

**Auckland Plan**

**Scenario Evaluation Workstream**

**Technical Report**

**Final Version**

**September 2011**

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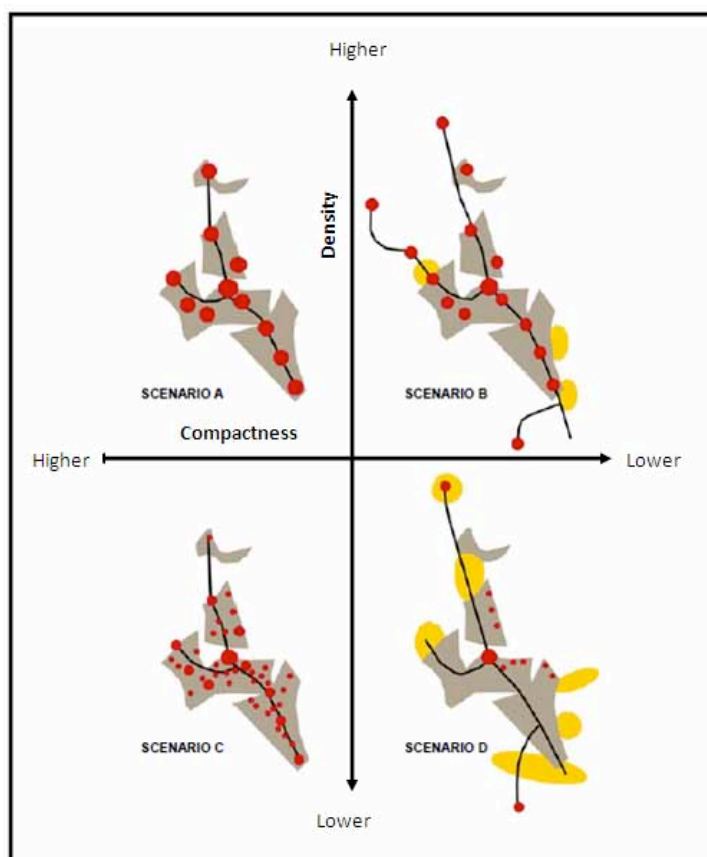
# 1 Executive Summary

## 1.1 Auckland Plan Scenario Evaluation Workstream

The Auckland Plan Scenario Evaluation Workstream involves the evaluation of four different future land use and transport scenarios that accommodate a population of 2.3 million by 2051. This project forms an important part of the evidential base underpinning the spatial component of the Auckland Plan process in that it tests different land use and transport concepts, timings and locations within the region. It will ultimately help guide decision making around a preferred future spatial form and the development strategy required to achieve that spatial form. The project evaluates each of the four scenarios against a range of economic, environmental, social and cultural criteria to explore how each scenario performs against long term goals and aspirations for the future of Auckland.

## 1.2 The scenarios

The four integrated land use and transport scenarios were developed in accordance with the conceptual diagram shown below. The scenarios are positioned in a quadrant, the two axes being density (vertical axis), and compactness (horizontal axis), which are the two key factors by which macro urban form can be varied. The four scenarios, therefore, cover the full range of potential urban forms.



- Scenario A– Intensive Containment (similar to the region’s legacy policy) – growth is focused in a network of larger centres, corridors and existing future urban areas, within the currently planned urban area.
- Scenario B – Intensive Expansion – provides significant growth within the currently planned urban area throughout large centres and high amenity areas. Additional greenfield and satellite centre growth is also provided, which is beyond currently planned urban area.
- Scenario C – Dispersed Containment – all growth is retained within the currently planned urban area (as with Scenario A), however, growth is dispersed more evenly at lower densities within a large number of smaller centres and general suburban infill.
- Scenario D – Dispersed Expansion – growth is located in areas where development pressures exist with less residential and employment growth in centres (except centres where there is demand) with the most growth occurring in high amenity areas and greenfield land beyond the currently planned urban area.

Four varied transport network scenarios were developed jointly between representatives from Auckland Council, Auckland Transport, New Zealand Transport Agency and the Ministry of Transport, with other central government agencies and KiwiRail invited to participate. Each transport scenario was tailored to support the particular land use scenario.

Conceptualising and comparing the scenarios in this way allows scope for exploration of a number of different spatial form growth patterns, including: centres based intensification, growth in satellite towns, suburban and localised intensification, and urban expansion.

### 1.3 Process

The four scenarios were evaluated against a number of economic, environmental, social and cultural criteria to determine how each scenario performs against long term objectives for Auckland's future. The evaluation process brought together quantitative data in the form of model outputs from Auckland Council's integrated transport and land use models, and qualitative analysis from subject matter experts. This has enabled a comprehensive assessment of the relative merits of each scenario against the criteria. The evaluation process is shown in the diagram below.



#### *Integrated transport and land use models – quantitative evaluation*

Modelling was undertaken utilising Auckland Council's integrated transport and land use models, which are generally referred to as ATM2 (Auckland Transport Models version 2). The model integrates two complex models: a land use model (ASP3 - Auckland Strategic Planning model version 3); and a transport model (ART3 - Auckland Regional Transport model version 3). The two models pass information back and forth as the system models land use and transport system changes over the modelling period, from 2006 to 2051.

This model provides complex interactions between the land use, transport system, and employment and population growth demands based on a range of inputs (inputs are different across the scenarios) and through a model run will result in a wide range of outputs for further qualitative and quantitative evaluation, including where the model has allocated dwellings and employment within the parameters of the scenarios.

### Subject matter experts – qualitative evaluation

A qualitative assessment of the scenarios was also undertaken. Where outputs from the model required further interpretation or were not available, or a qualitative assessment was more appropriate, subject matter experts were asked to undertake an evaluation. This was particularly relevant for a number of the environmental and cultural criteria. The main qualitative input areas are summarised in the list below and were gathered through reports, workshops, meetings and presentations.

- Climate Change and Energy Resilience
- Developers Workshop
- Economic Wellbeing Workshops
- Environmental Policy
- Hazards Analysis
- Heritage Policy
- Housing Affordability Workshops
- Infrastructure Providers Workshop
- Māori Perspectives
- Rural Advisory Panel Workshop
- Social and Cultural Wellbeing Workshops
- Transport Network Workshop

## 1.4 Evaluation results

The following table summarises the scores afforded to each of the scenarios through the evaluation process. During the evaluation some ‘sub-criteria’ were added at the request of subject matter experts (for example Avoidance of Natural Hazards, was subdivided into three sub-criteria). The scoring used a seven-point scale which was applied to each criterion, with a zero score indicating nil impact or no change from the present. The scoring is as follows:

0	Neutral: nil/negligible impact
✓ (X)	Small positive (negative) impact
✓✓ (XX)	Moderate positive (negative) impact
✓✓✓ (XXX)	Strong positive (negative) impact

Subject / Criterion	Scenario A	Scenario B	Scenario C	Scenario D
<b>Economic wellbeing</b>				
Improved travel reliability (road)	XX	X	X	XXX
Improved travel reliability (PT)	✓✓	✓✓	✓✓	✓✓
Improved accessibility to economic activity	XX	XX	XX	XXX
Improved access to labour pool (road)	✓	✓	✓	XX
Improved access to labour pool (PT)	✓✓	✓✓	✓✓	0
Increased productivity	✓✓	✓✓	✓✓	✓
Land extensive business sectors	X	✓	X	✓
Energy resilience	0	0	0	X
Improved accessibility to productive rural areas	XX	X	X	XX



Subject / Criterion	Scenario A	Scenario B	Scenario C	Scenario D
Protection of productive rural land	0	X	0	XX
<b>Environmental wellbeing</b>				
Reduced greenhouse gas emissions	0	0	0	X
Protection of or enhancement of marine values	X	XX	XX	XXX
Protection of or enhancement of stream corridors	X	XXX	XX	XXX
Identify, protect and enhance terrestrial ecosystems	✓	XX	✓	XXX
Avoidance of existing hazards	X	XX	X	XX
Avoidance of new hazards	0	X	0	XX
Exposure to existing hazards	XX	X	XX	X
<b>Social wellbeing</b>				
Greater housing affordability	0	0	0	X
Greater housing affordability for deprived households	✓	✓	✓	X
Greater housing choice	0	✓✓	✓	X
Improved accessibility	✓	✓	✓	0
Improved accessibility for deprived households	0	0	0	X
Improved accessibility to social infrastructure	X	0	X	XX
Improved access to local employment opportunities	0	0	0	XX
Improved levels of physical activity	✓✓	✓	✓	0
Improved air quality (impact on public health)	X	X	X	X
Improved water quality (impact on public health)	X	XXX	XX	XXX
<b>Cultural wellbeing</b>				
Protection of Māori heritage and areas of cultural significance	0	0	0	XX
Enabling economic opportunities for Māori	X	✓	✓	✓✓
Promoting Māori culture	0	X	XXX	X
Preserving the Mauri	✓	X	XXX	XX
Provision of open space	✓✓	✓	XX	XXX
Protection of historic heritage	X	XX	✓	XXX
<b>Implementation</b>				
Market feasibility	XXX	✓✓	XXX	✓✓
Minimised infrastructure costs (transport)	0	XX	XX	XX
Minimised infrastructure costs (wastewater)	0	XX	X	XXX
Minimised infrastructure costs (water supply)	0	X	XX	XXX
Minimised infrastructure costs (stormwater)	0	X	XX	XXX
Minimised infrastructure costs (energy – electricity supply)	0	X	X	XX
Minimised infrastructure costs (broadband)	0	X	XX	XX
Minimised infrastructure costs (education)	X	✓✓	✓✓	XX

A full assessment for the scoring of each scenario against the criteria can be found in the main body of the report (Sections 6 to 10). It is important to note that there is no weighting (including equal weighting) attached to the criteria. The high level findings of the scenario evaluation are presented in the following sections.

## 1.5 Key evaluation themes

While each criterion can be considered individually in terms of scenario performance, the findings for each criterion cannot be considered in isolation, as there are many interrelationships between the criteria and across the wellbeings. This section summarises the key themes that emerged through the evaluation process. An assessment of the scenarios by wellbeings can be found within the main body of the report (Sections 6 to 9).

### 1.5.1 Economic development

A compact scenario could lead to a higher value economy with increased agglomeration of business services in centres, particularly the CBD and larger centres. In all scenarios, accessibility (including to ports and the airport) shows an initial improvement in line with transport infrastructure investment, but then begins to decline over time. This is likely due to transport infrastructure investment not keeping pace with continued population and employment growth in the longer term.

The lack of provision for new greenfield land for Group 1<sup>1</sup> industrial activities could result in the loss of lower value activities to elsewhere in New Zealand or even overseas. Provision of greenfield land beyond the current Metropolitan Urban Limits (MUL) for industrial activities is required and can provide locations for lower value activities as they are displaced from their current locations by higher value activities.

### 1.5.2 Transport

In terms of accessibility related model outputs, the more compact scenarios (A, B and C) generally perform similarly, and better than the most expansive scenario, D. This includes measures such as congestion, vehicle kilometres travelled, the cost of travel and the number, distance and speed of trips. However, generally speaking, accessibility decreases in all scenarios to 2041, therefore, additional tools and investment in the transport network will be required. The level of accessibility provided in the scenarios was an important consideration in the evaluation because improvements in accessibility provide benefits across all four wellbeings.

