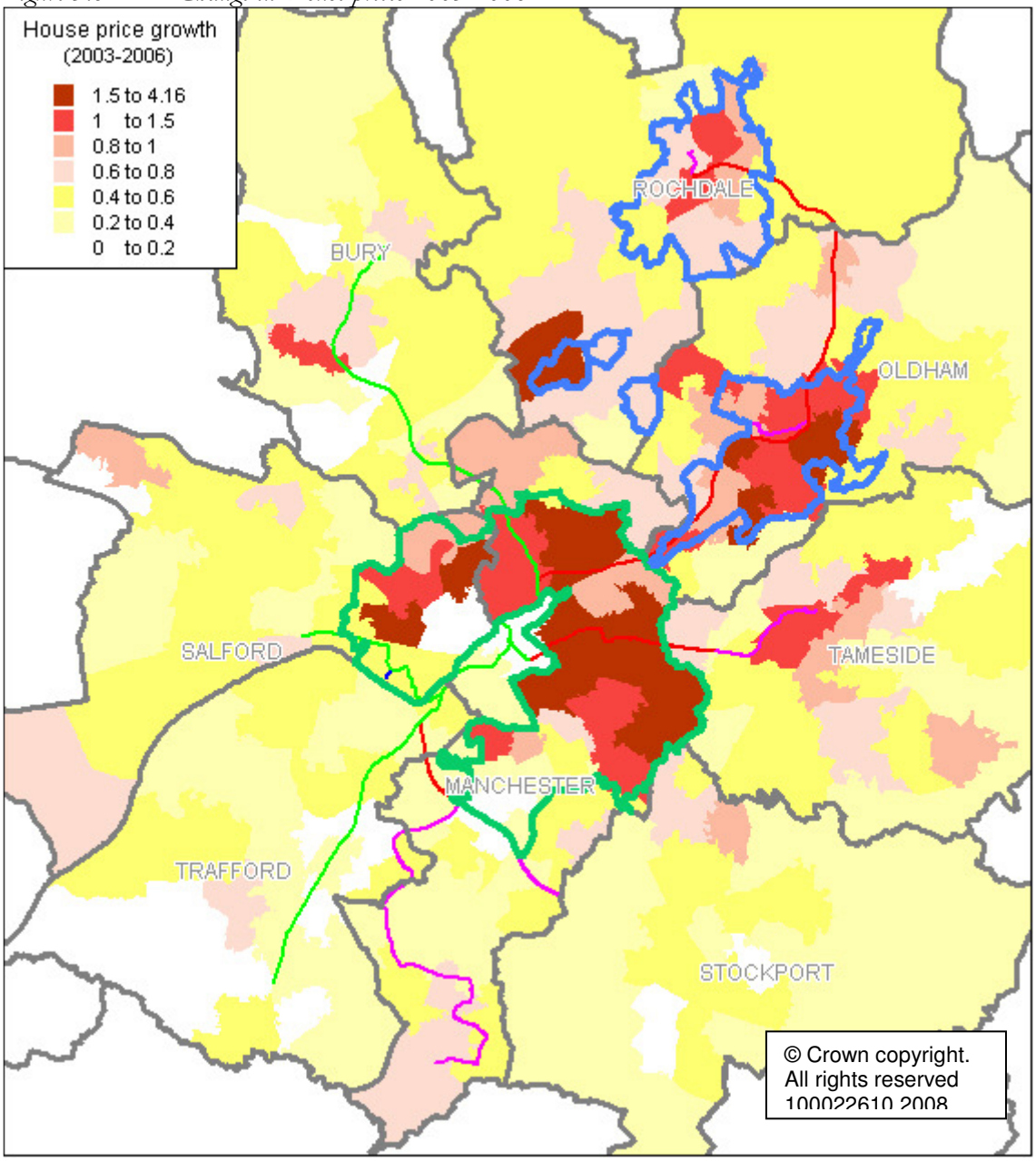
Data Source: ONS Neighbourhood Statistics

The map of the study area shows the higher average[20] prices in the southern part of the Trafford district, around Altrincham and Hale. Also highlighted in Figure 3.5 are the Oldham/Rochdale and Manchester/Salford Housing Market Renewal Pathfinders. As might be expected, these are situated around areas with low house prices in 2006. It is also evident that the Metrolink extensions pass through several of the pathfinder areas.

[20] The maps shows median house price. Mean prices were also considered, and they show very similar results.

Figure 3.6 shows how house prices have changed over the three year period from 2003-2006. This range is chosen due to the availability of data. As this is during the house price boom, large increases are seen across the whole area – with the majority of places experiencing between 20 and 60 per cent growth. Pathfinder area house price growth has seen a significant increase, albeit from a low base.

Figure 3.6 Change in House prices 2003-2006



Data Source: ONS Neighbourhood Statistics

Having considered the current house price differences which exist across the study area the next section looks at factors which may be driving these differences – affordability, deprivation and accessibility.

3.3.2 Affordability

In Trafford average house prices are eight times average incomes, and this gap widens to nine times when considering the lower quartile. Although this might appear to suggest an affordability problem in the area, the North West region has the second lowest ratio of prices to incomes (after the North East) across England as a whole. Charts showing affordability ratios across the study area are shown in Appendix B.

3.3.3 Deprivation

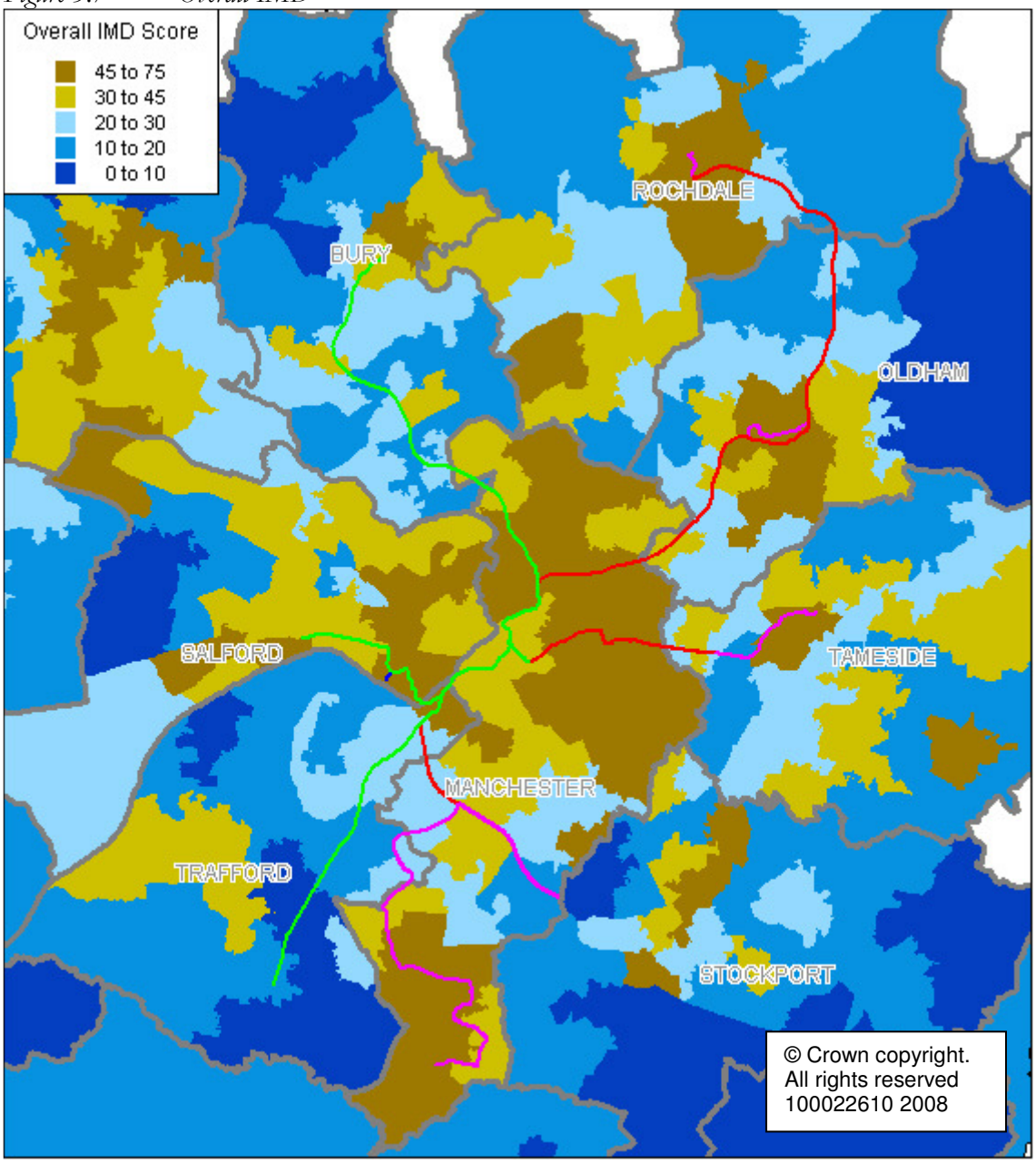
The Index of Multiple Deprivation is collated by the department for Communities and Local Government (CLG). It is made up of seven domains:

- Income
- Employment
- Health and Disability
- Education, Skills and Training
- Barriers to Housing and Services
- Crime
- Living Environment (contains sub-domains 'indoors' and 'outdoors')

These seven domains and the two sub domains of the Living Environment indicator are shown in the maps in Appendix C. The sub domains of 'indoors' and 'outdoors' are distinguished between because the 'outdoors' measure captures air quality and traffic accidents, and so tends to identify built up locations (cities), whereas the 'indoors' measure considers housing condition which is considered to be a potentially relevant factor when considering house prices.

