

# Transport and Development in the Growth Boroughs

Growth Boroughs Unit

A report by Volterra Partners, April 2015

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# 1 Preface

Professor David Begg,  
Chief Executive  
Transport Times

The Growth Boroughs have come together with the aim of achieving Convergence with the rest of London on income, employment, housing, health and quality of life. Transport is a means to an end and crucial in unlocking commercial and residential developments which will allow the Growth Boroughs to achieve their Convergence objectives.

In the past it has been too easy for the Mayor and Transport for London to dismiss the views of Boroughs in East and South East London on their transport priorities. There has been a failure on behalf of the Boroughs to compromise and prioritise on a list of strategic transport priorities which are crucial to their Convergence agenda. It carries little impact when Transport for London is presented with a list of around 50 uncommitted transport schemes. However if the Growth Boroughs can agree on half a dozen top priorities with robust analysis to back them up then it carries weight. This is what this report does: it's now up to the Growth Boroughs to decide if they want to influence the Mayor's and TfL's future priority list in a significant way.

There is no doubt that together the Growth Boroughs can be an effective and powerful Lobby that cannot be ignored. This is especially so as we approach the period when political parties are selecting their candidates for Mayor. These candidates will be in the market for ideas and projects to commit to. If the Growth Boroughs can demonstrate that with the right investment in transport projects they will be able make a significant contribution to London's economy in terms of jobs and housing, then it is of strategic importance to the capital that East London benefits from a larger share of future capital investment.

This report is focused on how transport can stimulate the maximum impact on the economy, jobs and housing. The Growth Boroughs will need to continue their efforts to ensure that local people have the skills required to fill the new jobs created and that as many as possible of the new houses built are affordable.

There is another transport agenda which is crucial to quality of life and social inclusion. Roads in the Growth Boroughs are chronically congested, they sever communities, they are the main cause of death for anyone under the age of 18 and pollution is a major contributor to respiratory failure. While public transport capacity and performance has been transformed since Transport for London was established at the turn of the millennium, for many fares are unaffordable. This report does not address this urgent and crucially important transport agenda. We have been asked to address a different question: how can transport investment maximise the growth in employment and housing?

It is important to acknowledge that there has been a step change in public transport capacity in the Growth Boroughs since Transport for London was formed in 2000. The extension of the Jubilee Line from Westminster to Stratford, the 30% increase in capacity on the Jubilee Line with 30 trains per hour, the addition of a 3rd car to the DLR and the lengthening of platforms to accommodate them, the DLR extension to Woolwich, and the integration of the old East London Line into the very successful London Overground. Like the rest of London, the East has benefited from a 50 % increase in bus patronage, Oyster – the world's leading and most popular smart card, and a cycling renaissance stimulated by cycling super highways and the popular Barclay's cycle hire scheme. It is little wonder that London has experienced a modal shift from car to sustainable modes of transport which is unrivalled anywhere in the world and that the transport system performed so well in East London during the highly successful 2012 London Olympics. New transport capacity in London fills up in a few years: look how quickly the extra seats on the Jubilee Line and the DLR were occupied.

But the economy and the population in London keep growing which is why the investment tap has to be kept firmly on. The list of committed rail schemes in the Growth Borough's is impressive: Crossrail, electrification of Gospel Oak to Barking, the rail link between Hackney Down and Central, West Anglia mainline upgrade, Bow Junction remodelling, the new Lee Bridge station, the redevelopment of Pudding Mill station on the DLR, and five further upgrades to the LUL network. However if the Growth Boroughs are to play their full part in delivering the housing and jobs that the London economy will need to continue to thrive, then there needs to be a further step change in transport capacity.

Volterra have looked at transport projects which are as yet uncommitted, but which are of strategic importance to the creation of jobs and population growth in the Growth Borough's. They have utilised a model which has been robustly tested in London in the past to forecast the new jobs and population growth that will result from future transport investment.

This is a departure from the old and antiquated method of appraising transport investment which put an emphasis on the value of time savings. Not only did this confer preferential treatment on road schemes versus rail but it failed to take cognisance of the fact that transport is a means to an end. Improved accessibility stimulates the economy, employment and population growth. One of the best examples anywhere in the world of this correlation is the creation of the second largest financial centre in Europe at Canary Wharf on the back of the DLR and the Jubilee Line extension.

Volterra have produced development impact forecasts for all these schemes within a short timescale. Their method is focussed on the relative performance of different projects more than the absolute. Forecasts will differ from those prepared by TfL for particular projects. Volterra have not taken account of the cumulative impacts of multiple projects on a single location and they have tested all the schemes as if they were implemented immediately, not at different dates in the future. Detailed forecasts by TfL for any particular scheme are therefore likely to be more accurate, but the work by Volterra applies a consistent approach to all schemes thereby providing a basis for comparison and prioritisation.

In terms of future uncommitted projects Crossrail 2 ranks higher than any other scheme on Volterra's model, followed by Crossrail 2 Eastern extension, Gallions Reach River Crossing and the extension of London Overground to Barking Riverside. It is these projects that the Six Growth Boroughs should unite behind and lobby for. They all feature in The Mayor's 2050 infrastructure Plan with one exception: Crossrail 2 Eastern Extension, despite the fact it has a compelling business case. If the Growth Borough's do not campaign for this scheme then it won't happen

While there is a very positive story to tell on the public transport front, you cannot say the same for roads. TfL concede that East London will experience a larger growth in traffic and congestion over the next 30 years than any other part of the capital and delays to address the worst transport congestion in the country at the Blackwall Tunnel and Dartford crossings is lamentable. While the recent consultation by TfL is to be welcomed - and it's not a surprise that two new crossings at Silvertown and Gallions Reach have the most compelling business case - if the Mayor had acted upon the professional advice he was given by his own transport authority the building of a new crossing would have been visible by now. Instead six years have been wasted and the Thames is a major barrier to the movement of people and goods in the east of the city that would not be tolerated in West London, nor come to that in any of the world's successful cities.

River crossings will play a strategic role in addressing London's housing crisis, facilitating housing growth in an area where overcrowding is the highest in the UK. The northern side of the River has over twice as much floorspace capacity that could support employment than on the south side, with the majority of this difference in the office sector. This potential imbalance in employment growth, combined with a relatively even distribution of potential housing growth, will lead to a greater demand for trips from those on the south side of the River commuting to the north, reinforcing the need for new river crossings.

Greater access to employment opportunities can help to combat high levels of unemployment and deprivation. River crossings will increase road access to jobs, creating greater choice for workers and opening up new opportunities for local residents. River crossings will play a strategic role in addressing London's housing crisis, facilitating housing growth in an area where overcrowding is the highest in the UK.

Improved connectivity and resilience of the highway network can help support the growing cluster of distribution and green industries in East London. Demand for good quality distribution premises has been growing around the A13 and A2, and is being partly driven by the new London Gateway port at Tilbury. Expansion of highway capacity is key to supporting this cluster, as well as the emerging green cluster in London Riverside. To pay for the new crossings it is proposed that they would be tolled along with the existing crossings at Blackwall and Dartford. This is sensible. It would not be advisable to divert capital from the public transport budget to pay for these crossings nor to impose further fare increases on public transport users to balance the books. Tolls are also attractive because they help to contain demand and prevent congestion building up.

Nevertheless there is an equity issue that should not be ignored. There are 16 road crossings over the Thames to the west of Tower Bridge with no charge proposed for vehicles while all the crossings in the east - both existing and proposed - will be tolled. This should give the Growth Borough's political leverage when lobbying for an increased share of the capital's transport investment pot.

If transport has been one of London's big success stories since the turn of the millennium then housing is at the opposite end of the success spectrum. Transport capacity has grown sufficiently to allow the economy, employment and population to continue growing but in stark contrast the supply of housing - particularly affordable housing - has lagged badly behind. This has forced too many people to live further and further from their place of work driving up the demand for transport. New transport infrastructure, by improving accessibility, can unlock the supply of much needed new homes. The central theme of this paper by Volterra and the basis of their model is the close correlation between transport - accessibility - employment and housing. While a city the size and complexity of London will always require people to commute long distances, the more we can develop communities in the Growth Borough's where people live, work, and play the more sustainable, vibrant and desirable they will become. We need to learn lessons from Singapore and Hong Kong.

From Singapore we need to learn what not to do in terms of developing central business districts which are deserted in the evening and at weekends. Employees are transported in - albeit efficiently on mass public transport - and return on mass to their housing estates in the evening. They are aware of their planning errors and are belatedly trying to rectify them.

From Hong Kong we need to learn how crucial high residential and commercial densities are to maximising public transport share, improving accessibility, sustainability and economic growth. In Hong Kong public transport's share of the market is in excess of 90% compared with less than 50% for Greater London. It's no coincidence that residential densities in Hong Kong are 4 times greater than London's. Because we built so many dreadful tower blocks in the UK in the post war era there is an understandable apprehension of a housing policy which in some critic's eyes takes us back to the future. However new technology, innovative and creative architecture and sustainable planning policies have made high rise living desirable. If we can build desirable and attractive tall buildings in close proximity to well-connected rail stations for the wealthy we should and must do likewise for those on lower incomes by making sure that the housing is affordable.

The list of transport projects recommended for the Growth Borough's in this report will provide the catalyst for housing growth which will play a crucial part in dealing with London's chronic housing shortage. We have another crucial lesson to learn from Hong Kong and that is affordable public transport. Successive Mayors in London have decided to increase fares above the rate of inflation to finance much needed public transport capacity. This has not been an easy choice to make but it has been the right one. It's futile having cheaper fares if people can't get on the trains and buses.

However in Hong Kong they have both: cheap fares and sufficient capacity to keep pace with growing demand. Moreover public transport requires very little public subsidy. The key to their success is the high density development mentioned above, but the developer is the state owned development corporation which purchases land around new and existing rail stations and ploughs the profits into the public transport network. MTR is the Hong Kong state owned company which both runs the public transport network and the development company.

While London has been more successful in recent times in getting the private sector to contribute more to transport infrastructure – Crossrail being a case in point – we can and must lever a much higher contribution from developers for future schemes such as Crossrail 2. If we don't then we will continue to have public transport fares which are amongst the highest in the world. We should not underestimate the extent to which affordability is a barrier to accessing employment opportunities – and a constraint on the economy, not to mention a worrying equity issue. Given some of the poorest Boroughs in the UK are in East London then this is particularly true here.

For London to continue to prosper new transport capacity is a necessity. In deciding how to pay for it policy makers need to get the balance right between the contribution from fare payers, tax payers and business/developers. Getting this right will be crucial to establishing a more prosperous, sustainable and equitable East London.

Working together, prioritising strategic transport projects which have been robustly appraised, and lobbying effectively, the Growth Boroughs can work in partnership with the Mayor and Transport for London in achieving the Convergence that is so badly needed.

## 2 Introduction

Volterra has prepared this study to provide a basis for prioritising between future transport projects affecting the six Growth Boroughs. The traditional method of appraising transport schemes considers costs, revenues and transport user benefits, such as reductions in journey time and crowding. This does little to inform the Six Growth Boroughs about the potential for growth provided by these transport schemes.

Instead of holding land use unchanged, this study seeks to understand the potential growth attributable to particular transport schemes. These can change both residential and employment locations. This study forecasts the growth in employment and population that could arise from future transport schemes.

The work has only quantified growth that is driven by new transport infrastructure. There will be significant natural growth in employment and population within the Six Growth Boroughs, growth that can happen irrespective of future transport investments. This study does not take account of that growth. Furthermore, we have only assessed growth inside Greater London Authority (GLA) designated Opportunity Areas (OAs). There will be other growth in population and employment within each Borough, but outside OAs. Our focus on the OAs is because:

- The OAs represent the areas with the greatest opportunity for growth; and
- Research into the OAs meant that there was information available on planning policies, land ownership, socio-demographics, development potential and market values which made the forecasting easier and more consistent.