Capital and operational expenditure for transport projects in each of the scenarios were estimated to provide a relative comparison of the scenarios. When comparing scenarios, Scenario A (\$36.8b) has the lowest estimated cost. Scenarios B (\$45b), C (\$43.7b) and D (\$44.7b) have similar total costs, and while Scenarios B and C perform similarly to Scenario A in terms of accessibility outcomes, Scenario A's total cost is \$6.9b lower than the next lowest scenario. This significantly lower cost is attributable to Scenario A not including an additional Waitemata Harbour crossing (road or rail) within its transport network. In developing the preferred transport scenario, policy initiatives such as parking management and road pricing or a congestion charge require further testing.

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<sup>1</sup> Group 1 activities are land extensive industries such as manufacturing, construction, wholesale trade, transport and storage

### 1.5.3 Infrastructure

Efficient and well-timed provision of physical and social infrastructure will be essential to achieving the objectives of the Auckland Plan. Each infrastructure class has particular preferences, however, generally, infrastructure providers favoured Scenario A, as it was seen that a compact urban form with concentrated growth in a limited number of large centres is much more efficient (and less costly) for provision of infrastructure than an expansive, low density urban form. An important matter expressed by a number of providers was that when planning for growth, due consideration to previous infrastructure investments should be given in order to gain full return on the financial costs of these previous projects.

The key message conveyed from infrastructure providers was that land use planning priorities and the sequencing of infrastructure projects should be aligned to form the basis of a comprehensive spatial planning approach.

### 1.5.4 Market feasibility

Market commentators support intensification in appropriate market attractive areas, but note that this must be complemented with an appropriate provision of greenfield land. The preferred market scenario would be a combination of Scenario B (for choice) and Scenario D (for additional greenfields).

Auckland has a geographically unbalanced development market and different communities require different solutions. Intensification in non-market attractive areas would require interventions from local or central government. Importantly, certainty should be provided to the market by Auckland Council being definitive about the future location of the MUL and strictly controlling the release of developable land.

### 1.5.5 Housing affordability and choice

The model outputs indicate that the most expansive scenario (Scenario D) has the least affordable housing of all the scenarios; this is emphasised further when transport costs are considered. Scenario D is also more unaffordable for lower income households than for the region as a whole reaffirming that these households are more vulnerable to increases in housing and transport costs.

While increased transport costs in a more expansive scenario may be expected, an increase in housing costs is perhaps counterintuitive. This suggests that the market demand for houses in an expansive scenario would not deliver affordable housing, particularly in desirable greenfield locations. This is reinforced by the more compact and intensive scenarios, A, B and C, having housing costs that are considerably lower than Scenario D, and also lower than at 2006, in the lower income zones.

It is important to note that the discussion on housing affordability in this report is based on model outputs only, refer to the separate Auckland Plan housing workstream technical paper<sup>2</sup> for a more detailed discussion of housing issues and the impact of spatial form.

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<sup>2</sup> Auckland Council. (2011) Technical Workstream Draft Auckland Plan: Housing.

Recent research papers indicate that there will continue to be strong demand for detached housing into the future. Studies also indicate that in order to meet the demand for housing there will need to be a greater reliance on more multi-unit housing. Scenarios B and C provide the greatest range of housing typology choice, while Scenario D provides the greatest locational choice.

#### 1.5.6 Climate change

None of the scenarios achieve the Mayor's target of a 40 per cent reduction in net Greenhouse Gas (GHG) emissions by 2031 on 1990 levels. Model outputs show that total CO<sub>2</sub> emissions from vehicles are similar in the more compact scenarios of A, B and C, all three being significantly less than the expansive Scenario D. However, all scenarios show a decline in CO<sub>2</sub> emissions per capita, as a result of assumed technological advancements in the vehicle fleet.

This shows that land use policy alone will not deliver required reductions in GHG emissions. Travel demand by private vehicle will continue to increase with a growing population; the consequences of this growth will depend on the development of effective transport policy at a national, regional and local level.

#### 1.5.7 Natural hazards

Concentration of development within the current urban area will increase population and infrastructure vulnerability, particularly for low frequency hazard events (eg volcanic eruption or earthquake). The scenarios which expand the urban footprint (Scenario D, and to a lesser extent Scenario B) will disperse risk from both low frequency hazard events and localised frequent events (eg flooding). However, Scenarios B and D will also expose development to new hazards, such as flooding in the south and land instability and coastal hazards in the north.

Different growth patterns create different risks to hazards, extensive research on hazards and their risks should be undertaken and a long-term management approach for hazards and their consequences needs to be implemented for new growth areas.

#### 1.5.8 Environmental quality

All scenarios perform negatively because the scale of projected growth will inevitably put increased pressure on the natural environment, particularly if current policy and practice continue. A compact urban form is more desirable as it focuses growth in town centres and reduces environmental risk to new areas (as would occur through greenfield growth). It is best to avoid development in catchments and areas that are not currently developed because intensive development of an already degraded catchment is preferable to developing in an otherwise undamaged or highly valued area. Scenario D, inevitably, performs the worst against the environmental criteria due to its expansive form.

#### 1.5.9 Heritage and cultural values

All scenarios present risks and opportunities in the protection of heritage and cultural values. Intensification and infill in Scenarios A, B and C increase risks for built heritage through redevelopment within the existing urban area, this is of particular concern for Scenario B where

intensification of high amenity areas (which are often areas of cultural and heritage significance) may result in pressure or even loss of these values due to urban development. Greenfield expansion in Scenarios B and D can affect landscape amenity values and areas currently unknown for their inherent values. Additionally, the tendency for major arts, cultural, recreational, and to a lesser extent religious facilities, to locate in central areas could lead to capacity constraints and competition in an intensive urban environment, while in a dispersed urban form, accessibility issues may arise.

Urban form can have major impacts on heritage and cultural values, whether it is expansive or contained growth, policy which protects these areas from urban growth pressures will be essential into the future.

#### 1.5.10 Māori

The impacts of the different scenarios on specifically tangata whenua values are difficult to quantify. It will be important for Auckland Council and Māori to have on-going dialogue at all levels of planning from strategic to local, to ensure that the effects of different growth scenarios on the aspirations of Māori are understood and protected.

#### 1.5.11 Rural

Rural productivity was assessed in two ways: Loss of productive rural soils and general accessibility. Greenfield expansion in Scenario D inevitably leads to large areas of productive rural soils lost to urban expansion, this is also true for Scenario B, albeit to a lesser degree than in Scenario D. The most compact scenarios (A and C) result in no loss beyond that of already planned areas of greenfield growth.

In general terms, accessibility from important productive areas to the airport and port decreases in all scenarios, however, in a few cases current levels of accessibility are maintained. The largest decrease in accessibility is seen from the north in Scenarios A and D: the former so far as to display a doubling of travel time, which is a likely consequence of the transport network not including the Puhoi to Wellsford motorway; while the latter is likely due to significant amounts of greenfield growth to the north of Auckland.

## 1.6 Conclusions

The findings of the evaluation process, summarised in the preceding sections, provide the basis for some conclusions around the spatial form that could best enable Auckland to meet the challenges of the future.

### 1.6.1 The impacts of growth

The extent of population and employment growth projected for Auckland will inevitably cause some adverse effects. Accommodating a population of 2.3 million people by 2051<sup>3</sup> will put considerable pressure on the natural environment and require significant additional investment in infrastructure. Ensuring the most appropriate spatial form, which is supported by well-timed investment in infrastructure, will ameliorate some of the worst adverse effects. These will need to be supported by policy interventions in areas where spatial form and infrastructure alone are unable to make sufficient difference.

### 1.6.2 Spatial form

This evaluation clearly shows that a compact spatial form is preferable for Auckland. Scenarios A, B and C performed quite similarly in many respects, particularly in the modelling; Scenario D, the expansive scenario, however, was often an outlier and scored the most negatively (please see the full body of the report for the complete evaluation results and associated discussion). For most criteria, a compact approach performs the best by allowing for:

- An increased likelihood of fostering a more productive economy, through greater business agglomeration opportunities and protection of productive rural land. A compact form also leads to reduced traffic congestion allowing better access to skilled labour, and ensuring that important sites of economic activity, including the port and airport, are more accessible.
- More efficient and cost effective provision and servicing of physical infrastructure such as the transport network, three waters and energy.
- Less negative environmental impact due to lower greenhouse gas emissions, avoidance of higher quality environmental areas and better protection of ecological, landscape, heritage and marine values.
- A strong network of centres enabling better social cohesion, walkable neighbourhoods, ageing in place opportunities and better access to social infrastructure including local facilities.

However, it is important to note that for some criteria the expansive approach performs better. Therefore, while acknowledging that a compact approach is preferable, the following should also be taken into consideration in making trade-offs about Auckland's future spatial form:

- There are concerns that some of the more intensive theoretical densities implied in some of the scenarios could not be met through existing market demand.
- There is a clearly identified need for additional greenfield land for Group 1 business activities, which can only be provided by expanding the existing urban footprint.

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<sup>3</sup> Population and employment projections used in this workstream are those previously used by the Auckland Regional Council in the Future Land Use and Transport Planning Project (2010). These projections are inconsistent with (although not considerably different to) the current Auckland Council projections, which have been utilised in other Auckland Plan workstreams. This is due to this workstream commencing prior to the availability of the Auckland Council projections. This workstream involves a comparative analysis of macro spatial form between four scenarios, therefore the impact of using the different projections is considered minimal.

- Concentration of development increases vulnerability to low frequency hazard events (however expansion increases vulnerability to new and localised high frequency hazard events).

The results indicate a compact spatial form that includes some flexibility to take account of the factors discussed above. Further finer-grained assessment of key urban form typologies in the scenarios can be found in Section 11.3 of the main report, and includes evaluation of urban centres, satellite centres, amenity areas, suburban intensification, expansion areas (residential and Group 1 business) and business areas.

### 1.6.3 Infrastructure provision

The extent of growth anticipated in Auckland dictates the need for significant investment in infrastructure, particularly transport and water infrastructure. This evaluation has shown that a compact approach with focused intensification in specific locations provides the most cost effective and feasible form of development for infrastructure providers, and that expansive growth is often more costly, requiring significant investment in new network components. The challenge will be to ensure that investment is used in a way that is most efficient and effective. The main conclusions from this evaluation around provision of infrastructure are:

- A need for land use and transport integration. On balance, a wide range of outcomes, such as businesses agglomeration, social cohesion, opportunities for physical activity and local and sub-regional accessibility can be supported through a strong network of centres supported by a complementary transport network, particularly the rapid transport network.
- The model outputs identify that significant transport investment in the next decade will improve accessibility across the region, but that the level of accessibility will subsequently decline as growth overtakes the investment. Investment in transport infrastructure, particularly passenger transport, in the scenarios is effectively 'front-loaded' in the first decade. It is important to recognise that additional policy intervention and or investment would be required in the longer term to address key issues such as regional accessibility.
- Infrastructure provision is a lengthy and costly exercise that requires significant lead-in times, with infrastructure networks often less responsive to rapid changes in spatial form. Infrastructure providers need adequate time to reorganise their work programs and require a consistent approach to growth area prioritisation.
- Collaboration with physical and social infrastructure providers will be fundamental to aligning implementation and funding priorities, in order to achieve desirable land use outcomes.