The map showing overall IMD score is shown below. The Metrolink route is overlaid. Higher numbers (and brown colours) represent higher deprivation and lower numbers (and blue colours) represent lower deprivation. Deprivation across all measures is evident in the pathfinder areas. The Barriers to Housing and Services measure is heavily focussed in Manchester and Rochdale. The 'indoors' living environment measure (a proxy for housing condition) shows a slightly different spread of deprivation which, whilst still heavily focused in central Manchester, also highlights pockets of low quality housing within all of the districts.

Figure 3.7 Overall IMD



Data Source: CLG Indices of Multiple Deprivation 2007

3.3.4 Accessibility

Volterra were provided with model results from the SDG model for the Oldham-Rochdale line. This model is based on 'SHRM' Zones.

The SDG model data gives origin-destination generalised travel time matrices for highway and public transport costs[21]. This means, for example, that it tells us how long it takes to get from Zone 326 in Rochdale to Zone 440 in Stockport or Zone 4 in Central Manchester both by highway and by public transport. Generalised travel times account for in vehicle time, waiting time (for public transport) and walking time at either end of a journey.

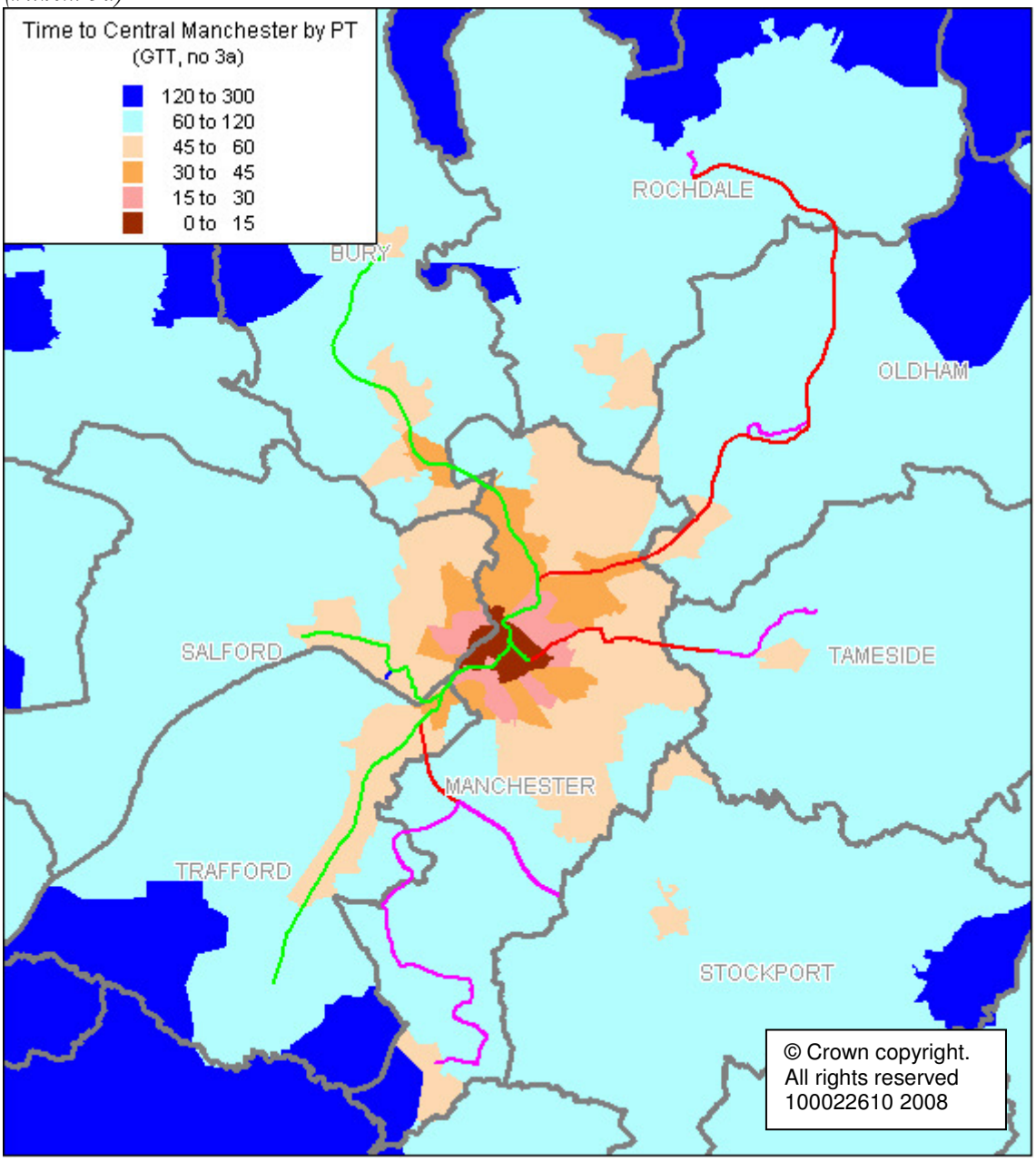
Several manipulations of this data were considered in order to find a simple but informative measure of relevant accessibility within the study area. These manipulations are detailed in Appendix D. Our chosen indicator is a measure of travel time by public transport taken to reach central Manchester.

Employment density in central Manchester was examined and a central core[22] identified. Figure 3.8 below shows the time by public transport to reach this central core. It is evident that the shorter times circle out from central Manchester and then follow the Bury and Altrincham lines. They do not yet follow the new lines as this travel time is based on the network prior to the implementation of these new routes.

[21] The data provided contained public transport generalised travel times for each pair of zones for two scenarios – with and without car ownership. For the purposes of simplifying the data an average between these two data series is taken

[22] This is defined as SHRM Zones 1, 2, 4, 10, 16, 17, 25, 26, 32, 33 and 34

Figure 3.8 Generalised travel time (minutes) to reach central Manchester by Public Transport (without 3a)



Data Source: Volterra derived from GMPTE SDG Model outputs

The local house price and deprivation data presented in the previous sections is available on Middle Super Output Area boundaries. As discussed in this section, the accessibility data is based on outputs from the SDG model which is available on SHRM zones. A map showing these two sets of boundaries is shown in Appendix D. For the purposes of modelling, the accessibility data must be converted from one geographic definition to another. At any data translation stage checks have been carried out to ensure the data has converted appropriately. For comparison, the same map is shown in Appendix D using raw data on SHRM zones and also when it has been converted to MSOA boundaries.

4 Analysis and Results

This section details the analysis undertaken, all assumptions made in order to undertake the analysis and the results of the work. Section 4.1 discusses the analysis associated with the agglomeration benefits of 'move to more productive jobs' and 'pure agglomeration', section 4.2 describes the results of these two estimates. Section 4.3 then considers the analysis associated with estimating the 'house price impacts' and section 4.4 summarises the results of this analysis.

4.1 Analysis – business benefits

4.1.1 Overview

In order to estimate the 'move to more productive jobs' and 'pure agglomeration' elements of Wider Economic Benefits in relation to Metrolink the following must be understood:

- the routes on which Metrolink will operate
- the areas around Manchester upon which these extended / improved routes will impact
- the capacities and frequencies which will be available on these routes
- the demand for these services and the degree to which this demand is 'new' and for travel to work purposes
- the productivity of people who work in the impacted areas
- specific Department for Transport estimates of 'effective density' and the elasticity of productivity with respect to 'effective density'

The information available and assumptions made in each of these areas are now described and explained in more detail.

4.1.2 The Metrolink Network

The complete Metrolink route is shown in different forms in Figures 2.1 and 3.1. The route has also been highlighted in the maps in this report. The green lines represent the existing Bury, Altrincham and Eccles lines, the red lines represent Phase 3a and the purple lines represent Phase 3b.

For the purposes of modelling it is important to know which districts the stations fall into and therefore where the passengers are likely to be travelling from.

Existing lines
The Altrincham line falls entirely within Trafford district and all boarders from the patronage data fall within this area. The Bury line is within the Bury district until the stop after Prestwich, Heaton Park. The most recent patronage data shows that just under 80 per cent of passengers board from stations within the Bury district. The Eccles line falls entirely within Salford district and all boarders from the patronage data fall within this area.

New lines

Seven stations on the Oldham-Rochdale line fall within the Rochdale district, eleven stations fall within the Oldham district (although three of these are on the Oldham loop) and the final three station fall within the Manchester district. Using the Bury line as a comparator, it is assumed that 80 per cent of passengers will board from outside Manchester and that these boarders are split evenly between Rochdale and Oldham districts. With the exception of Sale Water Park, all stations on the Manchester Airport and East Didsbury lines fall within Manchester district. All of the passengers on this line are therefore assumed to board from within Manchester district. The Ashton-under-Lyne line falls predominantly in Tameside district. Again, using the Bury line as a benchmark, it is assumed that 80 per cent of passengers travelling in the direction of Manchester board from within the Tameside district.