Forecasts are necessarily uncertain, even short term forecasts of development impacts are uncertain, long term ones even more so. In terms of absolute outcomes within this study, a range of +/- 50% might be appropriate to apply. In interpreting the numbers presented in this report please further bear in mind that:

- Our approach is based on the historic relationship between accessibility and density in London. That provides a reasonable basis for quantification but it assumes those relationships stay constant over a long period of time.
- Our objective was based on consistency as much as accuracy. We have applied a similar approach to all projects and across all of the Six Growth Boroughs. That helps to prioritise between projects, rather than accurately forecast for any one single project.
- This work was done without access to model runs of these schemes. Assessment of scale of impact and geographic spread is based on simple Small, Medium, Large classifications.

The Volterra forecasts will differ from those prepared by TfL. The timescale of this work imposed limitations on the method, including those listed above. Where TfL has produced detailed development forecasts for particular schemes, those might be expected to be more accurate than the

ones presented here. TfL forecasts will generally take into account cumulative as well as timing issues – something we could not do within this work.

Our focus is on the relative performance of different projects more than the absolute. Our work has applied a consistent approach across all projects to provide a basis for prioritisation.

The rest of this report is structured as follows:

- Chapter 3 describes the technical approach used to calculate employment and population growth from the transport schemes;
- Chapter 4 identifies areas across the Growth Boroughs that currently have transport capacity for more development,;
- Chapter 5 assesses the transport development impacts of future transport infrastructure;
- Chapter 6 presents sensitivity tests to assess the robustness of the results in Chapter 5; and
- Chapter 7 presents the conclusions, for use by the Six Growth Boroughs.

### 3 Technical Approach

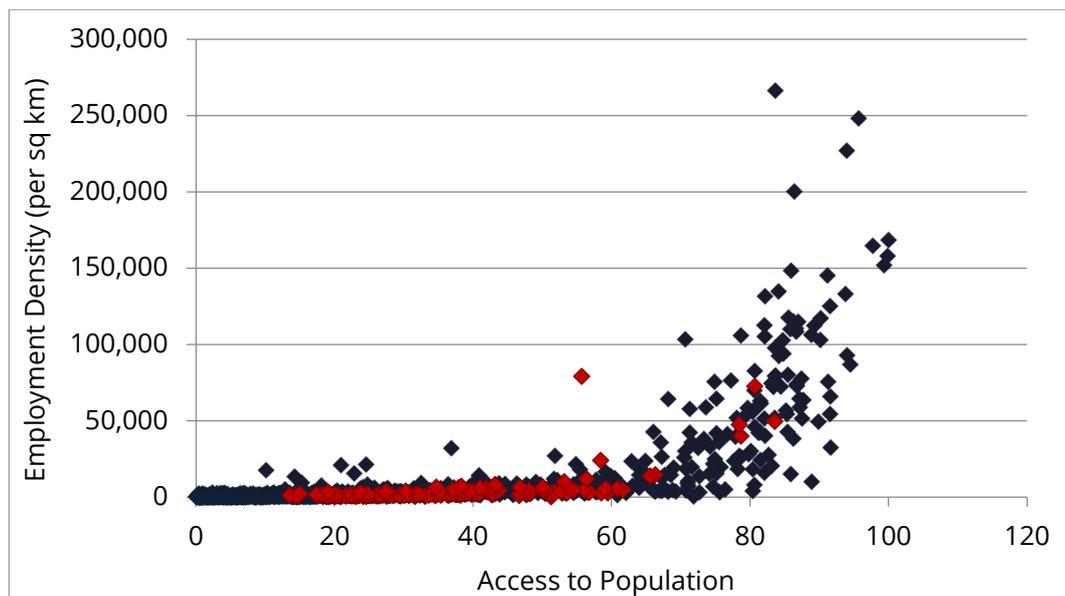
This study has a narrow focus on predicting growth arising from new transport infrastructure. To do this we use the Accessibility:Density tool, developed by Colin Buchanan & Partners for the Greater London Authority. It correlates how employment and population densities in London (across roughly 1,500 LTS model zones) vary according to the level of transport accessibility. It has been used to help distribute London Plan growth to take account of future transport infrastructure provision.



Figure 1 shows the Accessibility:Density relationship for employment in London, and Figure 2 for population. Each plotted dot represents a zone from the London Transport Studies model, with a corresponding level of accessibility and employment density. Employment density is measured in jobs per hectare, and accessibility is measured in the level of population accessible to the relevant location within 45 minutes. The graph shows a number of characteristics:

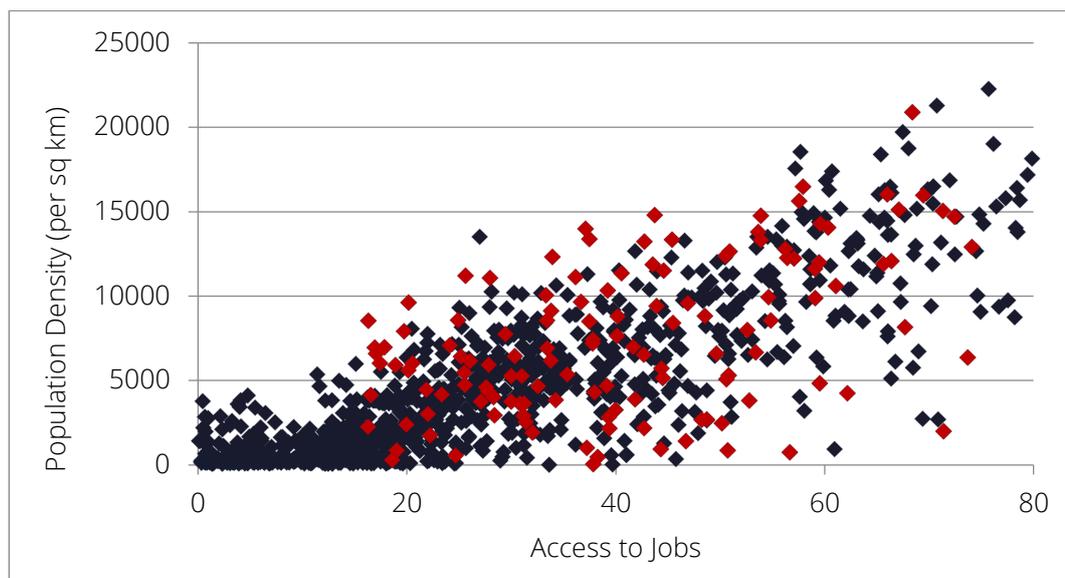
- At low and medium levels of accessibility, employment densities are low. These correspond to outer London suburban locations. There are a few areas of higher employment densities generally corresponding to the suburban regional centres (eg Kingston, Bromley, Ealing, Wood Green, Ilford) but in general employment is low and closely related to population;
- At very high levels of accessibility, employment density rises rapidly, to the extent that population is almost entirely crowded out by the higher value of commercial space in the City; and
- The relationship is powerful; variations in accessibility can explain roughly 85% of variations in employment density. Public transport accessibility is by far the most powerful driver although in the most recent GLA work (2013) highway accessibility was also included.

Figure 1: Accessibility: Density for Employment



Source: Volterra

Figure 2: Accessibility: Density for Population



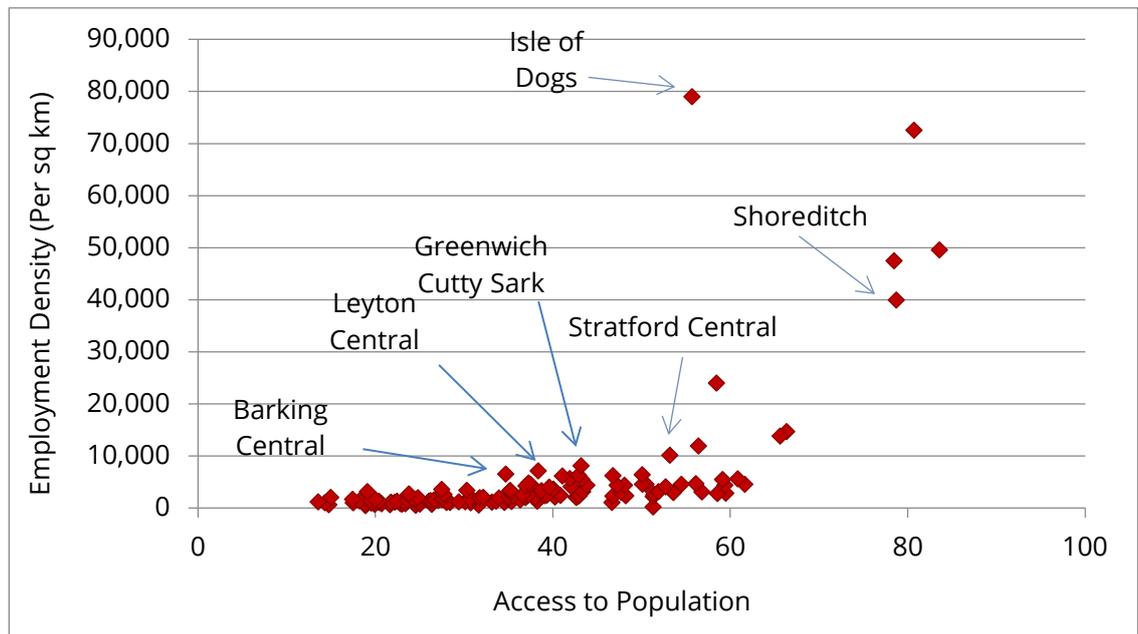
Zones within the Six Growth Boroughs are marked in red. As would be expected zones within the OAs are relatively inaccessible and have relatively low employment densities compared to parts of central London.

Figure 3 shows the Accessibility: Density relationship for employment in London with centres of the Six Growth Boroughs highlighted. The two centres that currently stand out for having a relatively high employment density compared to their accessibility are Isle of Dogs and Spitalfields in Tower Hamlets.

A point made by the Growth Boroughs concerned the fare zone boundaries and how the rezoning of Stratford may increase economic development. If that proves to be the case then the Growth Boroughs will want to consider

further rezoning; however this study focuses on hard transport infrastructure so fare zones play no part in our analysis.