### 1.6.4 Land use planning is necessary, but not sufficient

Determining and planning Auckland's future spatial form will not be sufficient, in itself, to deliver the outcomes sought. While agreeing that a compact spatial form provides the most benefits, this will need to be underpinned and promoted by a complimentary range of other, equally important mechanisms:

- A strong focus on implementation, setting a clear policy direction, supported by Area Spatial Planning, the Long Term Plan and the Unitary Plan and various other related plans. Partnership with central government and iwi will be critical and additional implementation tools (for example an urban development authority or Public Private Partnerships (PPPs)) will also have to be given serious consideration.
- Comprehensive investment in core infrastructure, such as passenger transport, roading, three waters and power supply. It is important that this investment is signalled in advance and that planning and provision is aligned with land use decisions.
- Future growth will be dependent on the securing of appropriate funding for infrastructure and new construction. Depending on the level of Auckland Council intervention and the requirements of growth areas, a variety of intervention mechanisms (such as funding) may be employed. While these are currently subject to a separate investigation, such mechanisms may include targeted rates, and refinement of development contribution policies.
- Central and local government policy interventions; for example those that can support achievement of national guidelines of standards, such as introducing emission standards for vehicles.

This technical report does not identify one of the four scenarios as the final and preferred spatial form for Auckland; it does, however, outline some of the key elements that should be considered when arriving at the preferred spatial form. This evaluation has shown that in order to achieve the outcomes sought, Auckland requires a compact spatial form which retains some flexibility to cater for future growth pressures. This needs to be reinforced through comprehensive planning, investment and provision of core infrastructure, as well as a range of supporting national and local policy interventions.

#### 1.6.5 Next steps

The Scenario Evaluation Workstream is one of a number of workstreams providing the evidential base for the Auckland Plan. The Draft Auckland Plan will articulate a proposed preferred spatial form which will be based upon the conclusions of these processes. The next stage of the scenario work will involve modelling and evaluation of the preferred land use and transport scenario. This will contribute to the further refinement of the preferred spatial form for Auckland.



## 2 Introduction

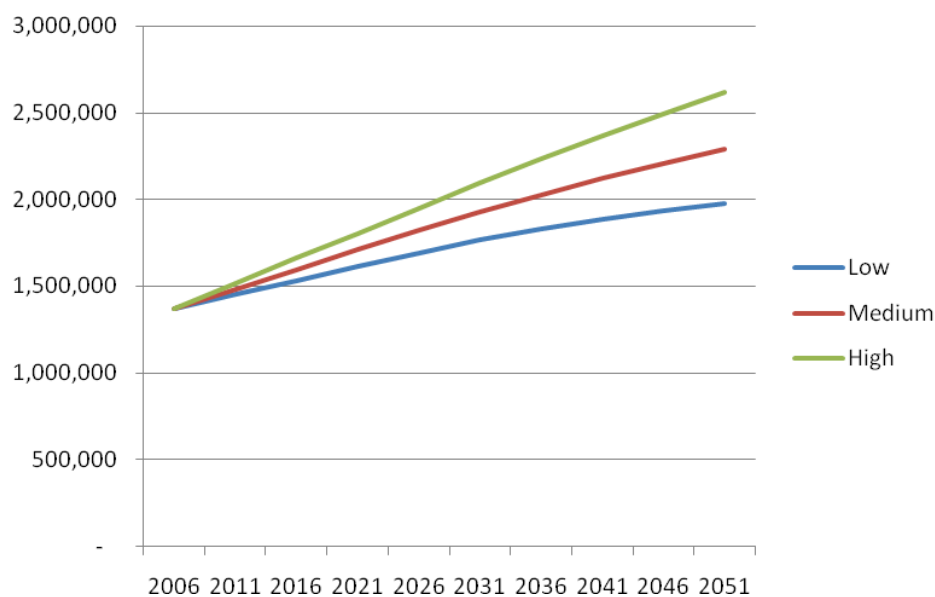
### 2.1 The growth challenge

Auckland faces a considerable growth challenge. Projections indicate a future population of 2.3 million by 2051, from the present population of around 1.4 million (medium series – Figure 1), but this figure could be reached as early as 2036 if the region experiences a high growth scenario. Employment projections show a similar trend (Figure 2) with 976,000 full time equivalent jobs projected by 2051 in a medium scenario<sup>4</sup>.

This strong growth trend is not new, and as it continues into the future increasing pressure will be placed upon the environmental, social and cultural qualities valued by Aucklanders, and upon the infrastructure required to maintain the quality of life of a growing population.

The population growth drives increased need for dwellings (which are expected to increase at a faster rate than population due to a decreasing average dwelling occupancy), as well as all the physical and social infrastructure, social, cultural and environmental services and facilities, and employment these current and future residents will require.

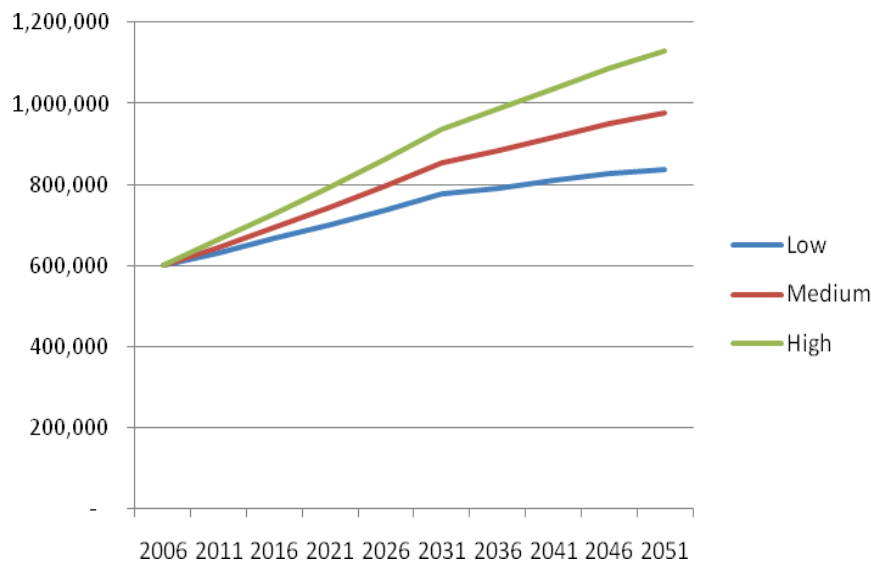
**Figure 1 Population projections**



Source: Auckland Regional Council (Statistics NZ Population Projections, 2006 base)

<sup>4</sup> Population and employment projections used in this workstream are those previously used by the Auckland Regional Council in the Future Land Use and Transport Planning Project (2010). These projections are inconsistent with (although not considerably different to) the current Auckland Council projections, which have been utilised in other Auckland Plan workstreams. This is due to this workstream commencing prior to the availability of the Auckland Council projections. This workstream involves a comparative analysis of macro spatial form between four scenarios, therefore the impact of using the different projections is considered minimal.

**Figure 2 Employment projections**



Source: Auckland Regional Council (Horizon Economic Futures Model version 1.5)

## 2.2 Purpose of this workstream

The Auckland Plan Scenario Evaluation Workstream involves the evaluation of four different future land use and transport scenarios that accommodate a population of 2.3 million by 2051. This project forms an important part of the evidential base underpinning the spatial component of the Auckland Plan process. In terms of the relevant legislation, the Local Government (Auckland Council) Act (2009) states that the Auckland Council must prepare and adopt a Spatial Plan (Section 79) that addresses the following:

- *Long-term social, economic, environmental and cultural objectives for Auckland and its communities;*
- *The role of Auckland in New Zealand;*
- *Existing and future land use pattern (residential, business, rural production and industrial use);*
- *Existing and future location of critical infrastructure such as transport, water supply, wastewater and stormwater, other network utilities, open space and cultural and social infrastructure;*
- *Identification of nationally and regionally significant:*
  - *Ecological areas that should be protected from development*
  - *Recreation and open space areas*
  - *Environmental constraints on development (such as unstable land)*
  - *Landscapes, areas of heritage, and natural features*
- *How Auckland might develop, including the sequencing of growth and provision of infrastructure;*
- *Policies, priorities, programmes and land allocations to implement the strategic direction and indicate how resources will be provided to enable that to happen.*

The Scenario Evaluation Workstream provides an important evidence base for the above legislative requirements of the Auckland Plan because it tests different land use and transport options, timings and locations within the Auckland region. This report will ultimately help guide decision making around a preferred future spatial form and required development strategy to achieve that form.

These scenarios should be considered indicative and are intended to enable the exploration and comparison of a range of potential futures by utilising a consistent amount of dwelling and employment growth, by:

- varying the location and density of future growth, and;
- varying integrated transport network configurations to serve the scenarios' land use.

The scenarios are not intended to be 'options' for one to be chosen at the end of the process, but rather aspects of various scenarios are likely to be explored in more detail as a preferred spatial form is developed and refined for inclusion in the draft and final versions of the first Auckland Plan.

The project evaluates each of the four scenarios against a range of economic, environmental, social and cultural criteria to explore how each scenario performs against long term goals and aspirations for the future of Auckland. The evaluation of the scenarios included both quantitative and qualitative components. Each scenario is quantitatively modelled using Auckland Council's integrated land use and transport models (refer Section 4.3) which provides comparable output data on accessibility, transport network performance and land use capacity take-up. From the qualitative perspective, a range of assessments against relevant criteria was undertaken by subject matter experts to both complement and interrogate the quantitative model outputs.

## 2.3 Purpose and structure of this report

This technical report documents the process and results of the Auckland Plan Scenario Evaluation Workstream. It describes the four integrated land use and transport scenarios and the criteria used to evaluate them, and provides a comprehensive assessment of how well the four scenarios deliver on the long term outcomes sought for Auckland.

This report includes the following sections:

- Section one contains the executive summary;
- Section two outlines the growth challenge facing Auckland and provides an introduction to the Scenario Evaluation Workstream;
- Section three introduces and describes the four land use and transport scenarios;
- Section four outlines the evaluation process, including the integrated land use and transport models, the evaluation criteria, and the qualitative input;
- Section five provides an overview of the model outputs used in the evaluation;
- Section six details how the scenarios scored against economic wellbeing criteria;
- Section seven details how the scenarios scored against environmental wellbeing criteria;

- Section eight details how the scenarios scored against social wellbeing criteria;
- Section nine details how the scenarios scored against cultural wellbeing criteria;
- Section ten details how the scenarios scored against implementation criteria;
- Section eleven provides an overview of the evaluation results and includes discussion around the emerging themes, locations and forms of growth and feedback received on implementation tools;
- Section twelve presents the conclusions of the evaluation, including recommendations about important aspects that could be contained in the preferred spatial form section of the Draft Auckland Plan.

The appendices provide further detailed information in the form of maps, tables, graphs and descriptions, which support the discussion in the main body of the report.