4.1.3 Geography / districts considered

As detailed previously, the study area is taken to be the eight districts of Bury, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside and Trafford.

4.1.4 Employment forecasts

Volterra were provided with the Greater Manchester Forecasting Model results for use in this analysis. This provides employment forecasts at a district level, split by sector. It is important to note that the employment growth forecasts produced for Greater Manchester are not constrained by either road congestion or lack of capacity on the public transport system. Even achieving reference employment growth forecasts may not be possible if the transport infrastructure is not able to cope with the increased numbers of people needing to commute in to, and move around, the city region. Research undertaken by GMPTE suggests that if congestion is allowed to continue unabated up to 30,000 forecast new jobs will be at risk in Greater Manchester over the next decade. In line with this, the assumption made within the modelling is that without the additional capacity into the centre from the Metrolink expansion, those jobs would be constrained[23]. The table below summarises the growth forecast by district in the GMFM.

[23] For the purposes of conservatism, when valuing the 'move to more productive jobs' element it is assumed that the constrained jobs would otherwise have been located elsewhere – this is so that the value attributed to them is only the increase in output created by those jobs being in a more productive centre, rather than the complete output associated with the jobs themselves. For the purposes of modelling it is therefore assumed that the constrained jobs are located in the origin district out of which the workers are constrained from travelling.

Table 4.1 Forecast employment in the study area

000s	Historic			Forecast		growth 07-26
	1991	**2001**	**2007**	**2016**	**2026**	
Bury	72.0	68.6	69.6	71.1	73.9	4.3
Manchester	312.1	310.6	330.7	382.9	431.6	100.9
Oldham	87.7	88.4	92.2	92.3	92.8	0.7
Rochdale	77.1	83.4	89.3	92.0	96.4	7.1
Salford	104.7	116.3	126.5	135.5	143.4	16.8
Stockport	127.5	131.3	136.9	139.5	144.6	7.7
Tameside	92.5	78.8	88.4	86.5	86.6	-1.9
Trafford	115.5	138.1	140.2	148.4	158.5	18.3

Data Source: Greater Manchester Forecasting Model

In line with the findings of our research into the main hubs of employment in Manchester, the largest growth both in absolute and percentage terms is forecast to occur in Manchester. Salford and Trafford are also forecast to experience reasonable growth. Stockport, Bury and Rochdale are forecast to have relatively low growth, and Oldham and Tameside are forecast to remain static, with Tameside experiencing a slight fall in employment. These trends are shown in the charts in Appendix E.

In order to be conservative, no further employment growth is assumed from 2026 onwards. If growth continues, the pure agglomeration benefits would rise.

4.1.5 Capacities

Table 4.2 summarises the capacities of the lines which were assumed. The work in this study values the Phase 3a and 3b Metrolink capacity expansions and route extensions.

Table 4.2 Hourly Metrolink capacities, by line

Line	Existing	Future 2013 (pre 3a & 3b)	Future 2013 (with 3a and 3b)	Future 2016 (with 3a and 3b)
Bury	2,200	3,000	4,000	4,800
Altrincham	2,200	3,000	4,000	4,800
Eccles	1,000	2,000	2,200	2,200
Oldham-Rochdale	420	420	2,000	2,000
Ashton-under-Lyne	n/a	n/a	2,200	2,200
Airport	n/a	n/a	2,000	2,000
East Didsbury	n/a	n/a	2,000	2,000

Data Source: GMPTE TIF Congestion Package Metrolink Phase 3 Metrics, 13 May 2008 v1

The peak period is assumed to run from 7:30-9:30am and that the capacity set out in Table 4.2 is available for both hours of this period.

For conservatism, it is assumed that 1.5 times the hourly capacity will be used, rather than the full two times which would be possible during the two hour peak period. On the basis of the Bury and Trafford modal commuting patterns discussed previously, it is assumed that 50 per cent of these journeys are people switching from car or bus to tram. It is also assumed that only two-thirds of the new journeys are for commuting purposes. Other commuting purposes include, for example, journeys to education, retail or leisure.

In order to understand how these assumptions about capacity, peak period, switch-rate and purpose impact upon our estimates, they are considered as sensitivities and results are presented for a range of scenarios.

4.1.6 Productivity

The estimate of the move to more productive jobs enabled by the increase in capacity into central Manchester is captured by considering the uplift in output that these workers can create by being in the denser central environment.

For the purpose of making the 'move to more productive jobs' element of the valuation conservative it is assumed that, without Metrolink, the jobs would instead have been located in the origin district and only the increase in productivity caused by enabling these jobs to be located in central Manchester is valued.

In order to estimate 'move to more productive jobs', it is therefore necessary to have estimates of the output generated by workers in the areas of interest. Data on earnings from the Annual Survey of Hourly Earnings (ASHE) has been used, and an uplift applied to convert it into output per worker. The uplift is derived by taking the ratio between total output and total earnings in the North West. The resulting estimates of output per worker at a district level are set out in the table below. The method behind these estimates is set out in Appendix F.

Table 4.3 Estimated output per worker by district

District	Estimated Output per Head 2006	Difference with Manchester	% relative to Manchester
Bury	£34,432	£10,018	-29%
Manchester	£44,450	-	-27%
Oldham	£33,239	£11,211	0%
Rochdale	£34,954	£9,497	-34%
Salford	£40,453	£3,997	-10%
Stockport	£36,773	£7,677	-21%
Tameside	£32,249	£12,201	-38%
Trafford	£40,625	£3,825	-9%

Data Source: Volterra, estimated using ABI employment, ASHE earnings data and NW GDP

Productivity growth of 1.13 per cent per annum is assumed which is the long term trend rate for the North West. A sensitivity where productivity growth is lower, at 0.86 per cent based on more recent trends is also considered. The basis for these assumptions is also set out in Appendix F.

4.1.7 Effective density

The estimate of the 'move to more productive jobs' element is captured by considering the uplift in output that workers can create by being in a denser environment. However, these workers also facilitate further 'agglomeration' benefits.

The reason for this is that more workers moving into the same area intensifies the existing cluster of employment. Co-location of employment leads to a number of

productivity benefits as mentioned previously in the discussion about agglomeration (saves transport costs, allows for labour market pooling, facilitates intellectual spillover for instance). Because of these reasons, the increase in employment in the centre causes the existing city centre workers to become more productive. This effect is the pure agglomeration benefit.

In order to calculate this therefore, it is necessary to understand the definition of clusters of employment, or employment density. Initial work in this area simply used actual employment density – so if the number of city centre workers increased by 10%, then density in the city centre was increased by 10%. The DfT now prefers to use 'effective density' as opposed to absolute density. As well as employment itself, this also attempts to take into consideration accessibility by including a measure of distance between areas in the calculation of density.

The DfT guidance defines the 'effective density' of a location to be equal to the employment in a location plus the employment in other locations, divided by the distance to each of those other locations[24]. The distance between locations is preferably measured as the generalised travel time between two zones. Volterra were provided with generalised travel times between zones in Manchester, however they are at a much smaller level of geography than the historic and forecast employment numbers which are only available at district level.

Two approximations to the measure of distance are therefore considered in the estimate of effective density and results presented based on both. These are:

- An 'as the crow flies' distance between the centres of the districts
- The generalised travel time between central zones[25] within the districts

In order to get one generalised travel time between central zones for each district, the ratio of highway to public transport trips (as set out earlier and in appendix A) is used to reach a weighted generalised travel time which takes account of both the highway and public transport elements.

4.1.8 Elasticity of productivity with respect to effective density

In economics, the elasticity is the ratio of the change in one variable with respect to change in another variable. Dan Graham has produced several reports for the DfT which look to estimate the agglomeration elasticity – the ratio of change in productivity with respect to change in density. This is an important factor for the pure agglomeration calculations as it allows us to value the change in productivity brought about by changes in effective density. The agglomeration elasticities by district which are available from the DfT are used. These are set out in the table below.

[24] This is a true simplification if the value of alpha is equal to -1. This is consistent with the DfT guidance.
[25] The central zones used are as follows: Bury zone 294, Manchester zones 4, 16 and 25, Oldham zone 370, Rochdale zone 326, Salford zone 129, Stockport zone 440, Tameside zone 393 and Trafford zone 110.

Table 4.4 Agglomeration elasticities by district

District	Elasticity
Bury	0.033
Manchester	0.052
Oldham	0.040
Rochdale	0.058
Salford	0.030
Stockport	0.040
Tameside	0.036
Trafford	0.045

Data source: DfT Agglomeration evidence by LA

These mean that a 10 per cent increase in effective density will lead to a productivity increase of 0.33 per cent in Bury, 0.52 per cent in Manchester and so on.

Elasticities are available split by industrial sector and are highest in the Transport and Communication and Financial Intermediation sectors, suggesting that these industries benefit the most from agglomeration effects. The elasticities split by sector are not used as this adds a level of unnecessary complexity.