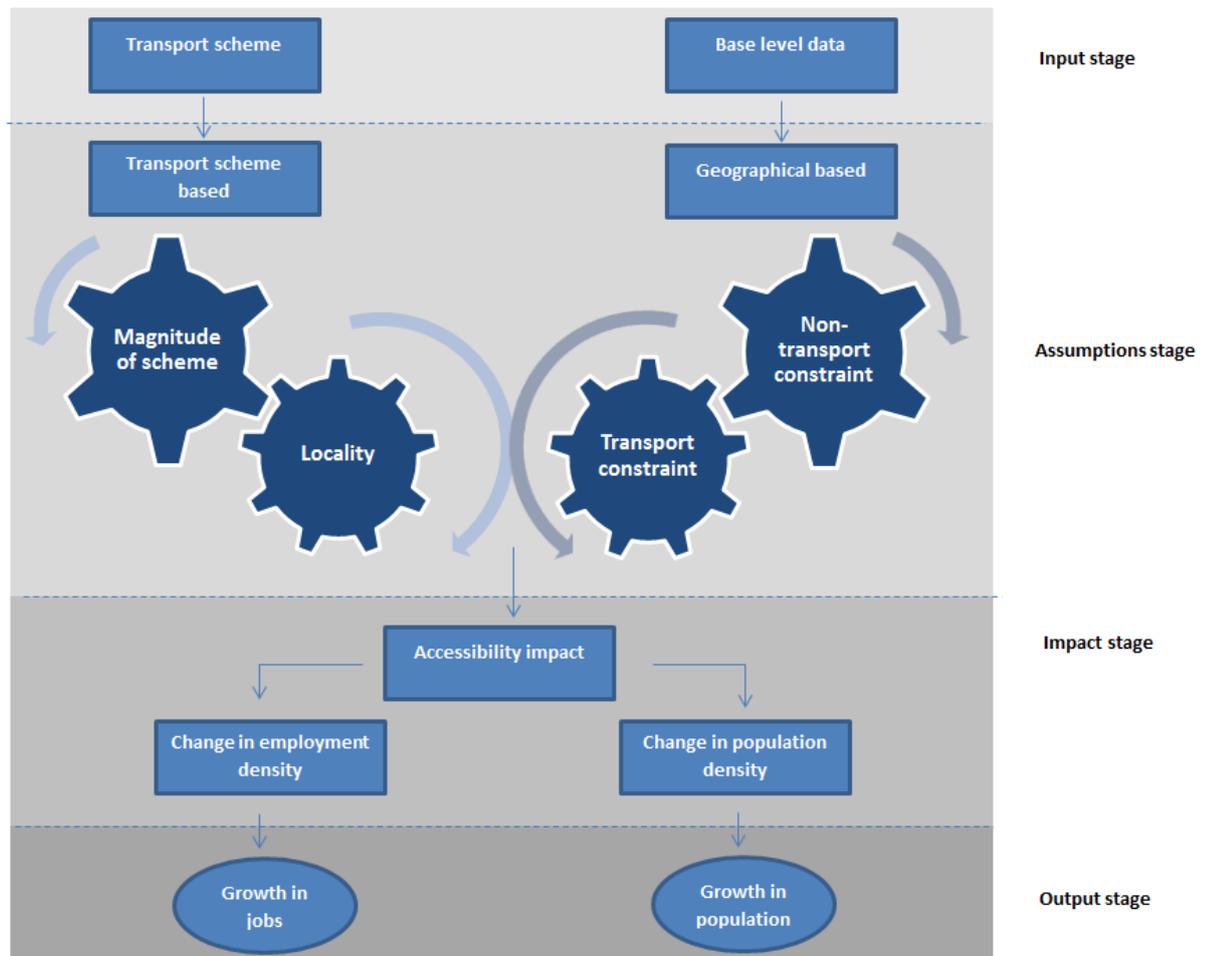
Figure 3: Example of Accessibility: Density for Employment with 6GB Centres



*Source: Volterra*

This study brings together the Accessibility: Density analysis with other indicators of transport led development potential, within an overall framework. The model applies a consistent approach across all Boroughs; the objective is to provide a basis for understanding the relative impacts of different schemes. It is a fairly mechanical model, with the ability to tune different parts to take account of advice and input from the Six Growth Boroughs. Figure 4 illustrates the different stages of the model used in this study to estimate transport led growth across the Six Growth Boroughs.

Figure 4: Transport Impact Assessment Model Visualised



Source: Volterra

## Input Stage

The first of two inputs into our model are the new transport schemes assessed within this study. Table 1 gives a list of the twelve 'committed' transport schemes, and the ten 'non-committed' transport schemes assessed within this study. Growth driven by the non-committed transport schemes will be of more interest, as this will inform prioritisation between schemes that are yet to be committed to by TfL. Table 1 also shows the timescale for the projects, in prioritising between projects the boroughs need to consider timing issues as well as the potential scale of development.

This study only assesses rail infrastructure schemes and the major Thames crossings. The assumption has been made that only rail infrastructure drives significant growth. The major Thames crossings are included at the request of the Boroughs, due to the importance of creating crossings in East London. Pedestrian, cycle or bus transport schemes are not included. These are not likely to lead development – they respond to development rather than drive it. That is in no way to undermine the vital role played by buses in delivering local transport, nor the importance of high quality walking and

cycling facilities. Many rail infrastructure schemes interact with bus routes, and bus services will be important across the proposed river crossings. Further work could take account of the importance of bus and highway infrastructure improvements in complementing rail schemes.

Transport schemes included in this study have been drawn from the East and South East London Sub-Regional Transport Plan. These are transport schemes that have been made public by TfL. Also included is the Crossrail 2 Eastern Branch proposal at the request of the Boroughs. The Boroughs will have their own strategic transport priorities with additional schemes, but they have not all been included in this study. Crossrail 2 has been classed as long term, given the provisional completion date of 2030<sup>1</sup>. The HS1 - 2 link has also been classed as long term after the project was removed from the phase one hybrid bill for HS2. The three river crossing options are categorised as non-committed schemes. Out of the Silvertown, Gallions Reach and Belvedere crossing options, Silvertown and Gallions Reach have been defined as short/medium term and Belvedere as long term.

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<sup>1</sup> <https://www.tfl.gov.uk/corporate/about-tfl/how-we-work/planning-for-the-future/crossrail-2>

Table 1: Transport Schemes within Study

Committed Transport Scheme	Future Non-committed Transport Scheme
<i>Short/Medium term</i>	
Electrification of Gospel Oak to Barking	L Overground extension to Barking Riverside
Link between Downs and Central	Stratford International interchange
Crossrail & complimentary measures	Custom House Gateway
West Anglia Mainline cap increase	DLR station upgrades
Bow Junction remodelling	Gallions Reach Crossing
DLR Pudding Mill Station	Silvertown Crossing
Lea Bridge Station	
London Overground Upgrade	
Victoria Line Upgrade	
District Line Upgrade	
Central Line Upgrade	
Jubilee Line Upgrade	
<i>Long term</i>	
	Crossrail 2
	Crossrail 2 Eastern Branch
	HS1 - 2 link
	Belvedere Crossing

*Source: Volterra; TfL East and South East London Sub-Regional Transport Plan*

The second input into our model is the base level data for the locations in which we are assessing the development impacts. Development impacts are assessed within Transport Zones (TZs), taken from the London Transportation Studies (LTS) model zones. TZs do not directly align to Ward boundaries but do sum to a Borough level. For each TZ data has been collected on their:

- Employment density;
- Population density; and
- Level of transport accessibility.

Areas (OAs) are also of interest in terms of the geographical input. The reason for using the OAs across the Six Growth Boroughs is the availability of non-transport indicators. Figure 5 shows the ten OAs, and the sections which span the Growth Boroughs, which we use as our study area. These include: Upper Lea Valley; Lower Lea Valley; Royal Docks and Beckton Waterfront; London Riverside; Woolwich; Charlton Riverside; Deptford Creek & Greenwich Riverside; Greenwich Peninsula; Isle of Dogs; City Fringe.

Figure 5: Opportunity Areas within overall study area

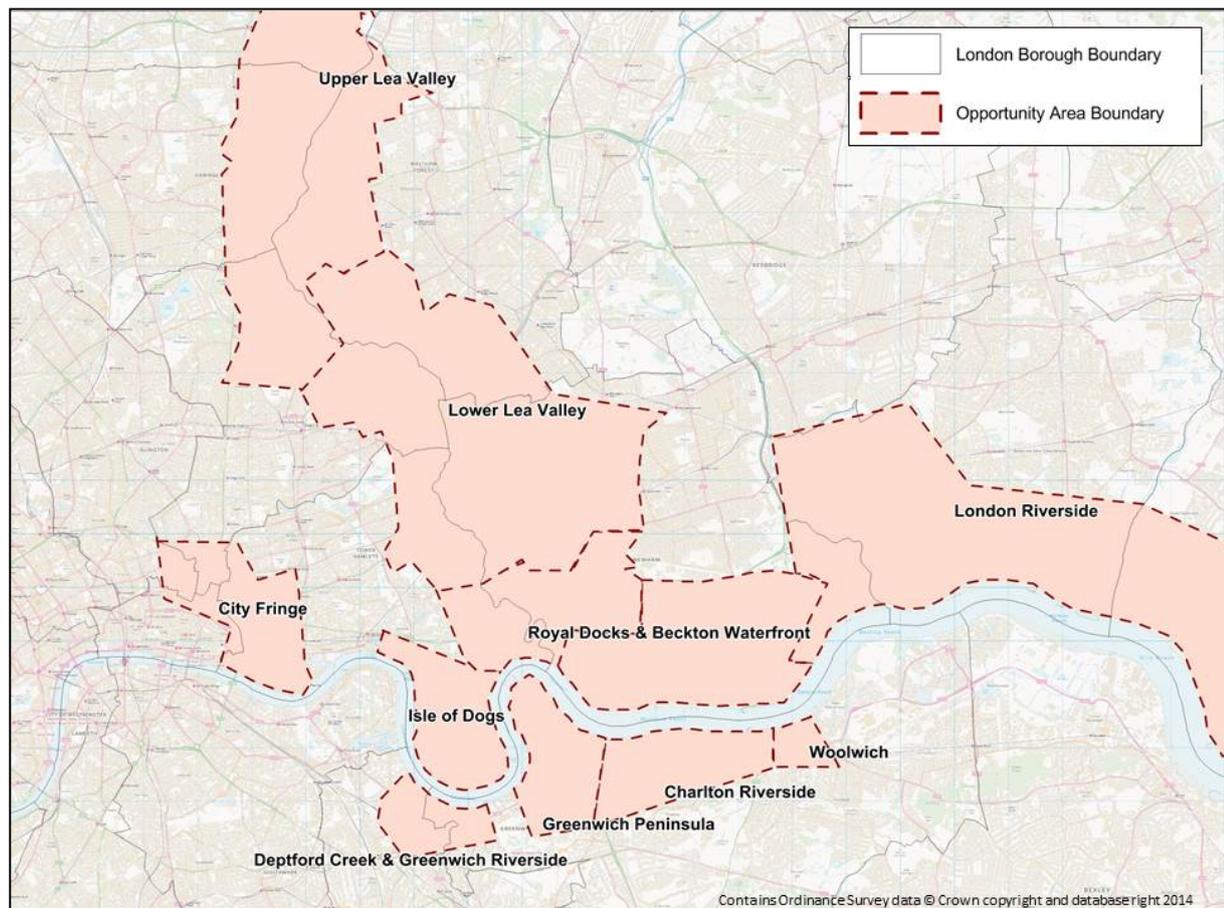


Figure 6 and 7 show the future transport network across the Growth Boroughs, including the provision of future transport schemes as listed in Table 1. The spread of new transport infrastructure will determine the distribution of growth. New transport infrastructure is distributed across the Six Growth Boroughs to the north of the river, and slightly less to the south. The Crossrail route to the south will generate disproportionate impacts; being a new alignment and opening up new patterns of travel.