Furthermore, there are two separate supplementary documents that provide additional background information:

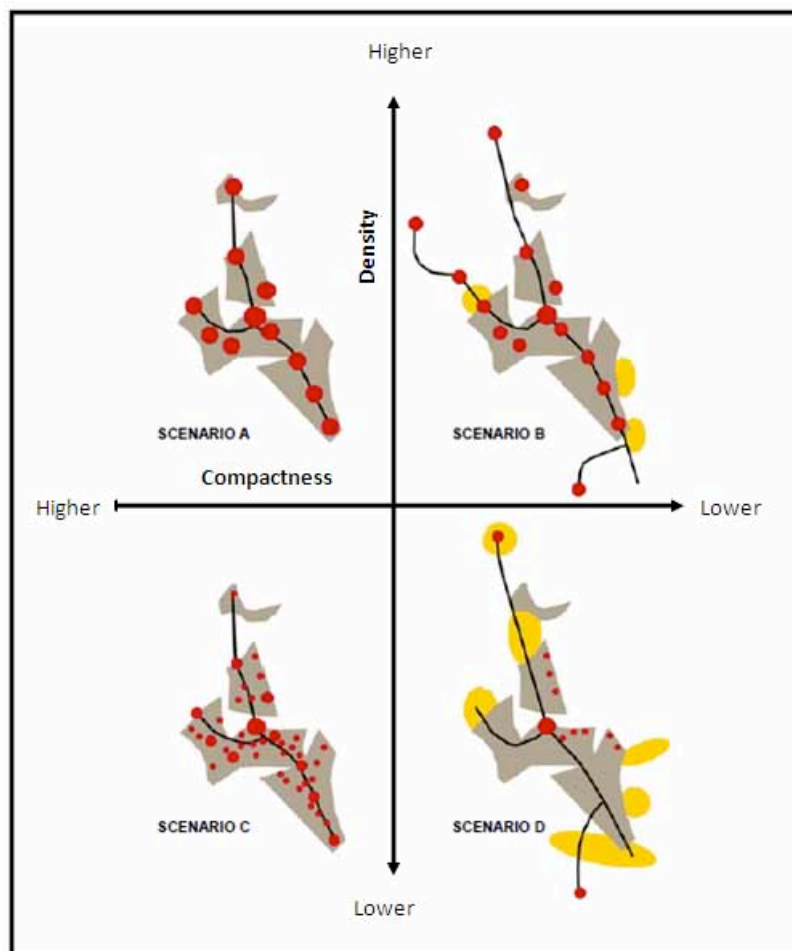
- Attachment 1 collates the full feedback received from subject matter experts.
- Attachment 2 contains a number of technical documents outlining input and modelling assumptions.

## 3 Scenario Descriptions

### 3.1 Scenario concepts

The four integrated land use and transport scenarios were developed in accordance with the conceptual diagram shown below in Figure 3. The scenarios are positioned in a quadrant, the two axes being density (vertical axis), and compactness (horizontal axis), which are the two key factors on which macro urban form can be varied. The four scenarios therefore cover the full range of potential urban forms.

**Figure 3 Scenario concepts**



- Scenario A– Intensive Containment (similar to the region’s legacy policy) – growth is focused in a network of larger centres, corridors and existing future urban areas, within the currently planned urban area.
- Scenario B – Intensive Expansion – provides significant growth within the currently planned urban area throughout large centres and high amenity areas. Additional greenfield and satellite centre growth is also provided, which is beyond currently planned urban area.

- Scenario C – Dispersed Containment – all growth is retained within the currently planned urban area (as with Scenario A), however, growth is dispersed more evenly at lower densities within a large number of smaller centres and general suburban infill.
- Scenario D – Dispersed Expansion – growth is located in areas where development pressures exist, with less residential and employment growth in centres (except centres where there is demand) with the most growth occurring in high amenity areas and greenfield land beyond the currently planned urban area.

Given that Auckland’s existing spatial form is inevitably contained as a ‘base’ within each scenario, the scenarios are reasonably tightly clustered within the quadrant. The higher density focused scenarios still allow for significant growth in lower density type locations and these compact scenarios also allow for considerable expansion (in line with currently agreed and planned future urban areas). Equally, the expansive scenarios allow for considerable intensification opportunities in a variety of locations. Therefore, it is only the *relative* emphasis on containment or expansion between the scenarios that varies.

Conceptualising the scenarios in the way shown in Figure 3 helps to compare them, and allows scope for exploration of a number of different spatial form growth patterns including centres based intensification, growth in satellite towns, suburban and localised intensification, and urban expansion. The following sections outline the core land use and transport components of each scenario in greater detail.

Further supporting information can be seen in the Appendices including: transport network maps (PT and roading) – Appendix 2; a comparison of the major transport projects contained in the scenarios – Appendix 3; and detailed transport network descriptions – Attachment 2, Section 3 and 4.

Four varied transport scenarios were developed jointly between representatives from Auckland Council, Auckland Transport, New Zealand Transport Agency, Ministry of Transport, with other central government agencies and KiwiRail invited to participate. Each transport scenario was tailored to support the particular land use scenario. The transport approach for each scenario is described in the following section and in more detail in Appendix 3 and Attachment 2. A programme of transport projects was identified and phased over five year time periods (acknowledging that for most projects further investigation is required to determine their cost effectiveness and timing). The costs of each of the infrastructure programmes were estimated and compared for relativity. It was agreed that adjustments be made to ensure the overall costs of the transport programmes for each scenario were relatively similar. This was to enable a comparison of the levels of service arising from the different transport approaches rather than different levels of investment.

Due to time constraints, it was agreed that a form of road pricing would be identified and modelled as a sensitivity test for all of the scenarios to determine the transport and land use effects. This work is still being undertaken as from August 2011.

The four scenarios vary in the location, scale and timing of growth in dwellings and employment capacity provided to accommodate the same amount of projected growth. The transport networks contained in the scenarios also vary, in order to serve the different land use patterns. Tables and graphs illustrating the differences in capacity between the scenarios are provided in Appendix 4 and detailed maps comparing capacities can be seen in the separate Attachment 2 (Section 2) document.

## 3.2 Scenario A

### 3.2.1 Land use

This scenario reflects legacy policy as per the Auckland Regional Policy Statement, Change 6 (RPS PC6), which originates from the Regional Growth Strategy, 1999 (RGS). Growth is focused in a network of centres, corridors and existing future urban areas (see Map 1). The land use categories contained within this scenario, and the role they play in accommodating residential and employment growth, are described below.

#### **CBD and CBD Fringe**

- Important location for Group 2<sup>5</sup> business and high density residential growth.

#### **Centres**

- Majority of residential and employment growth provided in identified 'growth centres' at scale and timing identified in RPS PC6. These centres are not necessarily serviced by the Rapid Transit Network (RTN) or centrally located, but are spread across the Auckland region.

#### **Corridors**

- Schedule 1 (RPS PC6) identifies two corridors for high density residential and business growth; Lincoln Road and Hobsonville Corridor.

#### **Business Areas**

- Business areas (major industrial or business park areas outside of centres and corridors) have a significant proportion of employment capacity. Particularly as a response to no additional provision of greenfield land for Group 1 business activities in this scenario.

#### **Suburban**

- Residential and employment capacity has been provided through general infill subdivision to existing District Plan capacity.

#### **Existing Future Urban**

- RPS PC6 lists 21 Future Urban Areas, within this scenario these areas are significant future residential and employment areas. Future Urban Areas are also critical for Group 1 business activities in this scenario.

#### **New Future Urban**

- No growth beyond areas identified for growth in the RGS, most of this is within the Metropolitan Urban Limits (MUL).

#### **Satellites and Rural Towns**

- Some rural towns to grow beyond current District Plan capacity for employment and residential capacity.

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<sup>5</sup> Group 2 activities are office based business services including professional and financial services, as defined by the Business Land Strategy, October 2006

## Rural

- Rural areas grow to the existing District Plan capacity for residential and employment capacity.

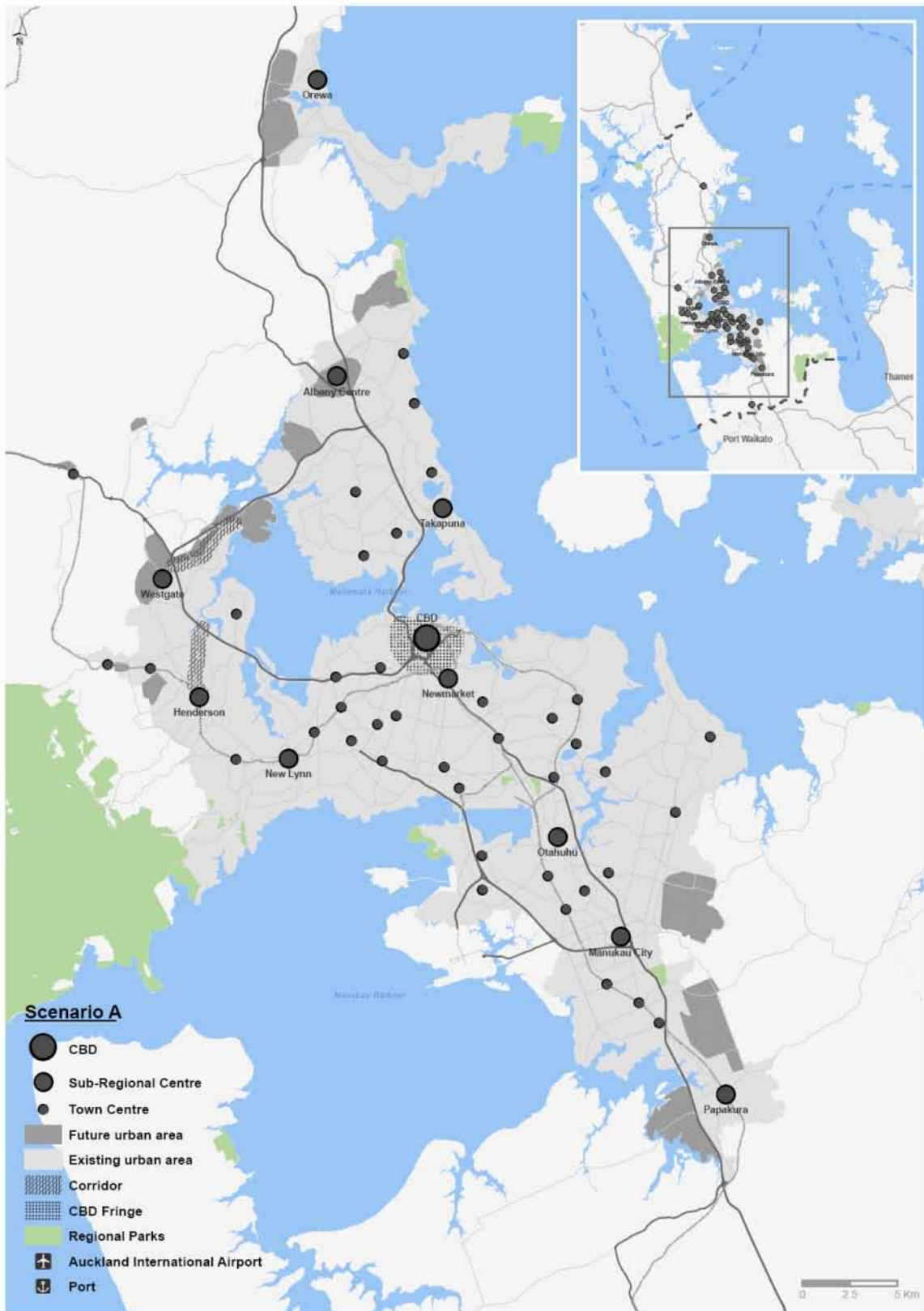
Table 1 below summarises the residential and employment capacities provided in Scenario A.