The effective density method is followed and these productivity elasticities are used as they are the official estimates, although our own view is that absolute densities might better capture reality and it is also hard to believe that Rochdale has a higher elasticity than Manchester. With this in mind, when presenting the results a sensitivity where the elasticity for Rochdale is equal to the elasticity for its neighbouring district Oldham is also considered.

4.1.9 Time horizon and discounting

The scheme is considered over three time horizons. Firstly the results are presented annually, secondly it is valued to 2026, as this is when the employment scenarios run to and the time horizon of main interest to Manchester Enterprises. Finally the scheme is valued for 60 years of operation (i.e. to 2072). In the 2026 and 2072 scenarios the values are discounted back to the base year of 2002 because this is the base year recommended in WebTAG[26] guidance. A discount rate of 3.5 per cent for the first 30 years and 3 per cent thereafter are used, again as defined in WebTAG.

[26] WebTAG is the Department for Transport's website for providing guidance on the appraisal of transport projects. The guidance provides advice on how to conduct an appraisal which meets the Department's requirements.

4.2 Results – business benefits

The Metrolink expansion as part of the wider TIF scheme has been appraised via conventional methods and it has been concluded that it is a value for money investment. The results set out here present a different, and additional, approach to estimating the wider economic impacts of the expansion to Metrolink.

Specifically this section of the report focuses on the two largest components of Wider Economic Benefits:

- Move to more productive jobs (the value of the increased output created by the workers who can now access employment in central Manchester as a result of the increased capacity)
- Pure agglomeration (the value of the uplift in output triggered by the increased density of central Manchester)

These benefits are valued in line with DfT guidance, using the assumptions set out in section 4.1.

Once the estimate of the move to more productive jobs uplift in output that workers can create by being in a denser environment has been estimated, in line with DfT guidance only 30 per cent of this benefit can be claimed as a welfare benefit within a transport appraisal. The resulting values are set out in the tables below, with a variety of scenarios.

The scenarios presented consider the various sensitivities discussed through the report. These are:

- Below trend productivity growth
- An alternative measure of distance to generalised travel time ('as the crow flies')
- Estimates about the number of 'new trips' (versus trips switched from other modes)
- Estimates about the proportion of trips which are for travel to work purposes
- Testing the impact of the Rochdale elasticity being equal to that of Oldham

Table 4.5 'Move to more productive jobs' – Present Value, discounted to 2002

Assumptions	Total Value (£m)		Welfare Value (£m)	
	To 2026	To 2072	To 2026	To 2072
1.5 capacity hours, 50% 'new', 2/3rd travel to work purpose, 1.13% productivity growth, DfT Elasticities	139.2	589.8	41.7	176.9
Other scenarios				
As above but reduction in productivity growth to 0.86%	133.6	538.7	40.1	161.6
As above but 75% 'new'	208.7	884.6	62.6	265.4
As above but 1/3rd travel to work purpose	69.6	294.9	20.9	88.5
Maximum scenario: 2 capacity hours, 100% 'new' and 100% travel to work purpose	556.7	2,359.1	167.0	707.7

Data Source: Volterra

Table 4.6 Pure agglomeration – Present Value, discounted to 2002

Assumptions	Total Value (£m)	
	To 2026	To 2072
1.5 capacity hours, 50% 'new', 2/3rd travel to work purpose, GTT distance, 1.13% productivity growth	20.2	86.5
Other scenarios		
As above but reduction in productivity growth to 0.86%	19.4	79.0
As above but 'as the crow flies' distance	10.1	43.2
As above but 75% 'new'	30.4	130.2
As above but 1/3rd travel to work purpose	10.1	43.4
Maximum scenario: 2 capacity hours, 100% 'new' and 100% travel to work purpose	82.3	353.5
As above but Rochdale elasticity replaced with Oldham	20.5	87.9

Data Source: Volterra

The ranges show the importance of the underlying assumptions. It is clear however, even under the most conservative set of assumptions, that Metrolink will make a large contribution to GDP growth.

The scenarios which change the assumptions around productivity growth or the Rochdale elasticity have the smallest effects on the benefits estimated. The biggest impacts by far are caused by flexing the assumptions around the number of new jobs enabled by the Metrolink expansion. This can be flexed in three ways:

- The proportion of Metrolink journeys which are 'new' rather than shifted from an alternative mode
- The proportion of peak period journeys which are for travel to work purposes
- And the capacity actually used (maximum 2 full capacity hours in the peak period, not allowing for any over crowding)

Within the 'move to more productive jobs' and 'pure agglomeration' benefit calculations, the values derive from the number of 'new' jobs which are able to be more productive in central Manchester as a result of the increased capacity, and the knock on impact of increased density on the productivity of all workers. As a result it is unsurprising that the results are heavily dependant upon the assumptions which underpin the number of 'new' jobs enabled by the expansion.

Once the lines and capacity expansions are operational, boarding counts will be recorded and it would be possible, retrospectively to narrow down this range of estimates, based on experienced data.

The assumptions made here are that the additional Metrolink capacity is filled in line with employment projections up till 2026, and not completely filled until 2026. Clearly this take up could be much more rapid. Altering the pattern of take up from this trend to complete within year one would uplift the 2072 value[27] by approximately 25 per cent.

[27] By definition it would have a bigger effect on the value to 2026.

In order to present a meaningful annual figure, it is therefore sensible to consider 2026 when the full impact of the Metrolink expansion has taken place and is being used. In the central scenario, by 2026, the Metrolink expansion is facilitating just over 3,200 new jobs in central Manchester each of which are creating additional output of between £4k and £10k more per annum due to their location in a well connected urban core. The 'move to more productive jobs' estimate for 2026, in 2006 prices, is £28m. In addition, the 'pure agglomeration' estimate for 2026 is £4.2m. Whilst the methodology is slightly different, this is of a similar order of magnitude to the SDG agglomeration simulation exercises for Manchester. Depending on the proportion of Metrolink users who are doing 'new' trips, this estimate can approximately halve or triple.

4.3 Analysis – residential benefits

4.3.1 Overview

There are two distinct modelling approaches to trying to identify the relationship between accessibility and house prices. These are:

- Time series
- Cross sectional

Time series
One could take time series data on house prices and build a relationship with other indicators available in a time series to see whether causal factors could be identified. This method might, for example, be useful in understanding the impact of interest rates upon house prices, because one might expect this to have a lagged impact as it affects peoples' willingness or ability to buy or sell property.

This approach is unfortunately not possible in this context. As described previously, the impacts of changes in accessibility are expected to be local in their nature, and therefore house price information is required at a smaller level of geography than district level. The MSOA house prices data presented in Section 3.3.1 is only available from 2003-2006. This method should be considered in the future however, once longer time series data is available.

Cross-sectional
Instead of using information across time, another approach is to collate data on different indicators across space. This is the approach taken. The previous sections described various data which is available to use. The next step is to try to understand how these indicators might be related to one another.

Whereas a time series relationship might tell you that if interest rates fall in year 1, other things equal, house prices might rise in year 2; a cross-sectional analysis might tell you that if area A and area B are identical in every way except area B has a higher crime rate and lower house prices, it might be expected that if crime were reduced in area B, house prices might rise to the level seen in area A.

The objective is to value the uplift in house prices which could be associated with the improved accessibility caused by Metrolink. The available data is collated and a cross-sectional analysis of the relationship between house prices and various factors is carried out.

4.3.2 Data

The data considered in the analysis includes:

- Housing variables: mean and median prices, sales and prices by type and prices by room
- Deprivation indicators: Overall index of multiple deprivation, the seven domains of Income, Employment, Health, Education, Barriers, Crime and

Living Environment. The sub-domains of the Living Environment indicator – Indoors and Outdoors
- Employment, population and workforce – levels and densities
- Accessibility: travel time to central Manchester and other measures of accessibility calculated as detailed in Appendix D

4.3.3 Analysis

The initial screening of the data involved considering pairwise correlations between all variables. Some variables were excluded due to over-correlation. The correlation tables can be found in Appendix G. Many of the deprivation indices, for example, are highly correlated with each other. Specifically, the income, employment, health and education indices have correlation coefficients of around 0.9 with each other and with the overall measure of deprivation. The Crime indicator is also highly correlated with these, but slightly less so than they are with each other. The 'indoors' living environment sub-domain, a proxy for housing condition, is much less correlated with all other indicators.

The purpose of this modelling is to understand what might be expected to happen to house prices if accessibility increases. In order to do this it is necessary to establish the drivers of house price, such as those described earlier – deprivation, access to schools and healthcare, accessibility etc. With a link established between these variables and house prices the model can then be used to test the scenario of an improvement in accessibility within the model.

The way in which house prices are linked with these variables is through a linear regression. This approach has been chosen for a number of reasons:

- It is one of the simplest and most transparent ways in which a number of indicators can be tested to hold a relationship with a single variable.
- A large amount of standard statistical and econometric testing can be carried out on the results to assess the validity of the derived results.
- It is a statistically robust way of linking house prices with location specific variables.
- The results obtained from using a linear regression can very easily be used to assess the potential impact of a change to one of the independent variables.