Figure 6: Transport Schemes within Study

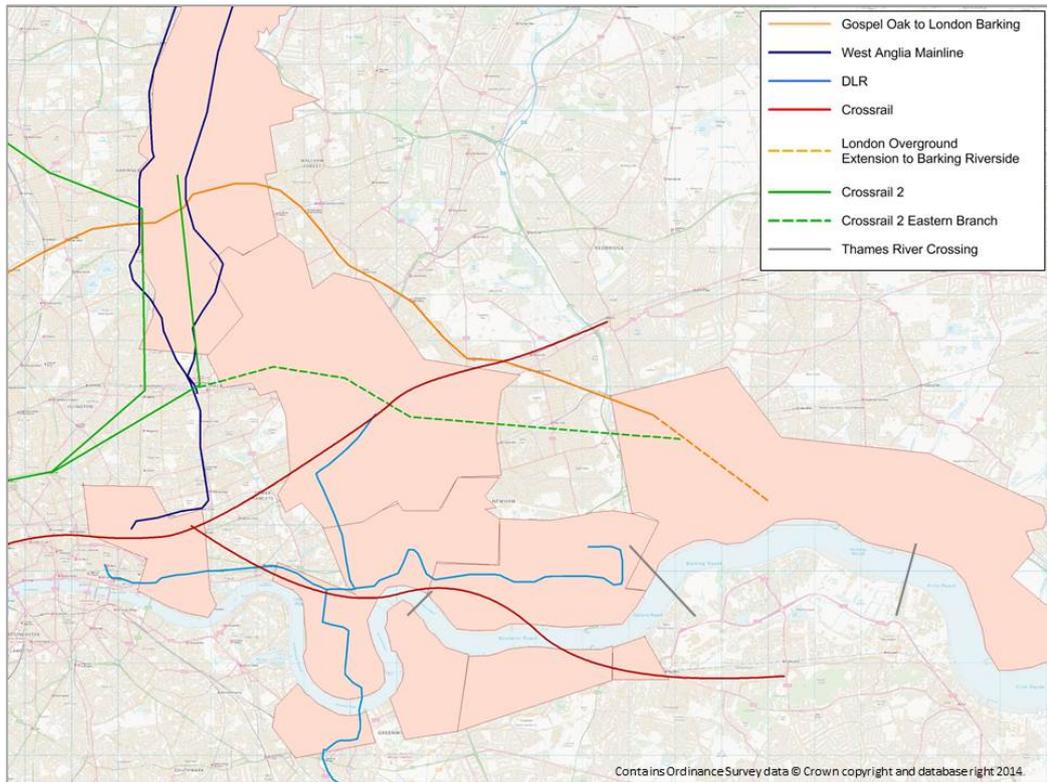


Figure 7: Transport Schemes within Study

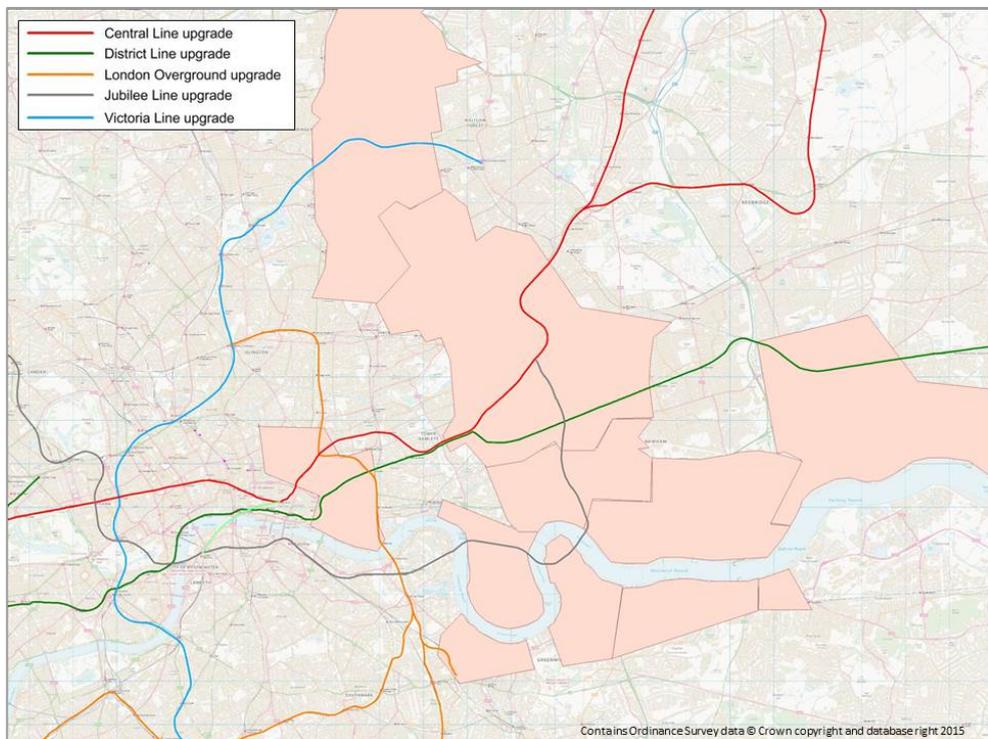


Table 2 provides detail of the stations affected by each new transport scheme.

Table 2: Affected Stations and Boroughs, According to Transport Scheme

Committed Scheme	Stations Affected	Boroughs Affected
Short/Medium term		
Electrification of Gospel Oak to Barking	Blackhorse Road, Walthamstow Queen's Road, Leyton Midland Road, Leytonstone High Road	Waltham Forest
	Wanstead Park, Woodgrange Park	Newham
	Barking	Barking & Dagenham
Link between Downs and Central	Hackney Central, Hackney Downs	Hackney
Crossrail & complimentary measures	Stratford, Maryland, Forest Gate, Forest Gate, Custom House	Newham
	Woolwich	Greenwich
	Whitechapel, Canary Wharf	Tower Hamlets
West Anglia Mainline cap increase	Stratford, Maryland, Forest Gate	Newham
Bow Junction remodelling	Stratford, Maryland, Forest Gate	Newham
DLR Pudding Mill Station	Pudding Mill Lane	Newham
	Bow Church, Devons Road, Langdon Park, All Saints	Tower Hamlets
Lea Bridge Station	Lea Bridge Station	Waltham Forest
London Overground	Dalston Kingsland, Hackney Central, Homerton, Hackney Wick, Haggerston, Hoxton, Shoreditch	Hackney
	Whitechapel, Shadwell, Wapping	Tower Hamlets
	Stratford	Newham

Committed Scheme	Stations Affected	Boroughs Affected
Victoria Line	Blackhorse Road, Walthamstow Central	Waltham Forest
District Line	Whitechapel, Stepney Green, Mile End, Bow Road, Bromley-By-Bow	Tower Hamlets
	West Ham, Plaistow, Upton Park, East Ham	Newham
	Barking, Upney, Becontree, Dagenham Heathway, Dagenham East,	Barking & Dagenham
Central Line	Bethnal Green, Mile End	Tower Hamlets
	Stratford	Newham
	Leyton, Leytonstone	Waltham Forest
Jubilee Line	Canary Wharf, Canning Town	Tower Hamlets
	North Greenwich	Greenwich
	West Ham, Stratford	Newham
Future Non-committed Scheme	Stations Affected	Borough Affected
Short/Medium term		
L Overground extension to Barking Riverside	Wanstead Park, Woodgrange Park	Newham
	Barking, Barking Riverside	Barking & Dagenham
Stratford International interchange	Stratford	Newham
Custom House Gateway	Custom House, Beckton Park	Newham
DLR station upgrades	Custom House, Beckton Park, Pontoon Dock, Royal Albert, Gallions Reach	Newham
Silvertown river crossing	-	Greenwich, Newham, Tower Hamlets, Barking & Dagenham
Gallions Reach river crossing	-	Greenwich, Newham, Tower Hamlets, Barking & Dagenham

Future Non-committed Scheme	Stations Affected	Borough Affected
<i>Long Term</i>		
Crossrail 2	Hackney Central, Dalston Junction	Hackney
Crossrail 2 Eastern Branch	Hackney Wick	Hackney, Tower Hamlets
	Stratford	Newham
	Barking	Barking & Dagenham
HS1 - 2 link	Stratford	Newham
Belvedere river crossing	-	Greenwich, Newham, Barking & Dagenham

*Source: Volterra; TfL East and South East London Sub-Regional Transport Plan*

## Assumptions

Our model uses four themes, within which assumptions are made, to determine the accessibility impact from each transport scheme:

- Magnitude of transport scheme – how significant is it;
- Locality – how well is it located with respect to the Opportunity Areas;
- Non-transport opportunities/constraints – what other factors might add to or constrain future growth; and
- Transport opportunities/constraints – how much will improved accessibility lead to increased development density.

### *Transport Scheme Assumptions*

The characteristics of each transport scheme are its magnitude and locality. The magnitude of each scheme is judgemental based on information available to us, including the likely increase in accessibility at each station. A larger magnitude is assumed for schemes creating an entirely new route, compared to those that add capacity to an existing route.

The locality of each new transport scheme is assessed according to how well it serves the OAs. A radius of 1km around each station has been assumed to capture the development impact, both commercial and residential. TZs within the selected radius of relevant transport schemes, for each affected station will amount to the study area for growth.

### *Local Characteristics*

There are a number of characteristics associated with the OAs, which will affect the level of growth. These have been divided into non-transport constraints and transport constraints. Table 3 shows the scoring

mechanism for the non-transport constraints. The data available to us, taken from the GVA report for the GLA<sup>2</sup>, limits the scoring to the OA level. For the five categories of non-transport constraints, a score of 3 is the highest and represents high opportunity for growth, whereas 1 is the lowest score and represents constrained opportunity for growth. The more categories that have a score of 3, the higher the level of growth that will be facilitated by our model for the transport scheme in the relevant area.

Table 3: Non-Transport Constraint Scoring, by Category

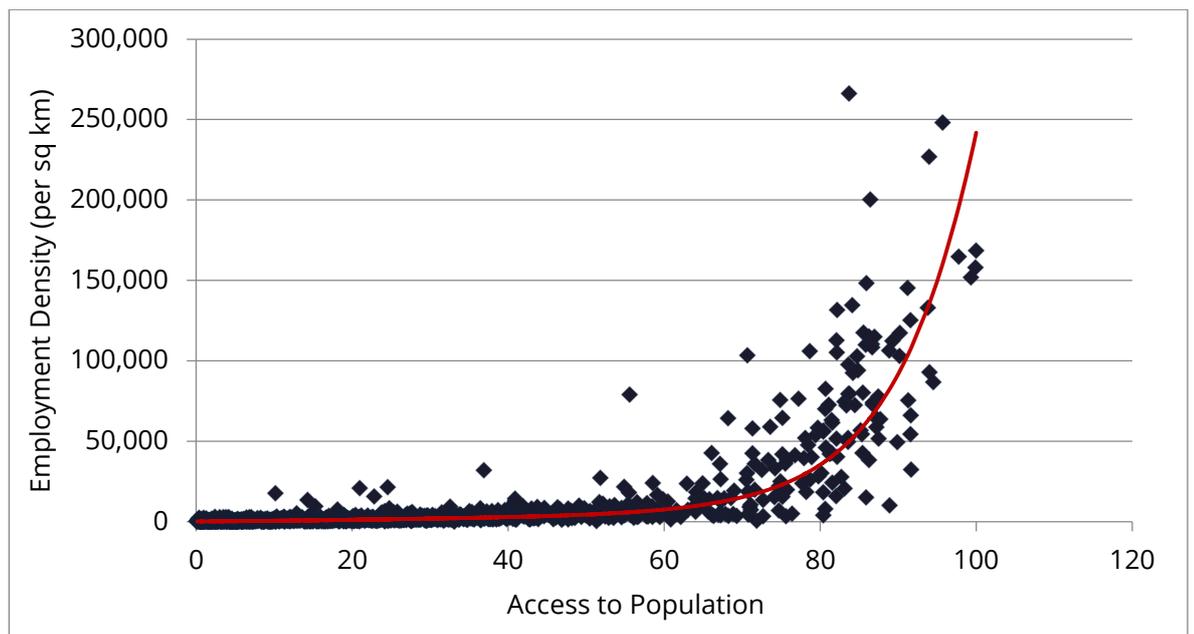
Land Use & Ownership	Planning	Market Conditions	Socio-Demographic Conditions	Development Targets & Deliverability
1-3	1-3	1-3	1-3	1-3
Availability of land and land ownership structure; proportion of land publicly owned.	Local planning policy position; integration of planning policies with delivery documentation.	Market value of residential and commercial land; vacancy rates.	Employment and population densities, unemployment rate; qualification level; deprivation levels.	Constraints against future delivery; speed of delivery targets; current progress.