**Table 1 Scenario A capacities**

Area Type	Dwellings (2006)	Total Additional Dwellings	Employee Count (2007)	Total Additional Employees
CBD	9,363	17,637	82,097	67,903
CBD Fringe	7,893	12,107	41,321	18,679
Sub-Regional Centre	9,045	98,955	59,183	111,837
Town Centre	35,022	138,578	73,359	123,924
Corridor	4,209	5,791	8,222	8,278
Business	8,856	7,241	186,233	79,364
Suburban	311,169	37,408	139,402	17,526
Future Urban	3,219	51,316	3,810	40,379
Rural Town	21,468	20,812	13,541	8,281
Rural	33,783	28,931	21,329	610
<b>Total</b>	<b>444,027</b>	<b>418,776</b>	<b>628,497</b>	<b>476,782</b>
2051 Demand		348,000		375,000
<b>Difference</b>		<b>70,776</b>		<b>101,782</b>



Map 1 Scenario A



### 3.2.2 Transport network

The transport network in this scenario is based upon the Regional Land Transport Strategy 2010-2040 (RLTS) which supports the land use articulated in RPS PC6. It has the fundamental premise of supporting intensive centres which are connected and served by a network of strategic roads, public transport, walking and cycling. Key components of the transport network include:

- Improvements across the transport network, with an emphasis on public transport (PT), walking and cycling, and behaviour change measures.
- Expanding the Rapid Transit Network (RTN) and Quality Transit Network (QTN) networks.
- Higher frequency of services on the RTN and QTN and improvements to the Local Connector Network (LCN).
- Improvement in the operation of existing roads, especially regional arterials with a focus on public transport and the regional strategic freight network.
- Construction of limited additional road capacity – completion of the strategic road network.
- Integrated transport ticketing and fares continuation in behaviour change initiatives.

Transport maps showing Scenario A's PT and roading network can be found in Appendix 2 (Maps 11 and 12).

## 3.3 Scenario B

### 3.3.1 Land use

This scenario focuses a significant amount of growth within the current urban area and has a strong emphasis on centres based growth (Map 2). However, it differs from Scenario A in that it also provides for relatively intensive greenfield development at the urban periphery (beyond the existing Future Urban Areas identified in the RPS PC6), significant growth in satellite centres, and intensification opportunities in areas of high amenity within the metropolitan area (ridgelines and coastal areas).

The land use categories contained within this scenario, and the role they play in accommodating residential and employment growth, are described below.

#### **CBD and CBD Fringe**

- Important location for Group 2 business and high density residential growth. Residential and employment capacity in the CBD and CBD Fringe is highest in this scenario.

#### **Centres**

- Significant residential and employment growth to be focused in growth centres, particularly those located on RTN and QTN and in high amenity areas.

#### **Corridors**

- Those corridors included in RPS PC6 supplemented by additional corridors identified through the Auckland Regional Growth Corridors Report (2010) selected because of their location on key transport routes and their proximity and orientation to the CBD.

#### **Business Areas**

- Business areas have a significant proportion of employment capacity, providing capacity for further residential, mixed use or town centre development and Group 1 business activities (depending on location). Increased employment capacity was provided in areas that fall within the economic corridors being explored in the Auckland Economic Development Strategy technical work.

#### **Suburban**

- Existing infill capacity provided with increased capacity in high amenity areas (eg coastal areas and ridgelines at 'redevelopment' rates)

#### **Existing Future Urban**

- RPS PC6 lists 21 Future Urban Areas, within this scenario these areas are significant future residential and employment areas.

## New Future Urban

- Growth in a small amount of additional residential greenfields to accommodate primarily residential growth; these greenfield areas are identified as Drury, Brookby and Whenuapai. Also, provision for a number of greenfield sites for Group 1 business activities on the urban periphery.

## Satellites and Rural Towns

- Increased capacity for growth in rural and coastal towns. Specifically, this scenario provides for significant growth in major satellites centres of Helensville, Warkworth, Pukekohe, Kumeu/Huapai and Wellsford, and two new satellites towns at Dairy Flat and Wesley

## Rural

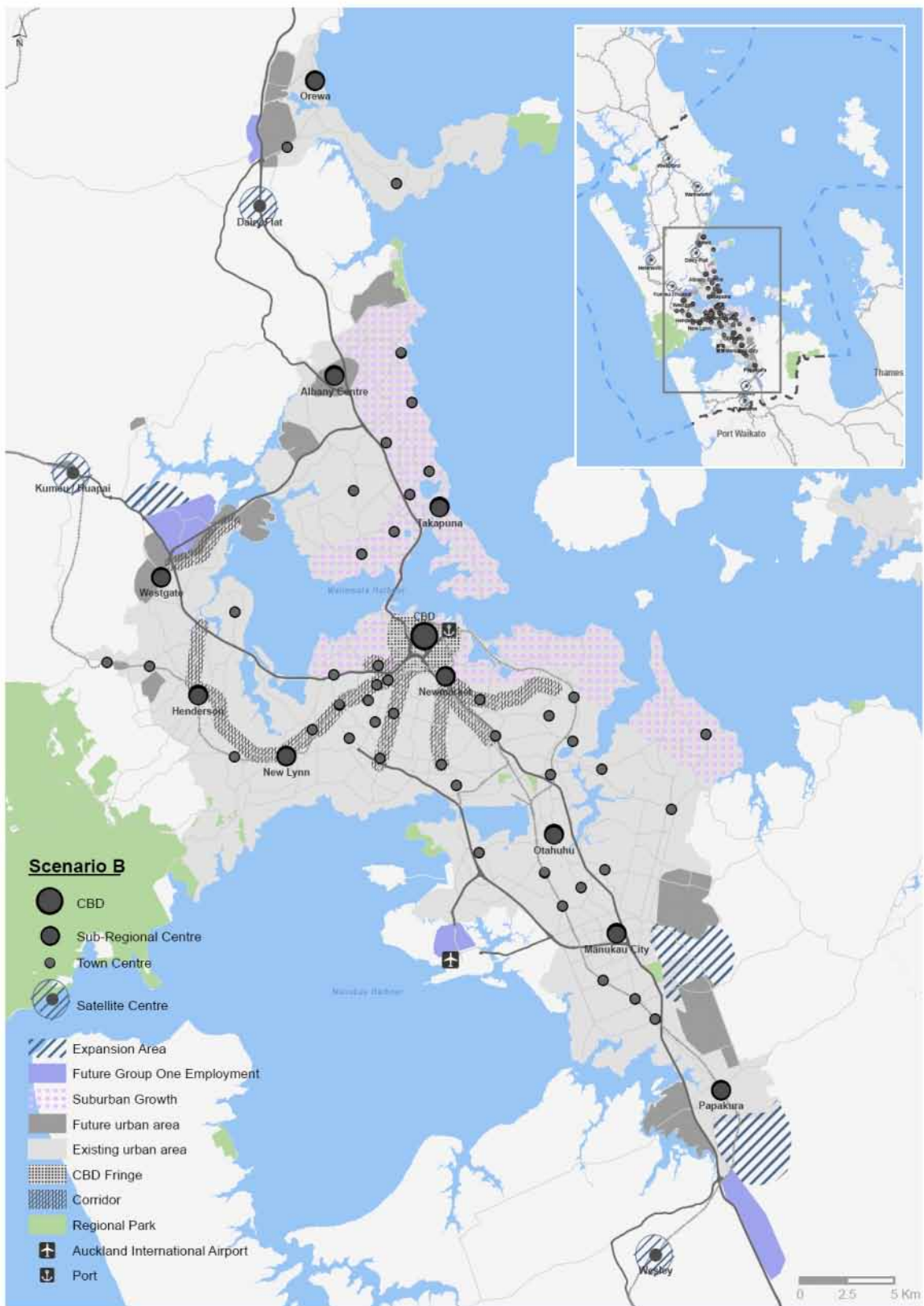
- Reduced capacity for countryside living that is currently available to focus rural growth in rural centres.

Table 2 below summarises the residential and employment capacities provided in Scenario B.

**Table 2 Scenario B capacities**

Area Type	Dwellings (2006)	Total Additional Dwellings	Employee Count (2007)	Total Additional Employees
CBD	9,363	25,637	82,097	82,903
CBD Fringe	7,893	17,107	41,321	18,679
Local Centre	9,306	13,792	7,061	9,652
Sub-Regional Centre	9,045	49,529	59,183	80,937
Town Centre	40,050	105,754	92,756	95,910
Corridor	12,813	17,187	21,805	15,680
Business	8,355	8,904	182,663	60,737
Suburban	200,454	5,078	69,638	4,843
High Amenity Coastal	88,086	41,983	32,478	4,169
Future Urban	5,394	84,352	7,496	80,051
Rural Town	21,639	48,160	13,772	20,919
Future Rural Town	507	19,493	309	7,691
Rural	31,122	54	17,918	60
<b>Total</b>	<b>444,027</b>	<b>437,030</b>	<b>628,497</b>	<b>482,231</b>
2051 Demand		348,000		375,000
<b>Difference</b>		<b>89,030</b>		<b>107,231</b>

Map 2 Scenario B



### 3.3.2 Transport network

This scenario sees a continuation of RLTS approach with RTN and QTN supporting intensification of centres, corridors and future urban areas. The main components of the transport network include all those identified in Scenario A, plus the following:

- Extension of the RTN and QTN to support intensification of centres and corridors in coastal areas and along ridgelines, on the urban fringes, and in rural settlements.
- Extension of rail RTN to provide high quality, high capacity services to reduce the greenhouse gas emissions.
- Extension of the ferry network to support coastal areas.
- Extension of strategic road network and PT services to new expansion areas.
- Extension of travel demand management (TDM) programme, investment in transit orientated development (TOD) and walking and cycling infrastructure in and around growth centres.

Transport maps showing Scenario B's PT and roading network can be found in Appendix 2 (Maps 13 and 14).

## 3.4 Scenario C

### 3.4.1 Land use

This scenario focuses on dispersed containment with most growth capacity provided within the existing urban area. The growth is dispersed more evenly, and at lower densities, across the urban area than in Scenarios A and B, with increased capacities in local centres and for suburban infill (Map 3). The land use categories contained within this scenario, and the role they play in accommodating residential and employment growth, are described below.

#### **CBD and CBD Fringe**

- Important location for Group 2 business and high density residential intensification, however growth is not to the same extent as in Scenario B.

#### **Centres**

- More but smaller growth centres meaning lower capacities and densities in larger centres and higher capacities and densities in smaller centres than Scenarios A and B.

#### **Corridors**

- There are no growth corridors contained in this scenario.

#### **Business Areas**

- Business areas have a dispersed allocation of employment capacity in this scenario to reflect the focus on local employment opportunities.

#### **Suburban**

- There is extensive capacity for infill development in this scenario to enable employment and residential growth to be widely dispersed within the existing urban footprint

#### **Future Urban Areas**

- In this scenario business areas are significant future residential and employment areas. Future Urban Areas are also critical for Group 1 business activities in this scenario.