The principles on which the preferred regression model has been selected are as follows:

- To have as high a predictive power as possible
- The variables should all be statistically significant at the standard 5% confidence level
- To have as many different location-specific indicators as possible (subject to the significance criteria)
- The variables must make intuitive sense as explanatory variables
- The regressions must be robust to validation and standard diagnostic testing.

4.3.4 Chosen model

The technical details of the preferred model are detailed in Appendix H, which also considers model validity.

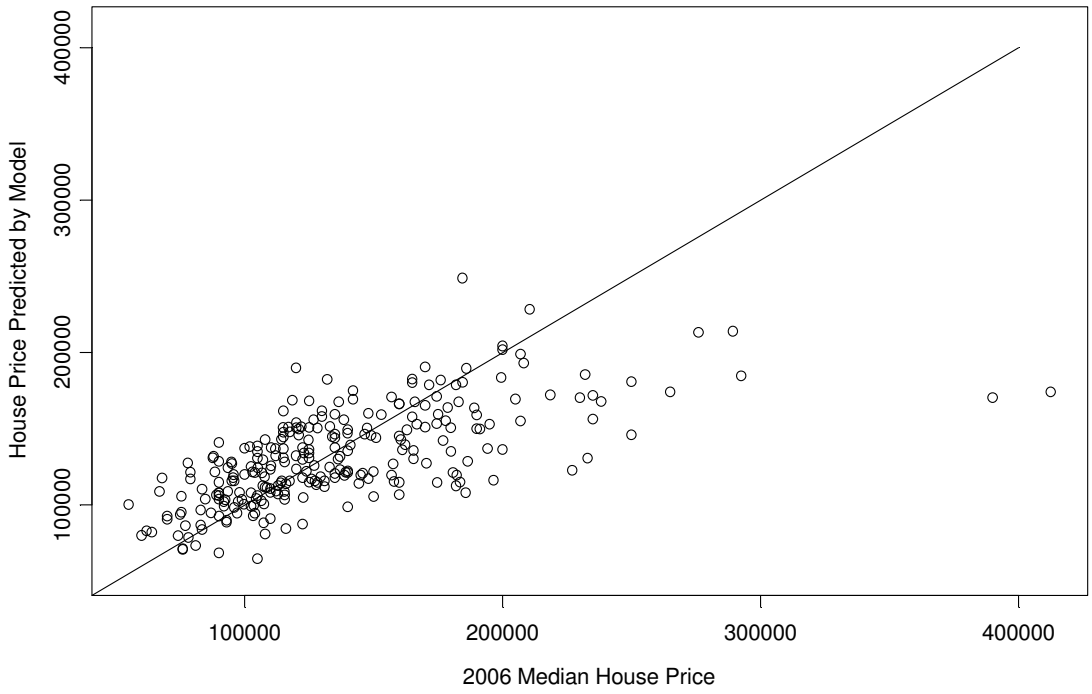
In summary, the dependent variable is the logarithm of median house prices in 2006. This transformation of house prices proved to be a more appropriate functional form than the level or a measure of change. The explanatory variables are the Crime deprivation measure, the 'indoors' living environment measure (a measure of housing condition) and the time it takes by public transport to access central Manchester.

The signs of the coefficients are intuitive:

- As crime increases, house prices fall
- As the 'indoors' deprivation measure increases (representing worse housing condition), house prices fall
- As the time it takes to get to central Manchester increases, house prices fall.

The resulting model predictions are shown in Figure 4.1. It is evident that the house prices predicted by the model closely match actual house prices, although the model fits the higher price areas less well. Other non-linear transformations of the house price variable – namely squared and cubed transformations – were also considered. These resulted in models with lower explanatory power. The two outlying observations are in the southern part of the Trafford district, renowned for its high house prices. These observations could have been removed from the modelling but this does not materially affect the results and the model remains robust.

Figure 4.1 Fitted against actual house prices



Data Source: ONS Neighbourhood Statistics 2006 house prices and Volterra model results

All variables used within the model are highly significant. An R-squared value is a measure of the goodness of fit of a model – it can range from 0 to 1. The value for this model is 0.5 which is a good fit for a cross-sectional dataset.

Now that a model which predicts the house prices across the study area well has been found, the objective is to assess the impact which accessibility has on prices. The standard way to do this is to test what the model would predict for house prices if the levels of accessibility change but everything else within the model remains the same (crime level and housing condition). The model implies that travel time savings would have the percentage impacts upon house prices as set out in the table below.

Table 4.7 Effects on house prices from time savings

Travel time saving to Central Manchester	Percentage uplift in House price
1minute reduction	0.35%
2minute reduction	0.70%
3minute reduction	1.05%
4minute reduction	1.41%
5minute reduction	1.76%
10minute reduction	3.56%
15minute reduction	5.38%

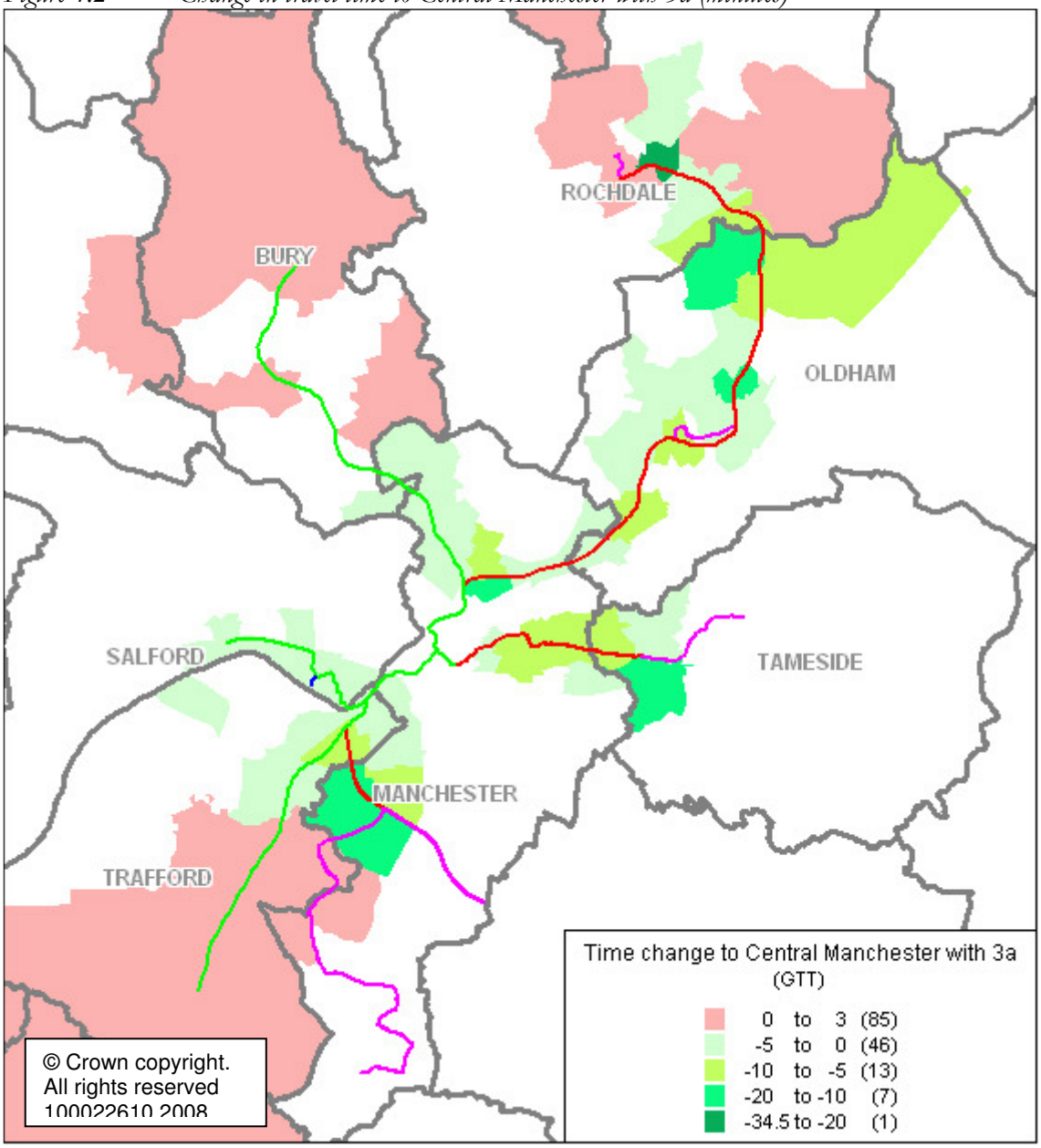
It is reassuring at this point to remember the results of the research examining the impacts of the Jubilee line extension (discussed earlier in Section 2.3) on residential value around Southwark and Canary Wharf stations. This found that the percentage of total residential value attributable to the Jubilee line extension ranged from between 0 and 5.4 per cent, depending on distance from the stations. This is consistent with our model results.

4.4 Results – residential benefits

Our model estimates that, for example, a 3 minute public transport travel time saving into central Manchester would result in a house price increase of just over 1 per cent. In order to understand how the Metrolink expansion may impact upon house prices in the study area estimates of the travel time savings the expansion will generate across the study area are required.