*Source: GVA 'Spatial Priorities Assessment'*

For the transport constraint assumption we use the Accessibility: Density ratio for employment and population. This is done at the TZ level, for all those TZs identified within the Locality assumption. For employment density and population density respectively, we plot each TZ against the Accessibility: Density line. An example of this for employment density is shown in Figure 8, and for population density in Figure 9. The red line is a result of the data shown in Figure 1, and shows the expected level of employment density for any given level of accessibility. Depending on part of the slope the TZ is located, a change in accessibility will have a different impact on employment density. If located on a steeper section then a change in accessibility will have a larger impact on employment density than if located on a flatter section.

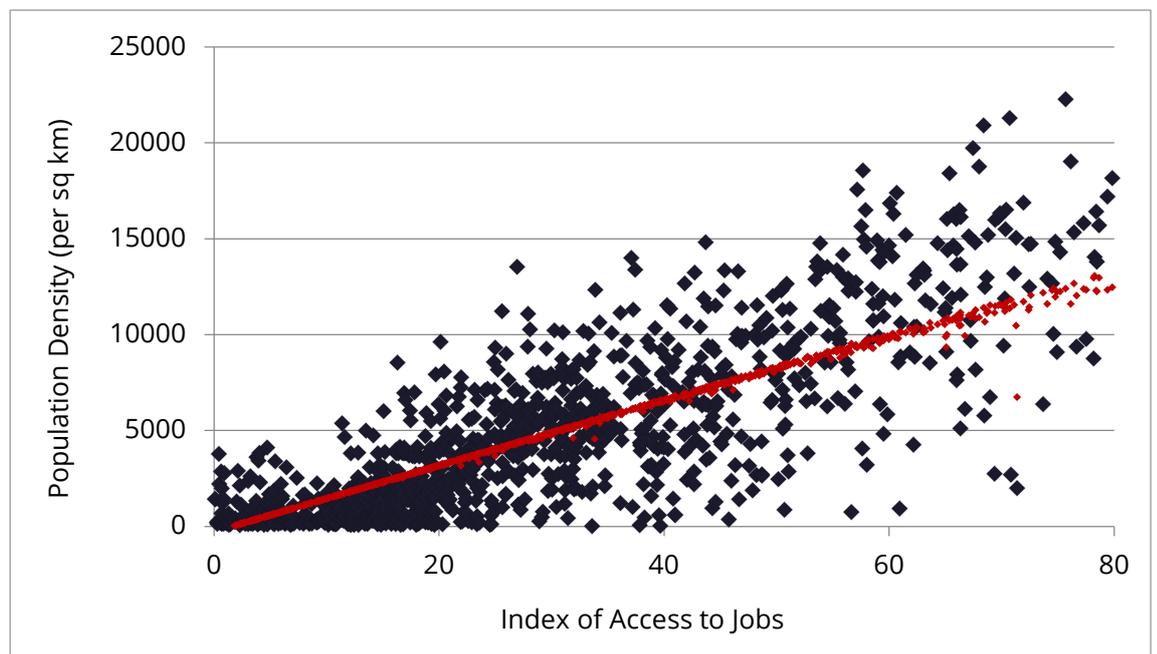
<sup>2</sup> GVA, 2010, 'Spatial Priorities Assessment', GLA.

Figure 8: Example of Employment Density versus Accessibility



Source: Volterra

Figure 9: Example of Population Density versus Accessibility



TZs are then categorised according to their distance from the Accessibility: Density line. TZs well above the curve are clearly attractive to employment opportunities and residents, having developed to higher densities than would be expected given the level of accessibility and transport infrastructure. With new transport infrastructure densities are expected to increase relatively quickly in these TZs, given they are currently transport constrained. The development impact from an increase in accessibility is revised upwards by the model for these areas. The opposite

is true for TZs well below the curve. These areas are non-transport constrained and are unlikely to respond to additional transport infrastructure, they probably require other, non-transport interventions. These areas receive a lower development impact from an increase in accessibility in the model. The development impact from an increase in accessibility is revised downwards by the model for these areas.

One of the implications of Figures 8 and 9 is that there are multiple zones across London and within the Growth Boroughs where there is already transport capacity for additional development. Some zones are transport constrained; some are constrained by other factors including planning policy, land ownership and the quality of public realm. It is important that the Six Growth Boroughs maximise existing potential as well as using new transport infrastructure to deliver growth. This is discussed in the next section.

#### *Results Stage*

The Results stage produces figures of employment and population growth. These are necessarily uncertain. A 50% range either side of the central forecast might be an appropriate level of accuracy. It is the relative growth, rather than absolute growth, driven by the transport schemes that is most important to this study; this is what will drive the ranking and prioritisation of future transport schemes

#### *Review*

A review with representatives from each of the Six Growth Boroughs was held to get further input on the assumptions that were made within this study.

## 4 Base Position

The Accessibility: Density model not only provides a mechanism for quantifying the potential increase in density in response to improved accessibility, it also helps to identify areas which currently have transport potential for more development. These are the non-transport constrained areas as defined in the previous section.

### Identifying the Non-Transport Constraints

TZs that are more than 33% below the curve are classified as non-transport constrained. Additional transport would have less impact on growth in these areas, there are other issues presenting development.

There are 39 TZs across the Growth Boroughs that are identified as non-transport constrained for employment growth. For population growth there are 32 TZs. The TZs significantly below the curve are identified in Figures 10 and 11, and are listed in Tables 4 and 5.

Figure 10: Growth Borough Transport Zones Above and Below Curve, Employment Density

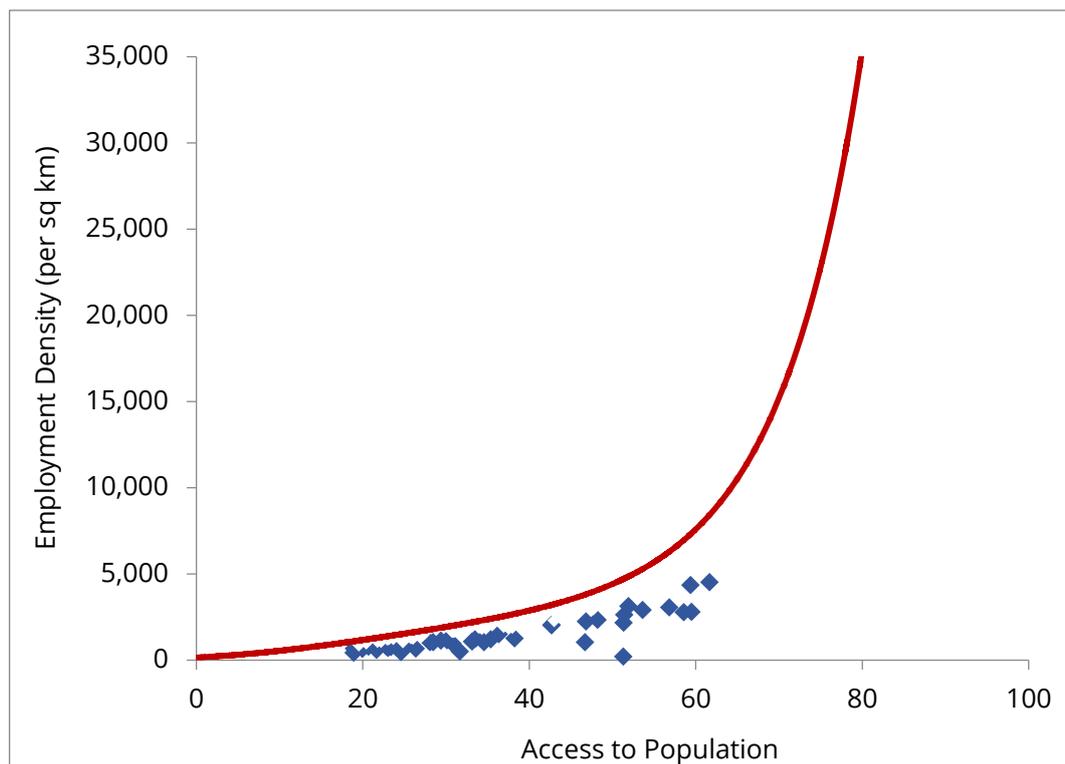


Table 4: Non-Transport Constrained Transport Zones for Employment

Transport Zone	Borough
Old Dagenham Park, Marks Gate, Becontree West, Castle Green, Dagenham West, Barking East, Becontree East, Upney South	Barking & Dagenham
Greenwich East, Greenwich South, Eltham West and Lee, Blackheath Park, Kidbrooke, Eltham North, New Eltham, Avery Hill	Greenwich
Brownswood Park, Clapton	Hackney
North Woolwich, Stratford Newington, Royal Albert and King George V Docks, East Ham North, Royal Victoria Dock, Manor Park, West Ham, Stratford Marsh and Mill Meads	Newham
Victoria Park, Bow South, Stepney, Shadwell, London Docks, Wapping, Bromley-By-Bow, Bow North, South Bromley and North Blackwall, Bethnal Green	Tower Hamlets
East Chingford, Walthamstow West, Highams Park	Waltham Forest

Figure 11: Growth Borough Transport Zones Above and Below Curve, Population Density

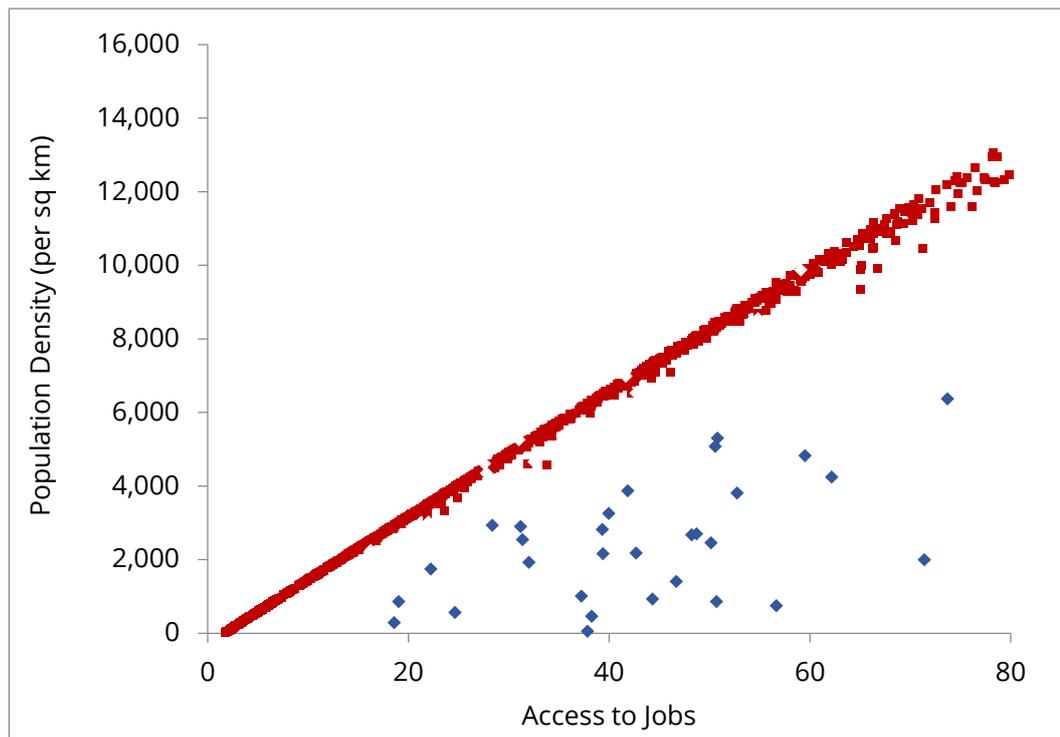


Table 5: Non-Transport Constrained Transport Zones for Population

Transport Zone	Borough
Dagenham Marshes, Rippleside East, Creekmouth	Barking & Dagenham
Blackwall Tunnel North, Greenwich Marshes, Thames Barrier South, Kidbrooke West, Eltham, Greenwich East, Avery Hill, Greenwich North, Woolwich Barracks	Greenwich
Broad Street Station North, Hackney Wick	Hackney
Royal Albert and King George V Docks, Mill Meads South Gas Works, Silvertown, Cyprus Drainage Works, Stratford Marsh and Mill Meads, Royal Victoria Dock, North Woolwich, Stratford Newington	Newham
Victoria Park, Old Ford, Poplar, Blackwall, Tower Hill Station East, Poplar East, London Docks	Tower Hamlets
Lea Bridge, Highams Hill, East Chingford	Waltham Forest

The distribution of these non-transport constrained areas across the Growth Boroughs is important. Figure 12 shows the areas that are non-transport constrained for employment growth. These are scattered across the Growth Boroughs. TZs including major greenspaces like Victoria Park should be discounted. The areas that are furthest below the curve, but without any obvious physical constraints on development, include: North Woolwich (Greenwich), Stratford Newington (Newham) and Marks Gate (Barking & Dagenham).