#### **New Future Urban**

- No growth beyond areas identified for growth in the RGS most of which is within the MUL.

#### **Satellites and Rural Towns**

- Rural towns to grow to current District Plan capacity for employment and residential capacity. No New Towns.

## Rural

- Rural areas grow to the existing District Plan Capacity for residential and employment capacity.

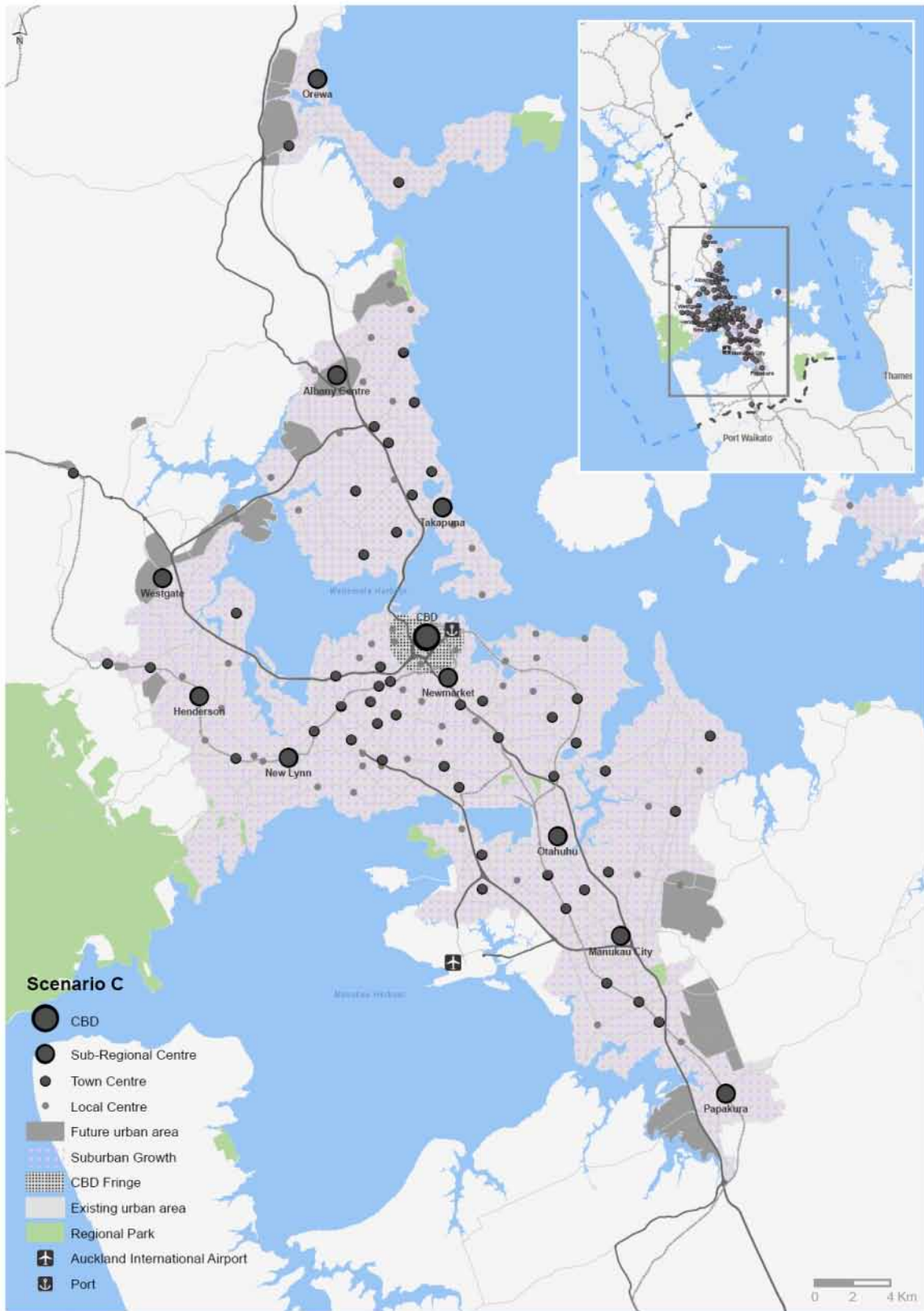
Table 3 below summarises the residential and employment capacities provided in Scenario C.

**Table 3 Scenario C capacities**

Area Type	Dwellings (2006)	Total Additional Dwellings	Employee Count (2007)	Total Additional Employees
CBD	9,363	17,637	82,097	67,903
CBD Fringe	7,893	12,107	41,321	18,679
Sub-Regional Centre	9,045	33,455	59,183	93,537
Town Centre	41,316	97,616	94,118	86,612
Local Centre	8,040	17,173	5,699	9,881
Business	8,361	8,781	180,518	70,295
Suburban	301,539	155,861	126,881	39,319
Future Urban	3,219	55,072	3,810	65,174
Rural Town	21,639	11,693	13,772	16,081
Rural	33,612	28,531	21,098	321
<b>Total</b>	<b>444,027</b>	<b>437,926</b>	<b>628,497</b>	<b>467,802</b>
2051 Demand		348,000		375,000
<b>Difference</b>		<b>89,926</b>		<b>92,802</b>



Map 3 Scenario C



### 3.4.2 Transport network

With a compact spatial form that disperses growth widely through infill and a multitude of centres, Scenario C has a transport system that provides for a greater distribution of movement of goods and services. The focus on lower density centres means that expanding the RTN is less feasible. The main components of the transport network include all those identified in Scenario A, plus the following:

- Extension of the bus RTN and QTN network, to provide higher frequency feeder and cross-town services.
- Extensive improvement of the road (arterial and local) network in suburban areas to provide for higher levels of traffic due to more local employment, residents and freight truck movements.
- Extension of strategic and arterial road network to service new areas in north and south.
- Additional Waitemata Harbour Crossing (only road).
- Expansion of TDM programmes.

Transport maps showing Scenario C's PT and roading network can be found in Appendix 2 (Maps 15 and 16).

## 3.5 Scenario D

### 3.5.1 Land Use

The expansive scenario has a spatial form that reflects where development pressures exist. Less employment and residential intensification occurs within centres (except in those where there is market demand), while coastal, amenity areas and greenfields experience significant growth (Map 4). The land use categories contained within this scenario, and the role they play in accommodating residential and employment growth, are described below.

#### **CBD and CBD Fringe**

- Important location for Group 2 business and high density residential intensification, however growth capacity is not to the same extent as for Scenario A, B or C.

#### **Centres**

- Most centres retain their existing District Plan Capacity however some additional capacity is provided in market attractive centres and satellites. Additional Group 2 employment centres are provided at Wairau, Rosebank, Stoddard, Penrose, Puhinui and Hingaia to provide locations for business and retail employment.

#### **Corridors**

- There are no growth corridors contained in this scenario.

#### **Business Areas**

- Business areas retain a significant proportion of employment capacity.

#### **Suburban**

- Residential and employment capacity has been provided through general infill subdivision to existing District Plan capacity.

#### **Existing Future Urban**

- RPS PC6 lists 21 Future Urban Areas, within this scenario these areas are significant future residential and employment areas. However, stages not yet underway assume slightly lower density outcomes.

#### **New Future Urban**

- Extensive, generally contiguous greenfield development for business and residential development, in northwest (Westgate to Kumeu), north (Long Bay to Orewa to Dairy Flat), southwest (Karakā to Drury) and southeast (Brookby Valley). Also, provision for a number of greenfield sites for Group 1 business activities on the urban periphery.

#### **Satellites and Rural Towns**

- Extensive growth in a number of these towns, particularly those with high coastal amenity.

## Rural

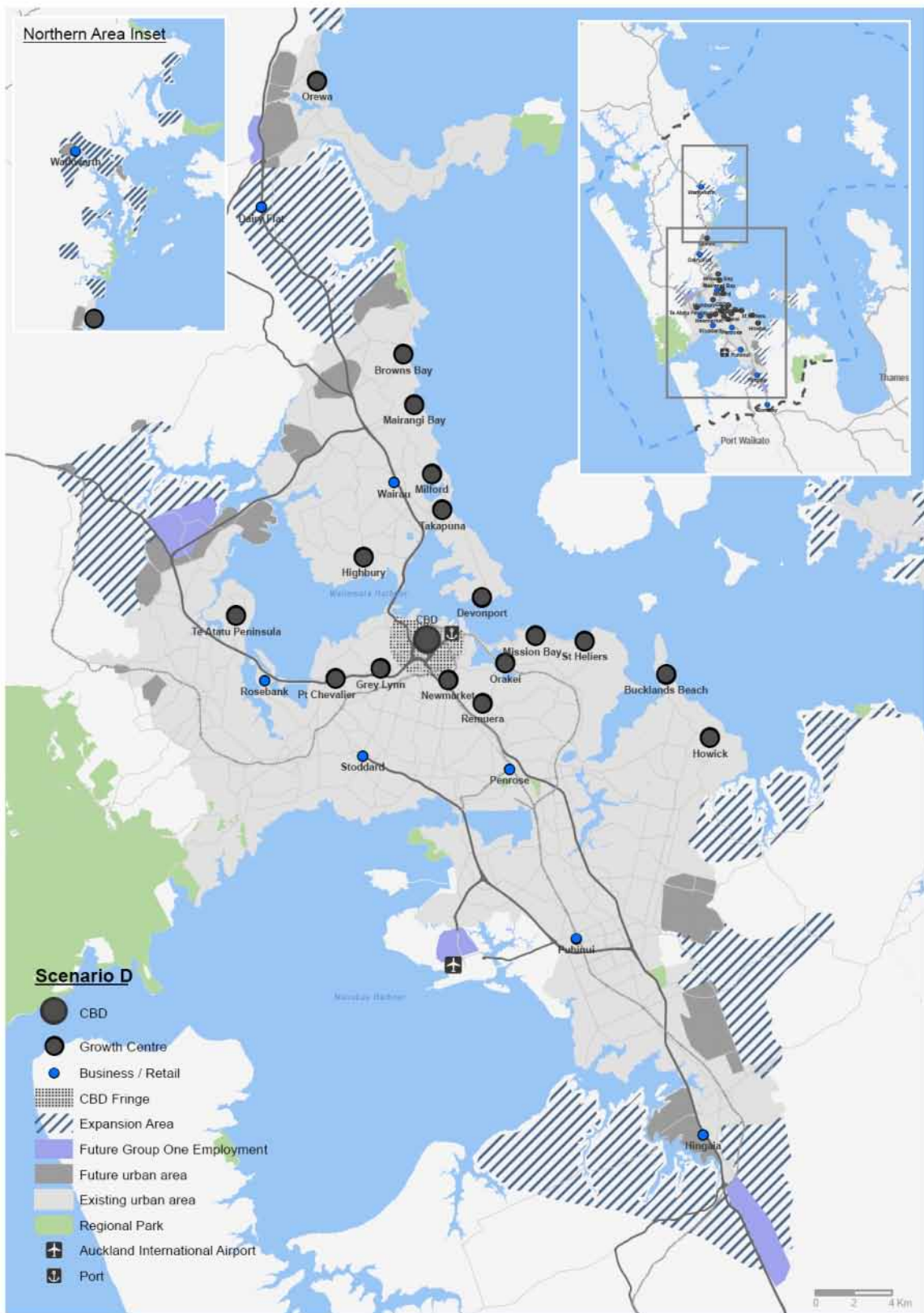
- Additional residential and employment capacity over and above that provided by existing District Plans is provided in the rural area.