A complete transport appraisal calculates the time savings as a result of transport improvements. A complete appraisal for the entire Metrolink extension was not available for us to use at the time of analysis. Volterra were however provided with results for the 3a routes. The map below shows the change in our calculated indicator (travel time to central Manchester by public transport) modelled to result from introducing the Phase 3a improvements.

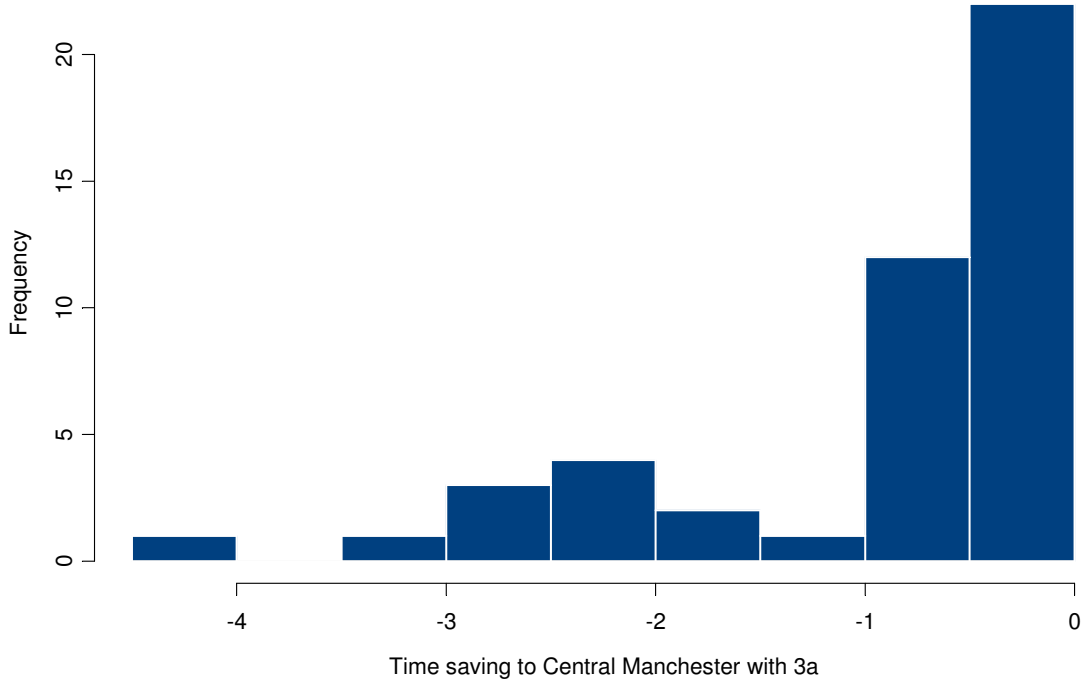
Figure 4.2 Change in travel time to Central Manchester with 3a (minutes)



Data Source: Volterra derived from GMPTE SDG Model outputs

This shows that along the new and improved routes, the modelled time savings range from 0-5 up to 20 minutes. The majority of time savings are between 0 and 5 minutes. The distribution of these is shown in Figure 4.3. They are heavily weighted towards under 1 minute.

Figure 4.3 Distribution of 0-5 minute savings in travel time to Central Manchester with 3a



Data Source: Volterra derived from GMPTE SDG Model outputs

For the zones where the SDG model provides a 'with 3a' time change (as shown in Figure 4.2) this can be used. For the other zones, where 3b will deliver travel time savings, a reasonable estimation of the size of these effects must be made in order to understand how house prices might change. The areas along the 3b routes were identified and the results are provided for two scenarios of travel time savings to those zones:

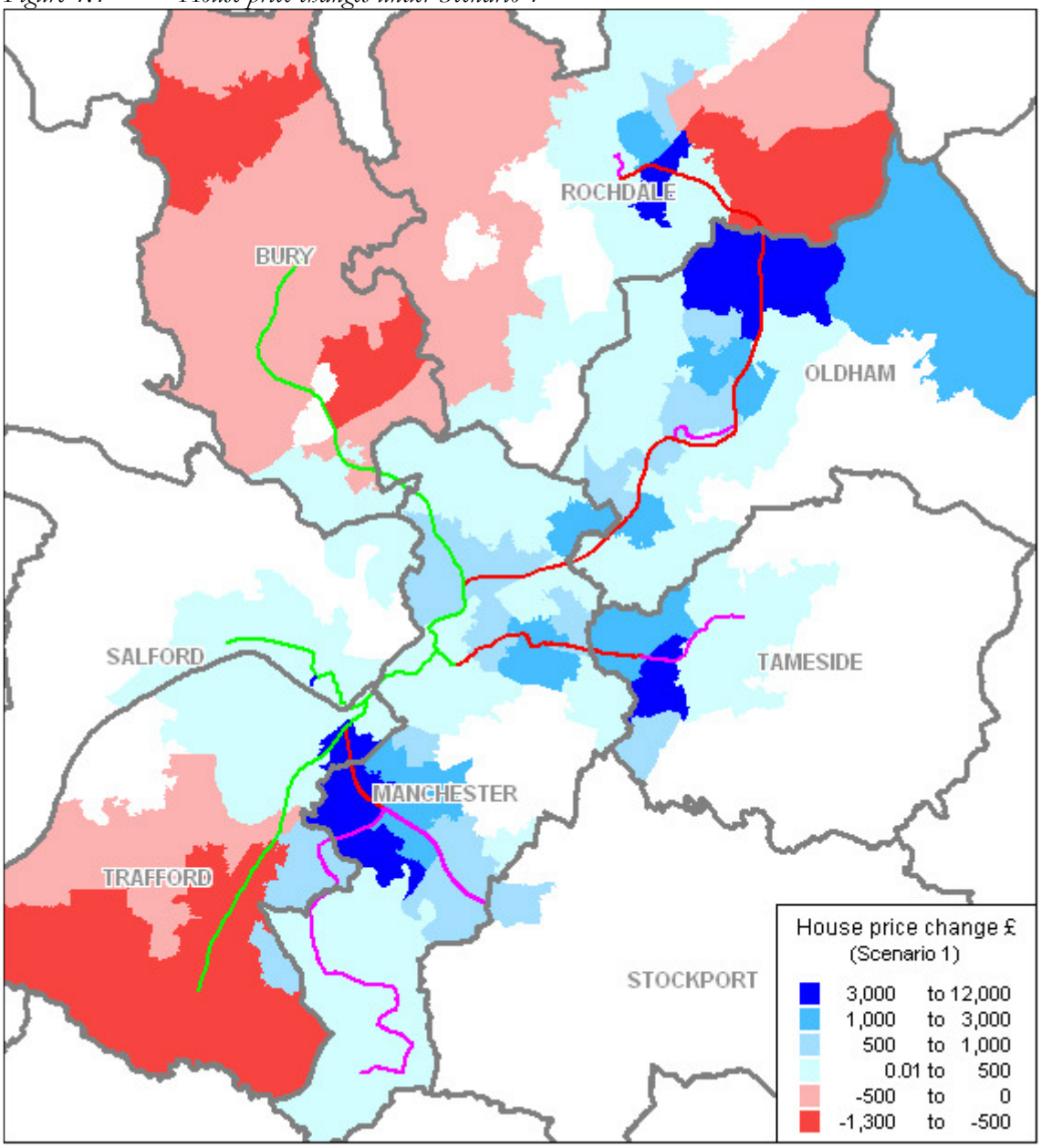
- allocate them a time saving equal to the median time saving seen across the zones positively impacted by 3a (a saving of 0.975 minutes) [Scenario 1]
- allocate them a time saving equal to the time saving seen in the closest zone which is positively impacted by 3a [Scenario 2]

The resulting house price increases are shown in Figures 4.4 and 4.6 below. As you would expect, given the definition of our scenarios, the impacts are higher under Scenario 2.

It should be noted that as 3a has a negative impact upon travel times from some of the zones, these are shown to have reduced house prices. This is a result of slightly increased travel times (of around one minute) to the city centre. Bury and Trafford are most affected by this as the existing Metrolink infrastructure will have to accommodate additional stock.