Figure 12: Non-Transport Constrained Transport Zones for Employment

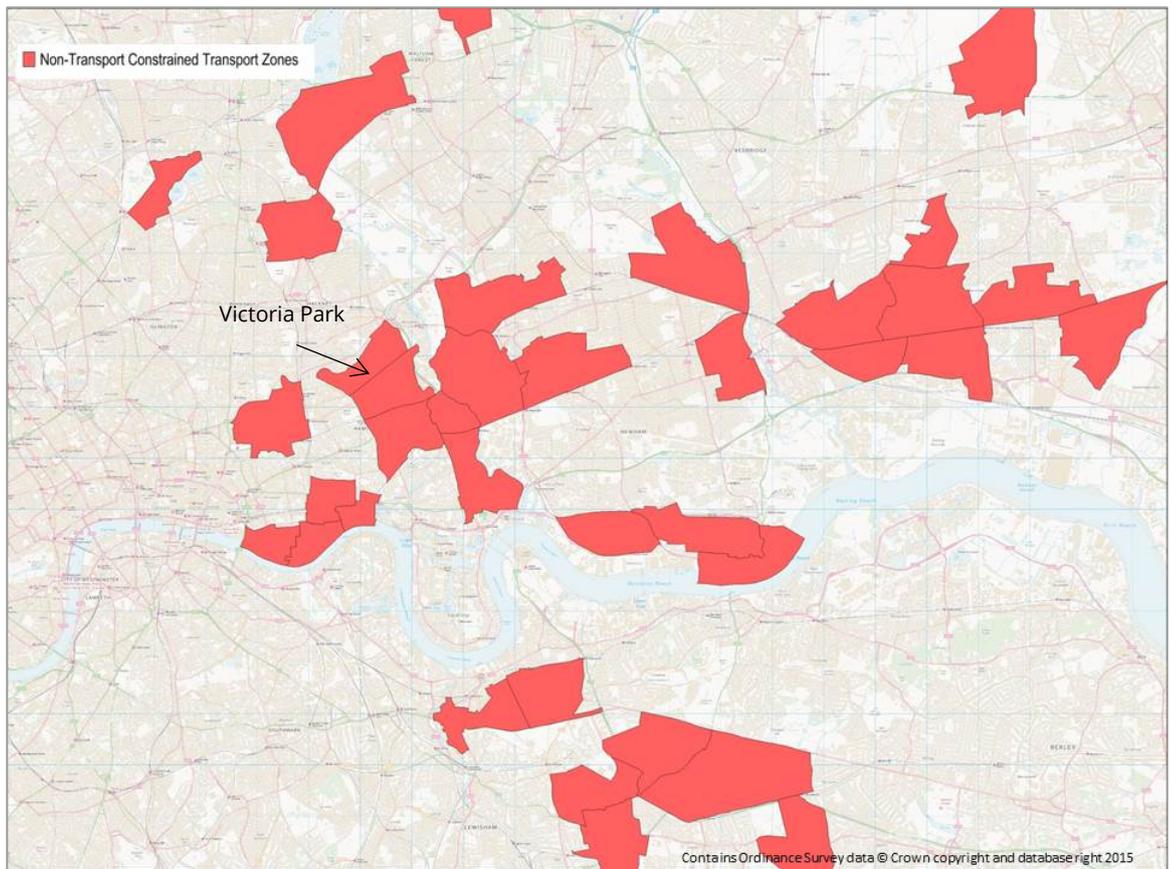
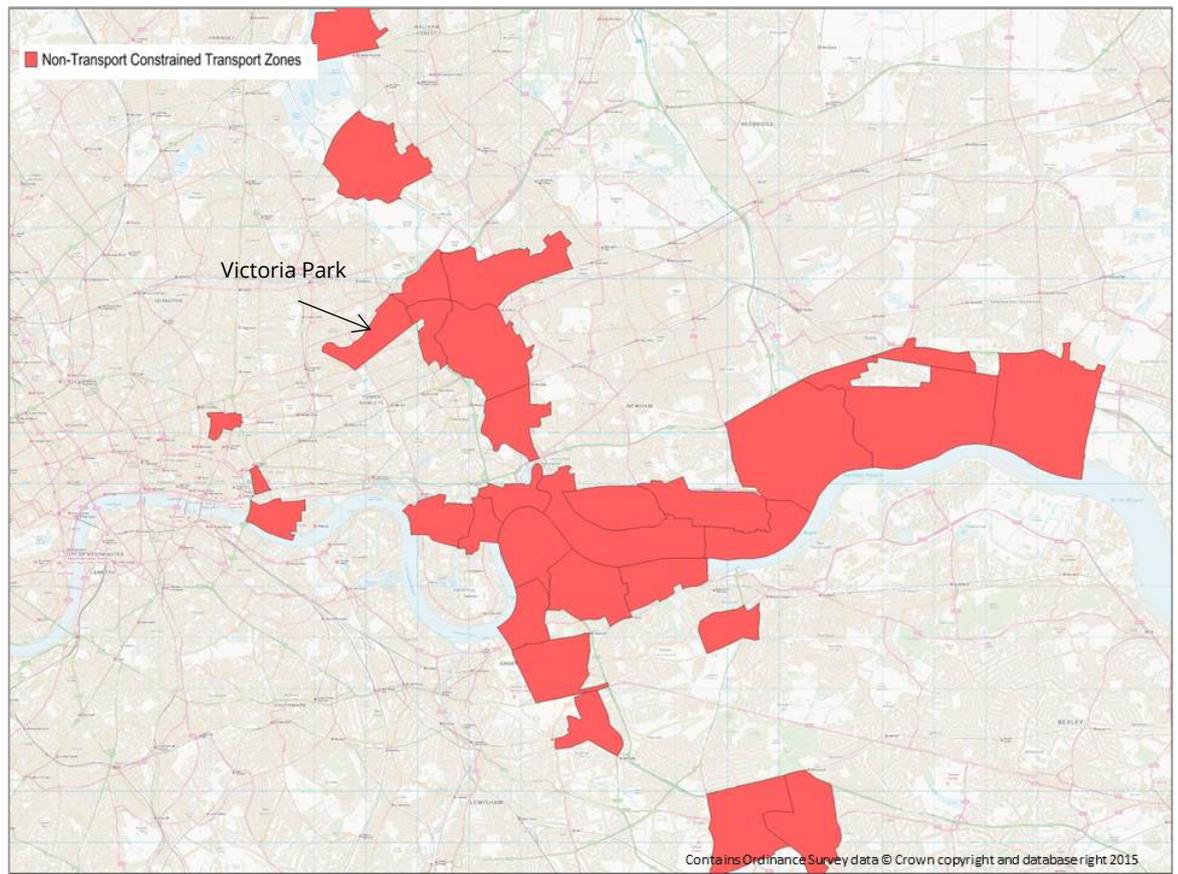


Figure 13 shows the areas that are significantly below the curve for population growth. These are concentrated in the Royal Docks OA, further east on the north bank of the Thames and between Canning Town and Stratford. The majority of TZs in the Isle of Dogs, Greenwich peninsular and the wider Docklands area appear to be non-transport constrained for population. Land use in the Isle of Dogs is for high density employment purposes, whilst land in the Docklands area has physical constraints for residential development such as the docks and brownfield employment sites. The areas that are furthest below the curve, but without any obvious physical constraints on development, include: Royal Albert and King George V Docks (Newham), Silvertown (Newham) and Rippleside East (Barking & Dagenham).

Figure 13: Non-Transport Constrained Transport Zones for Population



Overall there is a higher proportion of Growth Borough TZs 33% or more below the Accessibility:Density line for employment (29%), compared to the Greater London average (25%). The opposite is true for population density, where there is a higher proportion of Growth Borough TZs above the line (38%) compared to the Greater London average (24%). As a rule of thumb a TZ in the Growth Boroughs is more likely to be:

- Non-transport constrained for employment growth; and
- Transport constrained for population growth.

Using the Accessibility:Density model it is possible to estimate the development impacts from shifting non-transport constrained TZs back up to the curve. How much employment and population growth could be delivered without new transport infrastructure? This scenario is not realistic, not all TZs could be moved up to the curve and if they were, then the curve would be in a different place.

Table 6: Potential Employment Growth

Borough	Non-transport Constrained TZs for Employment	Potential Employment Growth
Waltham Forest	3	6,600
Hackney	2	10,700
Newham	8	14,900
Tower Hamlets	10	35,000
Barking & Dagenham	8	7,200
Greenwich	8	9,200
Total	39	83,600

*Source: Volterra calculations*

Table 7: Potential Population Growth

Borough	Non-transport Constrained TZs for Population	Potential Population Growth
Waltham Forest	3	14,000
Hackney	2	15,800
Newham	8	45,200
Tower Hamlets	7	46,800
Barking & Dagenham	3	9,200
Greenwich	9	41,500
Total	32	172,500

*Source: Volterra calculations*

So there appears to be significant potential, for 83,600 jobs and 172,500 new residents. The team therefore met with the boroughs to discuss these zones. A number of reasons were identified as to why areas are below the curve. These are:

- Areas where employment is crowded out by higher residential density and vice versa;

- Areas with physical barriers to development (park, marsh, reservoir etc.); and
- Areas where timing is the issue – development is on the way and simply catching up with transport improvements

Those causes explain about 90% of the differences. The majority of them are simply the balance between population and employment. The zones with lower than expected population densities have higher than expected employment densities and vice versa. . That process is shown in Table 8. Relatively little growth could be achieved by addressing the non-transport constrains alone.

Table 8: Realistic Potential Growth

	Employment	Population
Total potential growth	83,600	172,500
Crowded out by residential	57%	-
Crowded out by employment	-	46%
Physical barriers	21%	22%
Timing issue	11%	23%
Unexplained	11%	9%
Realistic potential growth without transport <sup>3</sup>	9,300	15,200

*Source: Volterra calculations*

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<sup>3</sup> This is total potential growth without transport

## 5 Results

This section presents the results from the model, the forecast development impacts from future transport.

Table 9 shows the distribution of transport-led employment and population growth by Borough. The growth in jobs and population is only from new transport infrastructure within the OAs listed in Section 3. Results cover both committed and uncommitted schemes. Growth is shown for each Borough and as a proportion of the Six Growth Boroughs' total. The growth figures presented in Table 9 are only related to new transport infrastructure. As explained previously this is down to the limited scope of this study, focusing solely on new transport infrastructure led growth within defined OAs.