Table 4 below summarises the residential and employment capacities provided in Scenario C.

**Table 4 Scenario D capacities**

Area Type	Dwellings (2006)	Total Additional Dwellings	Employee Count (2007)	Total Additional Employees
CBD	9,363	10,637	82,097	27,903
CBD Fringe	7,893	12,107	41,321	13,679
Regional Centre	2,961	14,564	33,166	49,572
Principal Centre	15,906	23,101	60,591	39,824
Town Centre	30,612	35,715	58,941	108,995
Corridor	5,502	739	18,230	3,498
Business	8,580	6,972	173,528	61,056
Suburban	304,761	36,374	121,438	13,234
Future Urban	12,822	217,731	12,556	150,827
Rural Town	19,512	13,106	12,450	12,372
Rural	26,115	59,793	14,179	159
<b>Total</b>	<b>444,027</b>	<b>430,839</b>	<b>628,497</b>	<b>481,119</b>
2051 Demand		348,000		375,000
<b>Difference</b>		<b>82,839</b>		<b>106,119</b>

Map 4 Scenario D



### 3.5.2 Transport network

This less intensive and dispersed scenario requires a transport system that provides for longer distances for travel to employment and distribution of goods and services. The main components of the transport network include all those identified in Scenario A, plus the following:

- Expansion of the bus RTN (supported by more park and ride facilities) to expansion areas.
- Expansion of ferry network and services to support coastal areas.
- New regional freight routes for new expansion areas.
- Extension of strategic and arterial road network to service new areas in north and south.
- Additional Waitemata Harbour Crossing.
- Reduced TDM programme.

Transport maps showing Scenario D's PT and roading network can be found in Appendix 2 (Maps 17 and 18).

## 4 Evaluation Process

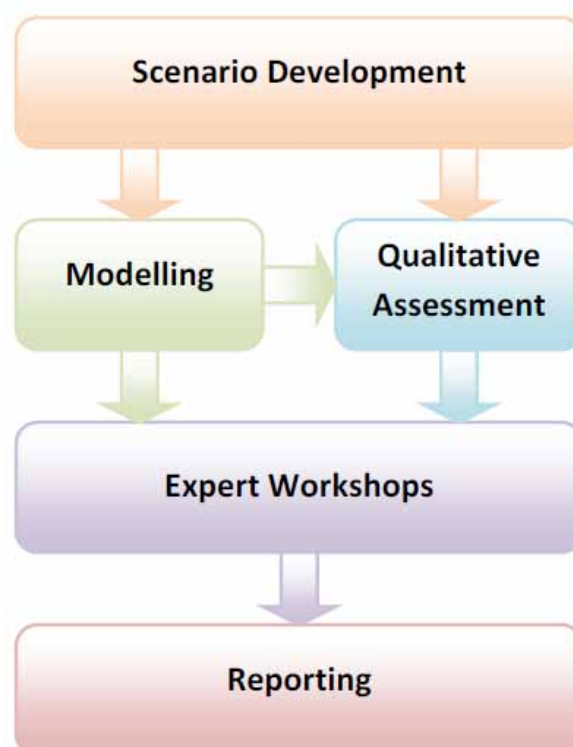
### 4.1 Background

The purpose of this evaluation exercise is to identify the strengths and weaknesses of the scenarios against a range of criteria, in order to inform the preferred spatial form section of the Draft Auckland Plan. The scenarios have some important differences and similarities. The aim was to compare and contrast the scenarios on a regionally consistent basis. A number of principles and assumptions were taken into account in both the development of the scenarios and their evaluation:

- A regional economy based on improving regional productivity.
- The need to leverage off existing and planned infrastructure investment.
- Provision of infrastructure and services to support population and economic growth.
- Protection of environmental values and heritage.
- Best practice environmental design, urban design and heritage protection.
- New or redeveloped areas would be compact (apart from Scenario D), well designed, well connected and transit orientated.

Important to this evaluation has been the bringing together of quantitative data from the integrated transport and land use models, with the qualitative assessments from the subject matter experts. This has enabled a comprehensive assessment of the relative merits of each scenario against the criteria. The evaluation process is shown below in Figure 4.

**Figure 4 Evaluation Process**



## 4.2 Evaluation criteria

Central to the process are the evaluation criteria, against which the scenarios are assessed against. The evaluation process assesses how well the scenarios might deliver against the long term outcomes desired for Auckland. Development of the evaluation objectives, criteria and measures has taken place through a number of processes and iterations, and has had input from a wide range of parties.

The process of defining the evaluation criteria commenced prior to the establishment of Auckland Council and involved identifying high level goals and outcomes in the region's existing high-level strategies and plans, determining whether these were likely to have any spatial elements and developing criteria and measures accordingly. The goals and objectives of the Auckland Sustainability Framework (ASF), the RGS and RLTS, and relevant legislation were considered

Draft criteria and measures were then developed, under the four wellbeings (of the Local Government Act, 2002) and workshopped with territorial authority and central government officers, and the criteria were finalised with input from experts in each area. The approach drew from existing processes and previous evaluation exercises (for RLTS and ASF) and from other jurisdictions.

The criteria and measures were used in the evaluation processes of both the RLTS and the Future Land Use and Transport Planning Project (Futures Project) in 2010. Since the establishment of Auckland Council the criteria have been developed further through input from subject matter experts, central government officers and Councillors. At this stage a fifth category, 'Implementation', was added alongside the four wellbeings as this was seen as a key component in understanding the feasibility of each scenario.

No attempt has been made to weight the criteria in terms of relative importance. Determination of priorities, and therefore, weighting of criteria, is essentially a political decision and more relevant to a process aimed at delivering a preferred scenario, rather than an assessment of four separate scenarios.

For many of the criteria, outputs from Auckland Council's integrated land use and transport model were able to provide information. However, for some criteria the model outputs were insufficient, therefore, additional 'qualitative' feedback from subject matter experts and workshops was sought.

The evaluation criteria and measures are listed below in Table 5. Also listed, is whether each criterion was addressed through model outputs or qualitative feedback (or a combination of both).

**Table 5 Evaluation criteria**

Section	Objective / Criterion	Measure	Source of information for evaluation
<b>6</b>	<b>Economic wellbeing</b>		
6.2	Improved travel reliability	Extent to which travel times are reliable	ART3 Model Outputs
6.3	Improved accessibility to economic activity	Accessibility to, between and within key economic areas	ART3 Model Outputs
6.4	Improved access to labour pool	Access to labour pool by business	ART3 Model Outputs
6.5	Increased productivity	Degree to which Group 2 employment ("Business Services") is concentrated (agglomeration benefits)	ASP3 Model Outputs
6.6	Land extensive business sectors	Degree to which there is sufficient Group 1 land available and that any new Group 1 land is appropriately located	ASP3 and ART3 Model Outputs



Section	Objective / Criterion	Measure	Source of information for evaluation
6.7	Energy resilience	Fuel consumption of the transport fleet	ART3 Model Outputs and VEPM fuel use rates
6.8	Improved accessibility to productive rural areas	Accessibility from key rural areas to Port and Airport	ART3 Model Outputs and workshop with Rural Advisory Panel
6.9	Protection of productive rural land	The degree to which urban development consumes the most fertile soils of the region	GIS Analysis and workshop with Rural Advisory Panel
<b>7</b>	<b>Environmental wellbeing</b>		
7.2	Reduced greenhouse gas emissions	CO <sub>2</sub> emissions	ART3 Model Outputs, VEPM emissions factors, and ARUP Modelling
7.3	Protection of or enhancement of marine values	Degree to which the scenarios avoid risk to areas of high ecological value	Qualitative analysis
7.4	Protection of or enhancement of stream corridors	Degree to which the scenarios avoid damage to stream form and character	Qualitative analysis
7.5	Identify, protect and enhance terrestrial ecosystems	Degree to which the scenarios protect ecologically significant areas including landscape, landform, geology and geological features and natural character	Qualitative analysis
7.6	Avoidance of hazards	Extent to which existing and new hazards are avoided, and extent to which population is exposed existing hazards	Qualitative analysis
<b>8</b>	<b>Social wellbeing</b>		
8.2	Greater housing affordability	Extent to which housing costs are affordable to households	ASP3 and ART3 Model Outputs
8.3	Greater housing choice	Suitability of the housing stock to meet projected household demand	Qualitative analysis
8.4	Improved accessibility	Access to a range of activities such as employment, education, health and social activities	ART3 Model Outputs
8.5	Improved accessibility for deprived households	Access to essential activities and services for the most deprived households (eg poorest 30 per cent)	ART3 Model Outputs
8.6	Improved accessibility to essential social infrastructure	Degree to which essential social infrastructure is accessible	Qualitative analysis
8.7	Improved access to local employment opportunities	Degree to which the location of residents/jobs are balanced	ART3 Model Outputs
8.8	Improved levels of physical activity	Extent to which the scenarios are likely to result in improved levels of physical activity.	ART3 Model Outputs
8.9	Improved air quality (impact on public health)	Extent to which population is exposed to harmful air emissions	ART3 Model Outputs and VEPM emissions factors
8.10	Improved water quality (impact on public health)	Extent to which options reduce the ability to swim safely at bathing beaches and collect shellfish, due to beach closures from water pollution	GIS and qualitative analysis
<b>9</b>	<b>Cultural wellbeing</b>		
9.2	Protection of Māori heritage and areas of cultural significance	Extent to which the scenarios contribute to the loss and desecration of Māori heritage and areas of cultural significance	GIS and qualitative analysis
9.3	Enabling economic opportunities for Māori	Extent to which economic opportunities for Māori are enhanced	GIS and qualitative analysis
9.4	Promoting Māori culture	Extent to which Māori can access places and resources for Māori culture	GIS and qualitative analysis
9.5	Preserving the Mauri	Extent to which the scenarios impact on the Mauri of the resources	Qualitative analysis
9.6	Provision of Open Space	Extent to which the scenarios provide for open space	Qualitative analysis
9.7	Protection of historic heritage	Extent to which the scenarios contribute to the loss of heritage places and values	Qualitative analysis
<b>10</b>	<b>Implementation</b>		
10.2	Market Feasibility	Extent to which the market is likely to respond to the proposed land use pattern	Qualitative analysis
10.3	Minimised infrastructure costs	The extent to which an option results in measurable private and public monetary costs or losses over time.	Transport network analysis and feedback from infrastructure providers.

Procedures for evaluating the scenarios were developed in order to standardise the scoring. The methodology adopted was aimed at achieving a consistent approach within and between objectives, that is providing some confidence that a score is equivalent across all criteria and objectives. The scoring used a seven-point scale which was applied to each criterion:

0	Neutral: nil/negligible impact
✓ (X)	Small positive (negative) impact
✓✓ (XX)	Moderate positive (negative) impact
✓✓✓ (XXX)	Strong positive (negative) impact

### 4.3 Integrated land use and transport models

Important tools used in the evaluation were Auckland Council's integrated transport and land use models, which are generally referred to as ATM2 (Auckland Transport Models version 2). However, for the purpose of this report they will henceforth be referred to simply as "the model".