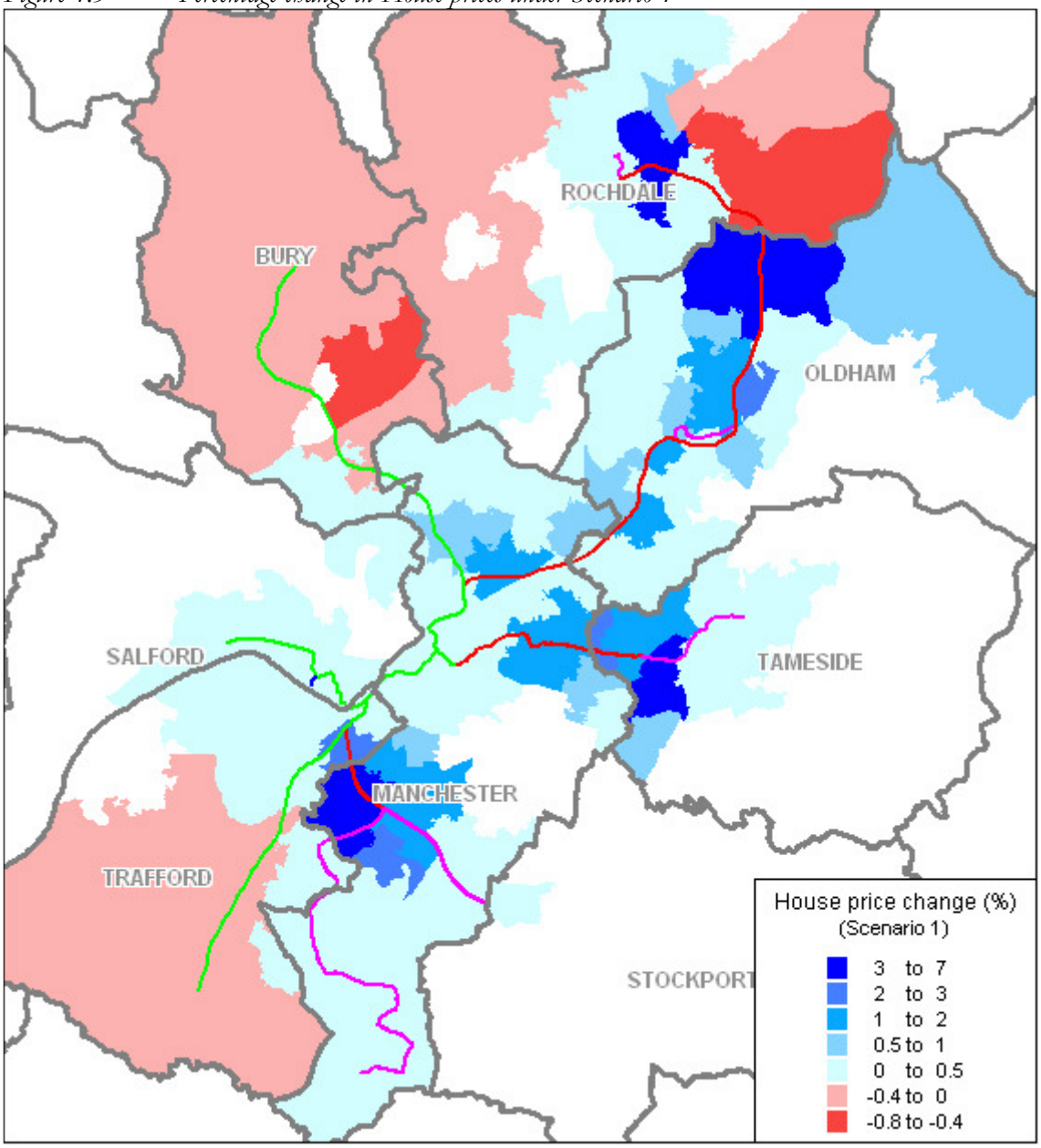
The percentage change in house prices under the two scenarios are shown in Figures 4.5 and 4.7.

Figure 4.4 House price changes under Scenario 1



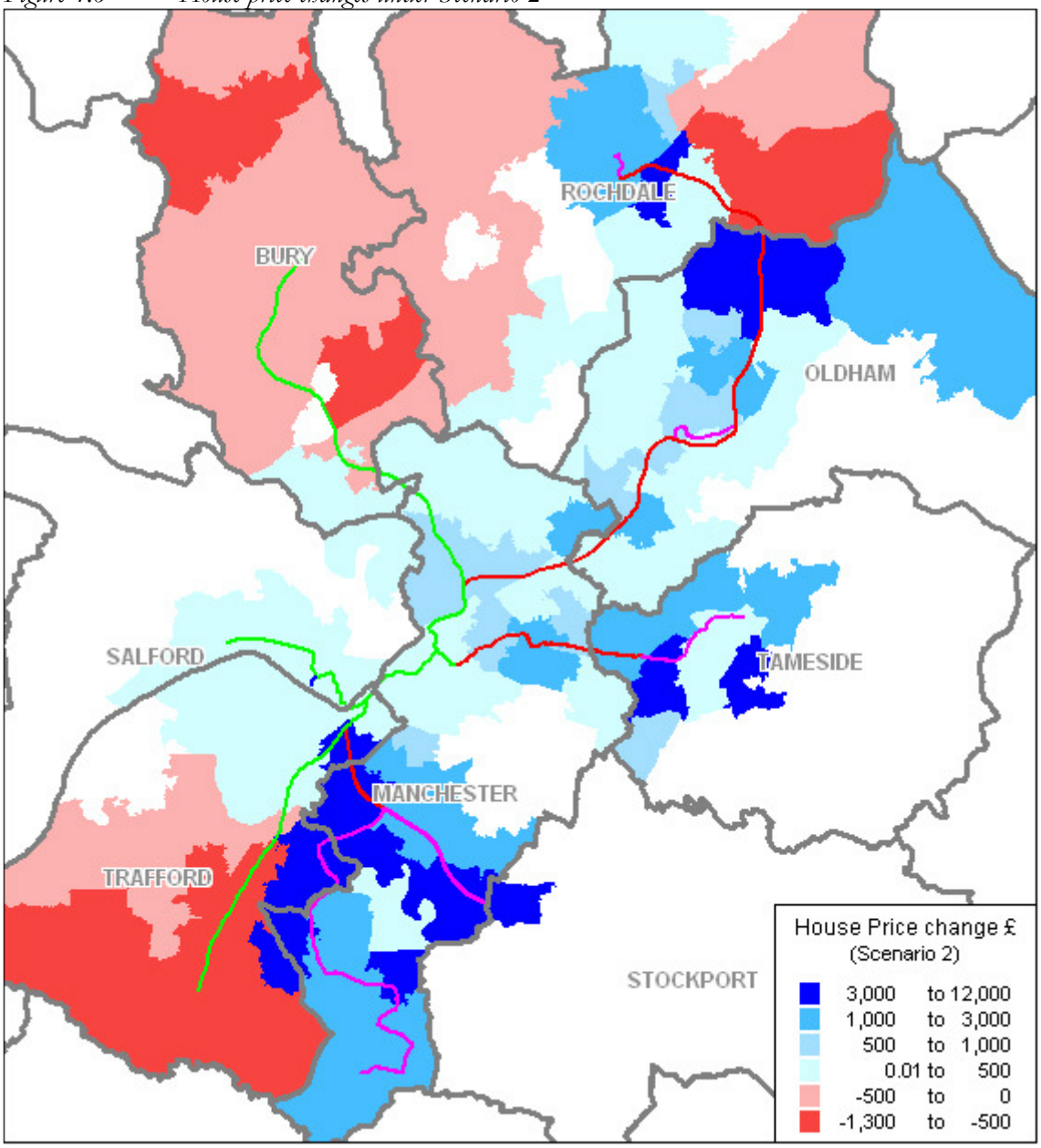
Data Source: Volterra model results, scenario1

Figure 4.5 Percentage change in House prices under Scenario 1



Data Source: Volterra model results, scenario1

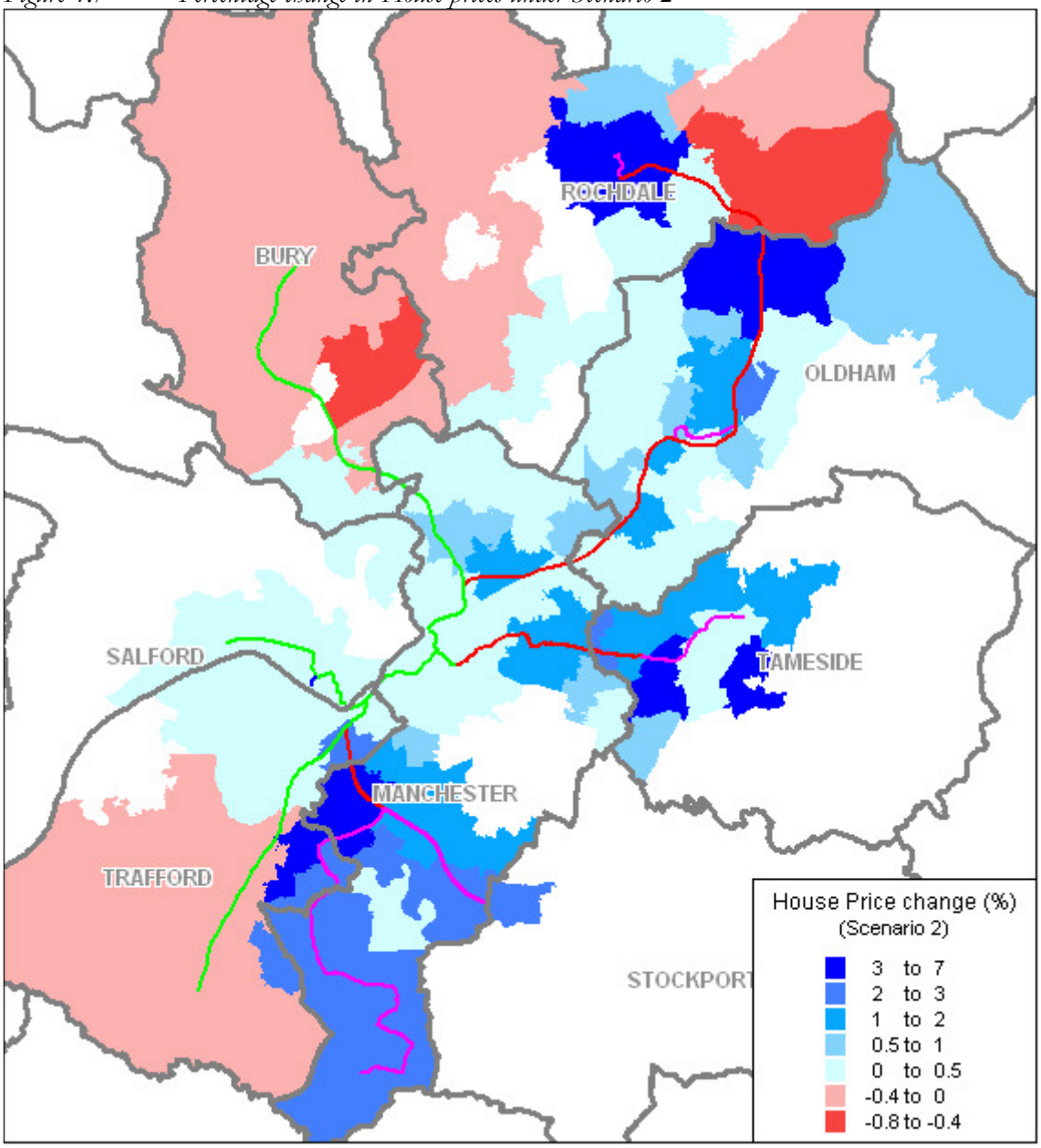
Figure 4.6 House price changes under Scenario 2