Table 9: Employment and Population Growth from Transport Investment, by Borough

Borough	Jobs	Proportion of total	Population	Proportion of total
Waltham Forest	2,300	1%	3,900	3%
Hackney	9,600	6%	17,500	12%
Newham	32,200	21%	34,600	24%
Tower Hamlets	81,600	53%	31,500	22%
Barking & Dagenham	14,400	9%	31,900	22%
Greenwich	14,100	9%	26,000	18%
Total	154,200		145,400	

*Source: Volterra calculations*

Figure 14 shows the distribution of employment growth from new transport investment, across the Six Growth Boroughs. Areas with the highest concentration of employment growth are shaded in darker red. These are fairly centralised, with a few high growth areas to the east, and the outer northern and southern areas of the Six Growth Boroughs seeing smaller growth.

Figure 14: Distribution of Transport enabled Employment Growth from Transport Investment<sup>4</sup>, across Six Growth Boroughs

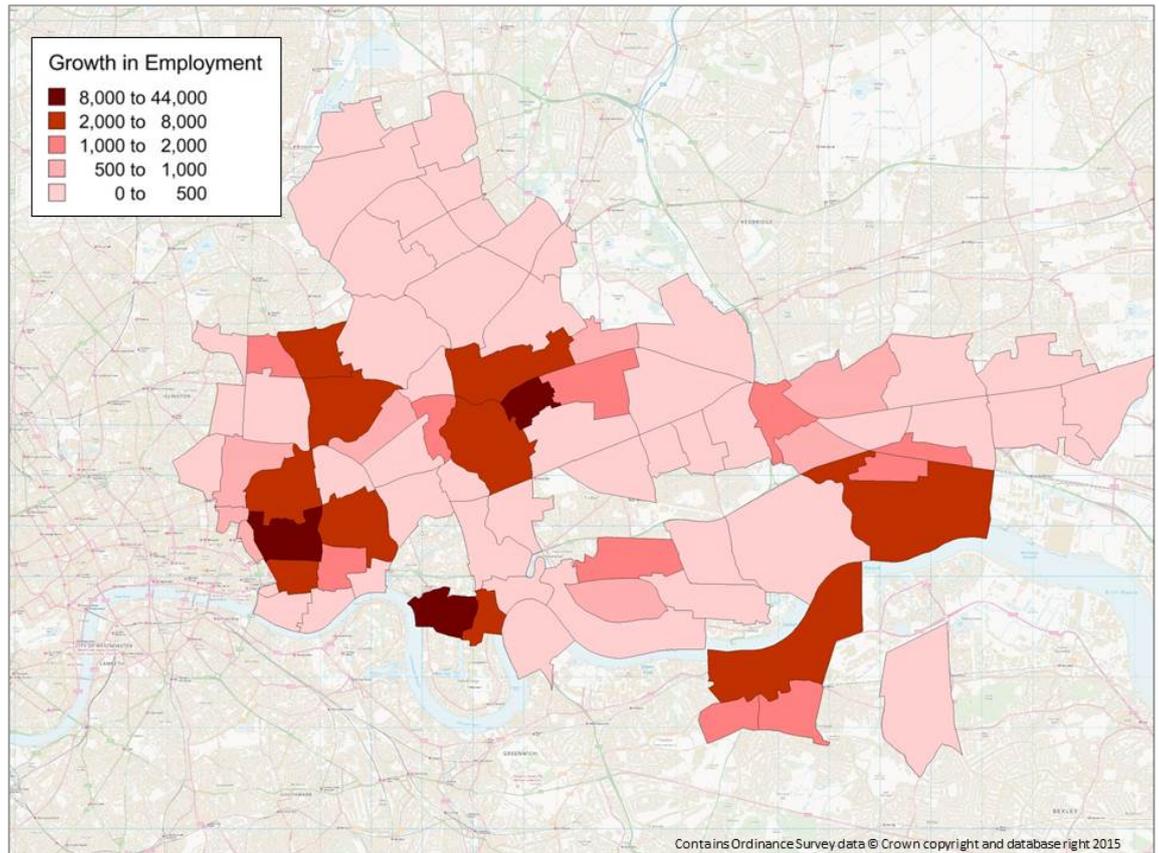
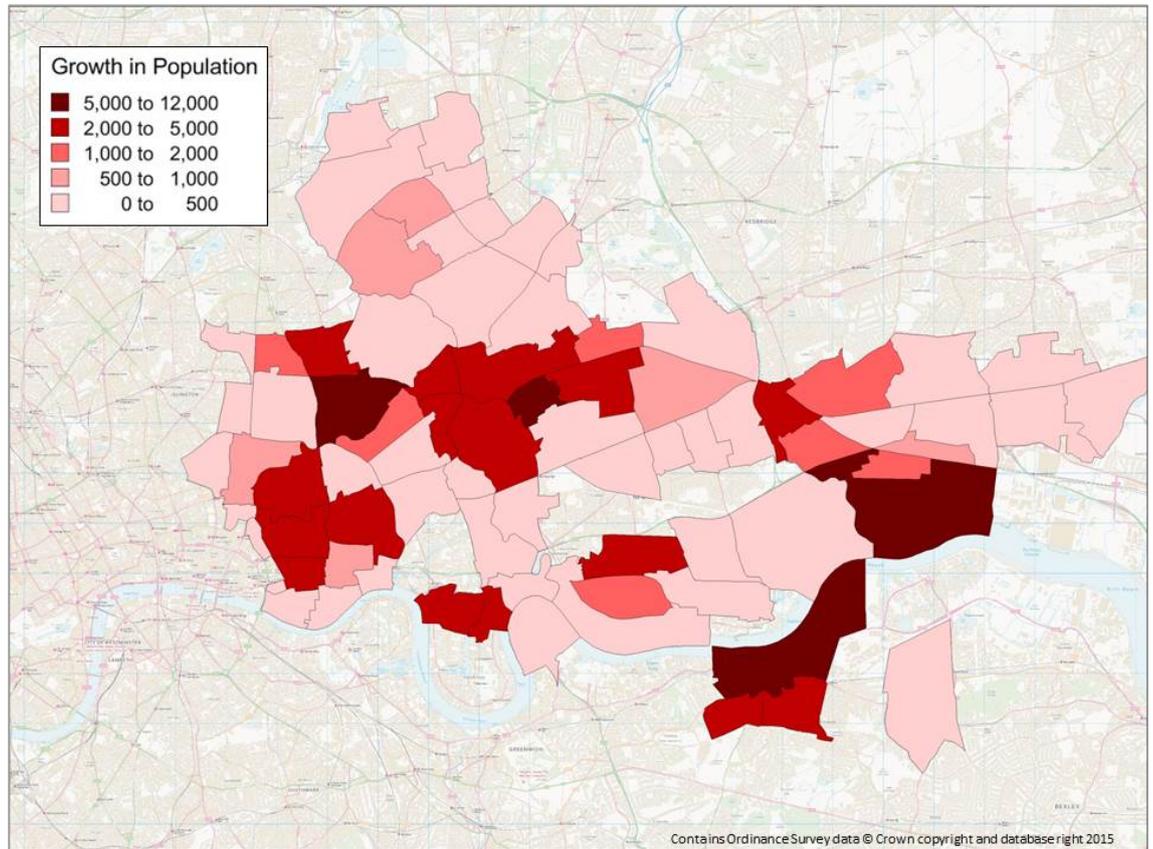


Figure 15 shows the distribution of population growth from new transport investment, spread across the Six Growth Boroughs. Areas with the highest concentration of population growth are shaded in darker red. Population growth is concentrated fairly centrally, with a few areas of high growth to the east, in a similar manner to employment growth. Including the three river crossing schemes shows that total population growth is spread more evenly across the Six Growth Boroughs than employment growth. This is shown in Table 9.

<sup>4</sup> Does not include the three river crossing schemes

Figure 15: Distribution of Transport enabled Population Growth, across the Six Growth Boroughs



### Comparison by Scheme Type

Tables 10 and 11 show the distribution of transport led employment and population growth according to three transport scheme categories:

- Crossrail;
- The committed transport schemes listed in Table 1 (excluding Crossrail); and
- The future non-committed transport schemes listed in Table 1.

Crossrail is given its own category because of the size of its development impacts. The committed transport schemes (excluding Crossrail) deliver similar levels of growth in employment and population. Crossrail delivers a higher level of employment growth. In contrast the future non-committed schemes deliver more growth in population than employment.

As a consequence of this, the split between committed impacts and future non-committed impacts is skewed towards committed for employment growth. It is the opposite for population impacts, with future non-committed schemes delivering the highest level of growth in population.

Table 10: Employment Growth from Transport Investment, by Scheme Type

Borough	Crossrail	Remaining Committed	Future Non-committed
Waltham Forest	-	2,300	-
Hackney	-	2,900	6,700
Newham	9,300	7,400	15,500
Tower Hamlets	69,500	7,300	4,800
Barking & Dagenham	-	600	13,800
Greenwich	9,400	100	4,600
<b>Total</b>	<b>88,200 (57%)</b>	<b>20,600 (13%)</b>	<b>45,400 (29%)</b>

Source: Volterra calculations

Table 11: Population Growth from Transport Investment, by Scheme Type

Borough	Crossrail	Remaining Committed	Future Non-committed
Waltham Forest	-	3,900	-
Hackney	-	2,800	14,700
Newham	11,400	8,700	14,500
Tower Hamlets	15,800	5,500	10,200
Barking & Dagenham	-	1,300	30,600
Greenwich	14,600	200	11,200
<b>Total</b>	<b>41,800 (29%)</b>	<b>22,400 (15%)</b>	<b>81,200 (56%)</b>

Source: Volterra calculations

The above results give the following conclusions:

- Crossrail enables the largest increase in employment, which comes from a large increase in accessibility to an area of already

high employment density – Canary Wharf, and growth at Whitechapel, Woolwich and Stratford.

- Future non-committed schemes enable the largest increase in population. Schemes such as Crossrail 2 Eastern Leg increase access to jobs – in central London and the West End – from areas such as Hackney Central, Hackney Wick and Barking.

However, in terms of informing prioritisation it is more important to look at the ranking of schemes that are yet to be committed to by TfL. Those transport schemes which have already been committed to are unlikely to be changed.

## Future Non-Committed Scheme Impacts

Crossrail 2 Eastern Branch delivers the highest level of both employment growth and population growth out of the future uncommitted schemes. The Eastern branch is not part of the current Crossrail 2 proposal, but at the request of multiple Boroughs it has been included as an option. The Gallions Reach crossing option and the London Overground Extension to Barking Riverside also deliver significant levels of employment and population growth. Although for both future schemes the proportion of population growth delivery is higher than for employment growth.

Tables 12 and 13 provide details all employment and population growth from each future uncommitted scheme, broken down by Borough and in order of employment and population growth.