Data Source: Volterra model results, scenario2

This second scenario suggests that house prices in parts of Rochdale could increase by over £3,000, in Oldham by £5,000 and in parts of central Manchester by as much as £12,000.

Figure 4.7 Percentage change in House prices under Scenario 2



Data Source: Volterra model results, scenario2

The time savings in scenario 1 for the estimated 3b zones of a reduction in travel time of 0.975 minutes are quite low and it seems likely that at certain points along the route time savings will be significantly larger than 1 minute and perhaps closer to those estimated in scenario 2.

The analysis in this report does not have access to the results of a complete transport appraisal. As a result the travel times savings to Central Manchester approximated to result from the Metrolink extension, and in turn the estimated house price improvements likely to be experienced in different places, should be viewed as indicative estimates. Figures 4.6 and 4.7 however provides a useful resource for understanding how large an impact the Metrolink extension may have on house prices based upon time savings experienced in an area.

In addition, for illustrative purposes, a simplified estimation of the total district level changes in house prices implied by this analysis and the scenarios on which they are based is found in Table 4.8.

Table 4.8 Estimated district level total house price changes

	Weighted average % change in house price due to Metrolink		Mean district house price (£) (Land Registry)	Households (GMFM) (000s)	Total Increase in house prices by district due to Metrolink (£000s) (2007)	
	Scenario 1	Scenario 2	2007[28]	2007	Scenario 1	Scenario 2
Bury[6]	-0.20%	-0.20%	150,200	77.232	-18,500	-18,500
Manchester	0.65%	1.06%	156,300	198.783	162,400	262,700
Oldham	0.71%	0.71%	131,200	90.169	67,200	67,200
Rochdale	0.41%	0.81%	132,200	86.418	37,300	74,300
Salford	0.03%	0.03%	143,100	96.918	2,900	2,900
Stockport	0.01%	0.06%	195,600	121.614	1,800	12,300
Tameside	0.38%	0.60%	137,800	93.277	39,000	61,700
Trafford	0.02%	0.29%	247,400	92.275	3,800	53,200
Total					**295,900**	**515,900**
Downward sensitivity					*369,900*	*644,900*
Upward sensitivity					*221,900*	*386,900*

In order to make these district level estimates, the following assumptions are made:

- the changes in house prices by area resulting from the model are weighted by population as a proxy for housing distribution across the district in order to give a weighted average estimate for each district
- the households are taken from the Greater Manchester Forecasting Model
- the Land Registry data on average house prices by district excludes sales at less than market value (e.g. Right to Buy), sales below £1,000 and sale above £20m. A 20 per cent reduction is therefore applied for conservatism

Due to the uncertainty around these estimates, sensitivities are also presented. In summary, this results in estimated house price changes in the study area as a result of the Metrolink improvements ranging from £220m and £385m to £370m and £645m under the two scenarios, with a central estimate of £295m and £515m.

[28] Land Registry data for 2007 is provisional

5 Conclusions

The expansion of the Manchester Metrolink as part of the TIF bid has been evaluated using conventional transport appraisal methods. Those transport appraisals have concluded that the investment is value for money in terms of the transport and user benefits that it will deliver.

The Metrolink improvement and extension will provide increased capacity for people to travel into central Manchester, and indeed across Manchester. This will provide capacity both in the peak period from 7:30-9:30am and throughout the day.

This report has estimated the 'move to more productive jobs' and 'pure agglomeration' GDP benefits which might be expected to be associated with this Metrolink expansion. It also provides new research into the potential relationship between accessibility and house prices.

For certain areas, Metrolink is quicker than other forms of public transport and provides links between outlying areas and the urban core. The Metrolink also provides a better commuting experience than other forms of public/private transport. This improves the likelihood of commuters using it to capacity. This is evidenced by demand on the existing lines and on lower car dependency in areas better served by public transport. This however also presents an area of uncertainty within the modelling in terms of estimating the proportion of increased Metrolink capacity which might be expected to be taken by 'new' commuters and the proportions who may switch from alternative modes such as bus or car.

Results are presented for the agglomeration benefits of the Metrolink expansion under a number of scenarios (productivity, elasticity, journey purpose, rate of modal switch, capacity utilisation). The most crucial assumptions are those surrounding how many actual 'new' jobs the expansion facilitates (as opposed to people switching modes or making journeys for none-work purposes for example). In the central scenario, by 2026 (the year by which capacity is assumed to be utilised), the Metrolink expansion is facilitating just over 3,200 completely new jobs in central Manchester which are creating output of between £4k and £10k more per annum due to their location in a well connected urban core.

The 'move to more productive jobs' estimate for 2026, in 2006 prices, is £28m. In addition, the 'pure agglomeration' estimate for 2026 is £4.2m. Whilst the methodology is slightly different, this is of a similar order of magnitude to the SDG agglomeration simulation exercise for Manchester. Depending on the assumptions used about the proportion of Metrolink users who are doing 'new' trips, this estimate can approximately halve or triple. When the central scenario values are summed up (i.e. cumulative) over the years to 2026 and discounted back to 2002, they result in total values of £139m 'move to more productive jobs' and £20m 'pure agglomeration'. When they are appraised over a 60 year horizon, the values are £590m and £87m respectively.

Further to enabling more commuters to access central Manchester and improving the productivity of central workers, the Metrolink extension will also benefit residents all across the study area. A robust and intuitive relationship is found between house prices

across the study area, accessibility, and indicators of crime and housing conditions. This relationship allows the estimation of the likely impact on house prices an improvement in accessibility may be associated with, if the other factors (crime and housing condition) remain constant.

Analysis of the impacts of accessibility on house prices suggests that travel time savings of between 1 and 15 minutes could be associated with increased house prices of 0.4 and 5.4 per cent. Clearly this could increase individual house prices by significant sums of money, the exact calculation of which depends upon house prices across the area, and the distribution of travel time savings. Results are presented for two scenarios – the first uses the available data on travel time savings as a result of the Metrolink Phase 3a extension and assumes that the zones impacted by Phase 3b receive savings equal to the average of those savings. The second uses the same data but assumes that each zone impacted by Metrolink Phase 3b receives savings equal to the closest zone to it which benefited from Phase 3a. Both scenarios suggest that house prices could increase up to £12,000 in the areas that would benefit from the Metrolink expansion. Given the house prices across the area and the fact that several of the lines will go through Housing Market Renewal areas, this could also create very real and valuable benefits for Manchester residents.

A simplified estimation of the total of these individual house price changes across the whole study area results in central estimates of £295m and £515m across Greater Manchester. The biggest impacts are seen in Manchester district, followed by Oldham, Rochdale and Tameside.

The 'move to more productive jobs' and 'pure agglomeration' estimates are entirely additional to the benefits estimated in a conventional transport appraisal. The house price impacts are less easy to define. Certainly, to some extent there is double counting as they are a way of capitalising the increased incomes which more productive workers would earn. Some of this effect may however also be additional, the guidance here is thin and further work would be required to begin to assess the exact level of additionality in these assumptions.

The combination of estimates present a tangible way to think about transport improvement. For example, a resident of Rochdale may learn from a conventional appraisal that they will save 15 minutes on their journey to work and from the 'house price impact' analysis that they might expect the value of their house to increase by 4 per cent. From the agglomeration analysis that they might also expect their productivity to rise. These present quantifiable and tangible ways of understanding the benefits of the expansion of Metrolink to businesses, workers and residents.