Table 12: Employment Growth from Future uncommitted schemes by Borough

Transport Scheme	Waltham Forest	Hackney	Newham	Tower Hamlets	Barking & Dagenham	Greenwich	Total
Short/Medium term							
Gallions Reach Crossing Option	-	-	3,400	2,100	1,800	2,100	9,400
L Overground Extension to Barking Riverside	-	-	-	-	6,500	-	6,500
Silvertown Crossing Option	-	-	1,700	1,000	900	1,100	4,700
Stratford International Interchange	-	-	500	-	-	-	500
Custom House Gateway	-	-	100	-	-	-	100
DLR Station Upgrades	-	-	100	-	-	-	100
Long term							
Crossrail 2 Eastern Branch	-	500	5,500	1,700	2,800	-	10,500
Crossrail 2	-	6,200	-	-	-	-	6,200
Belvedere River Crossing Option	-	-	1,700	-	1,800	1,400	4,900
HS1 – 2 Link	-	-	2,500	-	-	-	2,500

*Source: Volterra calculations*

Table 13: Population Growth from future uncommitted schemes by Borough

Transport Scheme	Waltham Forest	Hackney	Newham	Tower Hamlets	Barking & Dagenham	Greenwich	Total
Short/Medium term							
Gallions Reach Crossing Option	-	-	5,200	2,900	4,500	5,200	17,800
L Overground Extension to Barking Riverside	-	-	-	-	12,600	-	12,600
Silvertown Crossing Option	-	-	2,600	1,400	2,300	2,600	8,900
Stratford International Interchange	-	-	300	-	-	-	300
Custom House Gateway	-	-	200	-	-	-	200
DLR Station Upgrades	-	-	100	-	-	-	100
Long term							
Crossrail 2 Eastern Branch	-	2,600	3,200	5,900	6,700	-	18,400
Crossrail 2	-	12,100	-	-	-	-	12,100
Belvedere River Crossing Option	-	-	2,600	-	4,500	3,400	10,500
HS1 – 2 Link	-	-	300	-	-	-	300

*Source: Volterra calculations*

Although employment growth forecasts are shown by Borough, in reality jobs in one area will be accessible to residents across a number of Growth Boroughs. Employment growth is a benefit for the Growth Boroughs as a whole.

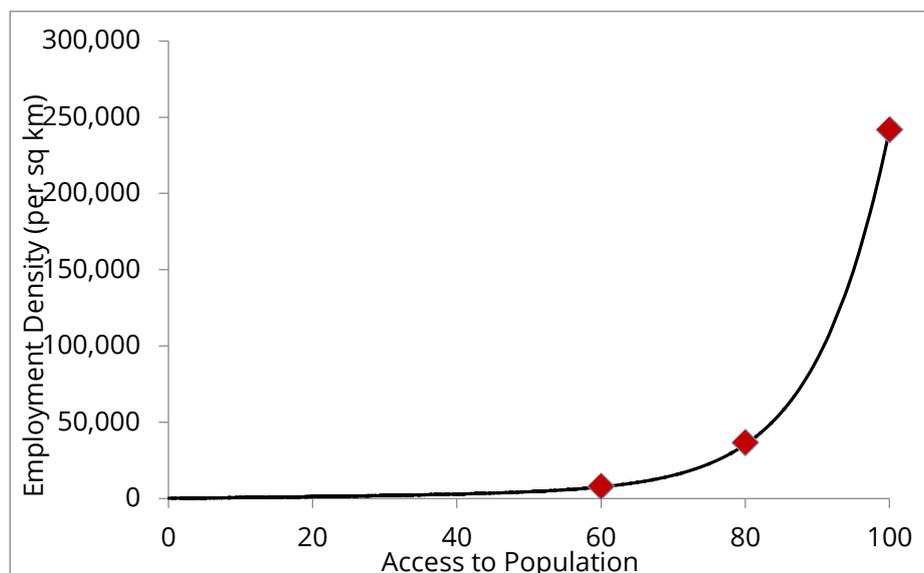
The completion of the transport schemes listed in this study will ensure an even higher level of accessibility for residents across the wider Growth Boroughs. The committed and future schemes will improve both inter-Borough connectivity and the overall connectivity in East London. The analysis in this reports looks at each scheme individually not at combinations of schemes.

## Cumulative Impacts

In determining the employment and population impacts, each scheme has, up to this point, been considered in isolation. For example Crossrail at Canary Wharf Station is given a defined increase in accessibility, which feeds through the model to produce an uplift in employment and population. This is useful in assessing the impacts of each individual scheme across the Growth Boroughs, and ranking schemes according to their impacts.

It does however not pick up on any cumulative impacts. These occur where there are multiple transport investments affecting a station. The cumulative impacts will be greater than the sum of individual impacts. Part of this is due to the compounding process: two 10% increases in accessibility is a 22% increase rather than 20%. The impact will also vary due to the increasing gradient of the Accessibility: Density relationship. As demonstrated below, doubling the accessibility impact more than doubles the density response.

Figure 16: Response of Employment Density to Changing Accessibility



There are 12 stations across the Growth Boroughs that are impacted by multiple transport schemes. Table 14 and Table 15 show the cumulative uplift in development impacts at each of these stations, compared to the sum of individual impacts as identified in Table 9. The additional cumulative impact for employment growth is largest at Canary Wharf, Maryland,

Stratford and Whitechapel, all of which are impacted by Crossrail. Work Package One identified Crossrail as the transport scheme delivering the most employment growth by some way. TZs around Stratford station see over a two thirds increase in employment potential after taking account of cumulative impacts.

Table 14: Cumulative Impacts at Stations with Multiple Schemes, for Employment

Station	Total of Individual Employment Impacts	Additional Cumulative Employment Impact	Uplift from Cumulative Impacts
Barking	3,300	200	6%
Blackhorse Road	300	10	3%
Canary Wharf	49,400	2,200	4%
Canning Town	100	10	10%
Custom House	1,700	100	6%
Forest Gate	2,300	400	17%
Hackney Central	6,500	300	5%
Maryland	6,400	2,300	36%
Mile End	600	10	2%
Stratford	12,700	9,200	72%
West Ham	200	10	5%
Whitechapel	21,800	1,800	8%

*Source: Volterra calculations*

The additional cumulative impact for population growth stands out at Stratford station. As identified in Work Package One, Crossrail and Crossrail 2 both drive employment growth and serve Stratford station.

Table 15: Cumulative Impacts at Stations with Multiple Schemes, for Population

Station	Total of Individual Population Impacts	Additional Cumulative Population Impact	Uplift from Cumulative Impacts
Barking	6,600	200	3%
Blackhorse Road	600	10	2%
Canary Wharf	7,600	100	1%
Canning Town	200	10	5%
Custom House	5,000	100	2%
Forest Gate	5,000	300	6%
Hackney Central	8,200	100	1%
Maryland	4,100	200	5%
Mile End	600	10	2%
Stratford	6,700	1,000	15%
West Ham	400	10	3%
Whitechapel	9,400	100	1%

*Source: Volterra calculations*

## 6 Sensitivity Tests

The robustness of the analysis and model results is tested by completing a number of sensitivity tests. In each test we modify combinations of assumptions. The focus of these tests is not so much about changes to the absolute numbers of jobs and population but whether that changes the rankings. If the top five transport schemes ranked for employment and population growth stay constant throughout all sensitivity tests we conclude that our findings are robust. Of note is that this section does not test the locality assumption of each scheme. The geography of each transport scheme, the stations affected and their proximity to the OA, is fixed throughout.

### Scheme Magnitude

Sensitivity tests changed the magnitude each transport scheme had on accessibility, decreasing or increasing them proportionately dependent on their initial scoring. Transport schemes that started with a small magnitude could only decrease slightly in the first test, but would see a large increase in the second. The opposite applied to transport schemes that started with a large magnitude. The magnitude of the schemes changed sequentially, so this would only affect the one scheme being looked at in that particular sensitivity test. With this test we found little change, the top 5 rankings of employment and population growth by Borough hardly changed. This is shown as Sensitivity Test 1 in Tables 16 and 17 of this Section.

### Non-Transport Constraint

The second round of sensitivity tests involved removing the weightings on the non-transport assumptions. As detailed in Section 2, there were five categories for which we changed various combinations of weighting: Land Use and Ownership, Planning, Market Conditions, Socio-demographic Conditions and Development Targets and Deliverability. Of interest was how this changed ranking for employment and population growth at both the transport scheme level.

Removing the non-transport constraint made a small difference to the top five transport projects in terms of employment and population growth. Crossrail 2 Eastern Branch and the London Overground Extension each move down a place, and Gallions Reach River Crossing and Bow Junction Remodeling each move up a place for employment. For population Crossrail 2 Eastern Branch and Gallions Reach swapped places. The top five schemes still remained the same for both, just in a slightly different order.

### Transport Constraint

The second round of sensitivity tests involved removing the weightings on the transport assumptions. The five levels of transport constraint are detailed in Section 2. The only impact this had was for population, where Crossrail 2 Eastern Branch and Gallions Reach swapped places.

Overall, although changing the assumptions changes the absolute results, they rarely changed the ranking of the. This suggests the rankings presented in Section 3 are relatively robust.

Table 16: Change in Employment Growth Rankings, According to Sensitivity Test

Committed Scheme	Test 1	Test 2	Test 3
Crossrail & complimentary measures	-	-	-
DLR Pudding Mill Station	-	-	-
Bow Junction Remodelling	-	+1	-
Future Non-committed Scheme	Test 1	Test 2	Test 3
Crossrail 2 Eastern Branch	-	-1	-
Gallions Reach Crossing Option	-	+1	-
London Overground Extension to Barking Riverside	-	-1	-

Source: Volterra calculations

Table 17: Change in Population Rankings, According to Sensitivity Test

Committed Scheme	Test 1	Test 2	Test 3
Crossrail & complimentary measures	-	-	-
Bow Junction Remodelling	-	-	-
DLR Pudding Mill Station	-	-	-
Future Non-committed Scheme	Test 1	Test 2	Test 3
Crossrail 2 Eastern Branch	-	-1	-1
Gallions Reach Crossing Option	-	+1	+1
London Overground Extension to Barking Riverside	-	-	-

Source: Volterra calculations

## 7 Conclusions

An assessment of the starting position of the Growth Boroughs shows there is not much potential for growth without new transport infrastructure. After discussions with the individual boroughs, most of the areas with lower employment density than expected have higher population density and vice versa.

Growth will therefore need to be enabled by new transport infrastructure. There is a significant amount of transport infrastructure that is already committed. This could deliver development impacts of over 100,000 jobs and 60,000 residents. Crossrail is the most important committed scheme for delivering these development impacts.

This study is to inform the Growth Boroughs about the impacts of future transport proposals enabling them to agree their priorities and make that case strongly. Crossrail 2 Eastern Branch would deliver the highest growth in jobs and population across the Growth Boroughs of the non-committed schemes: approximately 10,500 jobs and 18,400 residents. Compared to Crossrail 2 Main Branch alone, the benefits of the additional Eastern Branch across the Six Growth Boroughs area would be large. Crossrail 2 is a long-term proposal. Current plans and detail suggest that the route will be open in the early 2030s<sup>5</sup>. This gives the Growth Boroughs time to come to an agreement and lay out plans to prioritise an Eastern Branch scheme.

The Gallions Reach river crossing option and the London Overground Extension to Barking Riverside are also important transport schemes to the area, which are yet to be committed. The Gallions Reach river crossing could deliver development impacts of 9,400 jobs and 17,800 residents, whilst the London Overground Extension could deliver 6,500 jobs and 12,600 residents. A new Thames crossing in east London, specifically the Gallions Reach option, would help ensure a more even spread of job and population growth across the Growth Boroughs, and reduce the barrier of the river. The London Overground Extension to Barking Riverside would also deliver significant growth. There is also an option to extend this branch of the Overground past Barking Riverside and under the Thames to Greenwich. Both the Gallions Reach river crossing option and the London Overground Extension to Barking Riverside are in the medium term.

In reaching any consensus the Six Growth Boroughs will also need to consider factors such as: timing, likelihood of delivery, geographic distribution of impacts cost and blight amongst others. For the future

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<sup>5</sup> TfL, 'Planning for the Future: Crossrail 2', TfL

uncommitted transport schemes, details of these additional factors will become more apparent over time and as potential plans become more defined for each scheme. It is therefore important that continual dialogue between the Six Growth Boroughs continues after any initial agreement on prioritisation. Scheme details are likely to change before they are committed to by TfL, and this needs to be taken account of through discussions and flexibility in prioritisation.