The model integrates two models: the land use model is based on the Delta software and is referred to as ASP3 (Auckland Strategic Planning model version 3). The transport model is called ART3 (Auckland Regional Transport model version 3) and runs on the Emme software platform. Integration is achieved by the two models passing information back and forth as the system models land use and transport system changes over the modelling period, from 2006 to 2051. The model has successfully passed an independent peer review process.

This model provides complex interactions between the land use, transport system, and employment and population growth demands and through a model run will result in a wide range of outputs for further qualitative and quantitative evaluation, including where the model has allocated dwellings and employment within the parameters of the scenarios. The model is calibrated to 2006 data and the modelling process has three main components:

- Regional economic and demographic forecasts, which are sourced from the Economic Futures Model (EFM) and Auckland Council's population model respectively.
- Land use scenarios that describe the amount and location of enabled development (capacity)
- A transport system, which includes future road and PT network and services, economic and transport policies, and spatial parameters that describe the regional transport system.

Prior to the start of the modelling of the scenarios, the economic and relevant transport policy inputs to the transport model were developed in consultation with Auckland Transport and NZTA. The economic inputs relate to the values of time, vehicle operating costs (including future price of fuel), level of public transport fares, location and cost of parking and growth in heavy commercial vehicle trips. The level of non-price TDM assumed in the model was also agreed; it is important to note that this varies from the RLTS by assuming a lower level of TDM impact. The non-price TDM pertains to education, work and community initiatives.

Outputs are produced every year for the land use model and every five years for the transport model. These outputs are analysed in tabular, graphical and map form to interpret the model's responses and to compare different scenarios.

The modelling team has critically assessed the model outputs. It is important to remember that the integrated models are a tool to provide information and to assist in making trade-offs transparent. Modelling outputs are a subset of the wider evaluation process<sup>6</sup>.

#### 4.4 Qualitative assessment

The model outputs do not paint the full picture; therefore, a large amount of qualitative input has been sought from a range of experts in various fields. For some criteria this information was considered in conjunction with the model results and for others it was the primary or only source of information. This was particularly the case for many of the environmental and cultural criteria for which model results were not particularly appropriate or insightful. The main qualitative input areas are summarised in the list below and were gathered through reports, workshops, meetings and presentations.

- Climate Change and Energy Resilience
- Developers Workshop
- Economic Wellbeing Workshops
- Environmental Policy
- Hazards Analysis
- Heritage Policy
- Housing Affordability Workshops
- Infrastructure Providers Workshop
- Maori Perspectives
- Rural Advisory Panel Workshop
- Social and Cultural Wellbeing Workshops
- Transport Network Workshop

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<sup>6</sup> Further information on the model is provided in the model user manual, ASP3.2 Application Report (July 2008)

## 5 Overview of Model Outputs

This section provides an overview of the key model outputs around land use and transport. These model outputs are useful in providing broad contextual information that can be drawn upon in the subsequent sections where the specific criteria are evaluated. These key outputs provide information to help understand the scenarios generally over time in terms of housing and employment growth and transport related activities, such as mode shares, travel times and speeds, and passenger transport supply and demand.

In summary the main findings are:

- There is stronger growth in housing in centres in the more compact and intensive scenarios. This is most evident in Scenario A and least evident in Scenario D, with Scenarios B and C in between. This order is reversed for out of centre locations with Scenario A showing the least out of centre growth, Scenarios B and C showing significant housing growth outside centres but within the MUL, and Scenario D showing significant growth outside the MUL.
- Employment uptake tends to reflect the different locations of employment capacity provided in each scenario. The CBD and major centres provide for strong growth in employment irrespective of the scenario. In Scenarios A, B and C there is also strong growth in out-of-centre locations within the MUL (such as business areas), whereas in Scenario D there is strong employment growth outside the MUL reflecting the large amount of greenfield growth in this scenario.
- The share of trips by car (light vehicles) decreases over time in all scenarios, and the PT and active mode shares increases, with active modes noticeably higher in Scenario A.
- For all scenarios, there is a significant increase in traffic volumes and an associated rise in congestion levels especially during the interpeak period.
- Due to the extent of future growth, car trips will generally be at lower speeds and take longer for all scenarios and more so for Scenario D.
- It is likely that people will take more, longer trips by passenger transport, especially in Scenario D where there is significant urban expansion outside the existing urban area because of increasing congestion issues.

### 5.1 Land use outputs

This section provides land use outputs information on the scenarios derived from the modelling, specifically the distribution of household and employment growth. The distributions are considered in terms of the Auckland CBD, major centres, secondary centres, and the rest of the region, inside and outside the current MUL.

Household and employment capacities are determined through the scenario development process, and are model inputs, as discussed in Section 3. The model takes the demand for households (from the population data) and demand for employment (from the employment projections) and allocates it across the region. From the range of model outputs considered, key graphs are presented and discussed below, and additional graphs are provided in Appendix 5.

### 5.1.1 Growth in households

Figure 5 shows the uptake of households, that is, the growth in the number of households, between 2006 and 2041 by area category, and Figure 6 shows the growth as percentages of each category.

The growth varies between the categories and across the scenarios. Household growth in the CBD is around 12,000 in Scenarios A, B and C and 6,000 in Scenario D.

Scenario A has significantly higher growth in households in centres than the other scenarios; more than double that in Scenarios B and C, and making up a third of its total growth in households. Scenario D has the lowest growth in centres, just 13 per cent of its total household growth.

Outside the centres, Scenarios B and C have the highest growth within the MUL, making up almost 60 per cent of their total growth, and Scenario D has the lowest growth, 6 per cent of its total growth. But outside the MUL, Scenario D has very high growth, more than four times that in the other scenarios, and 80 per cent of its total growth in households between 2006 and 2041.

**Figure 5 Household growth by area category**

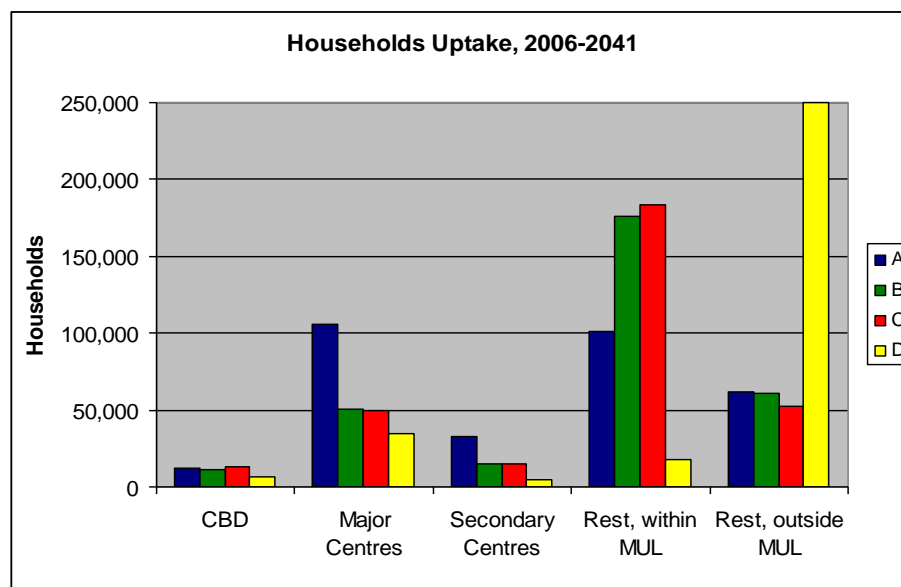
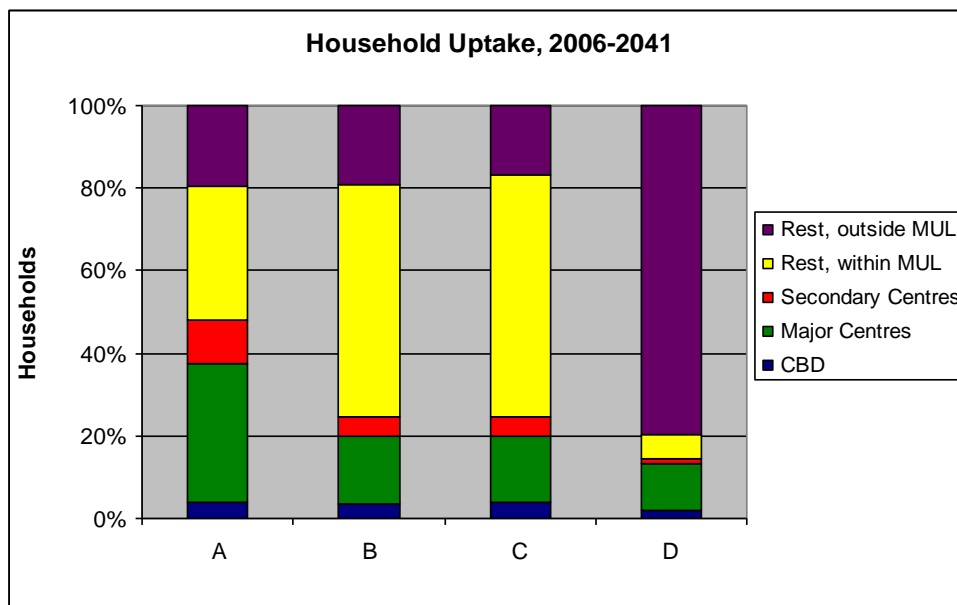


Figure 6 Household growth by area category, percentage



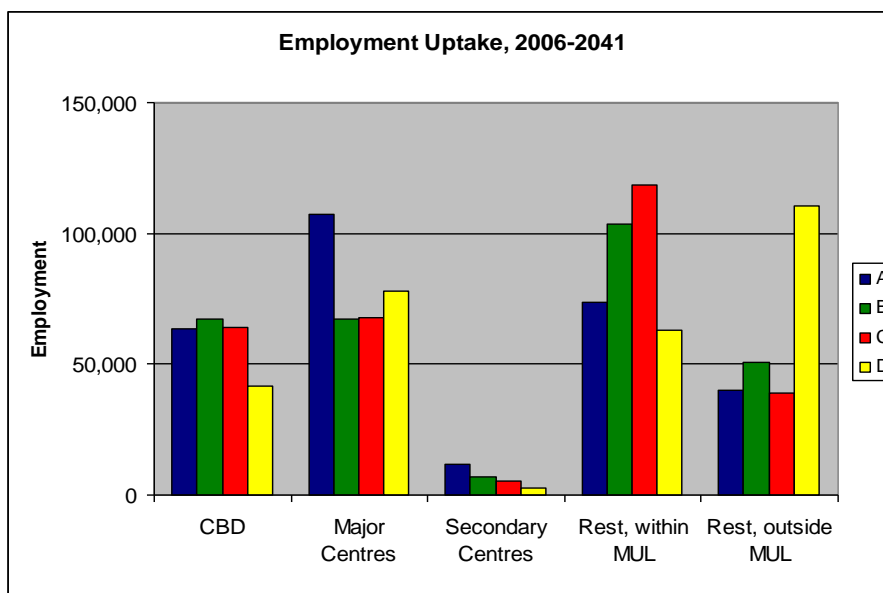
### 5.1.2 Growth in employment

The growth in employment between 2006 and 2041 by area category is shown in Figure 7 and in terms of percentages for each category in Figure 8.

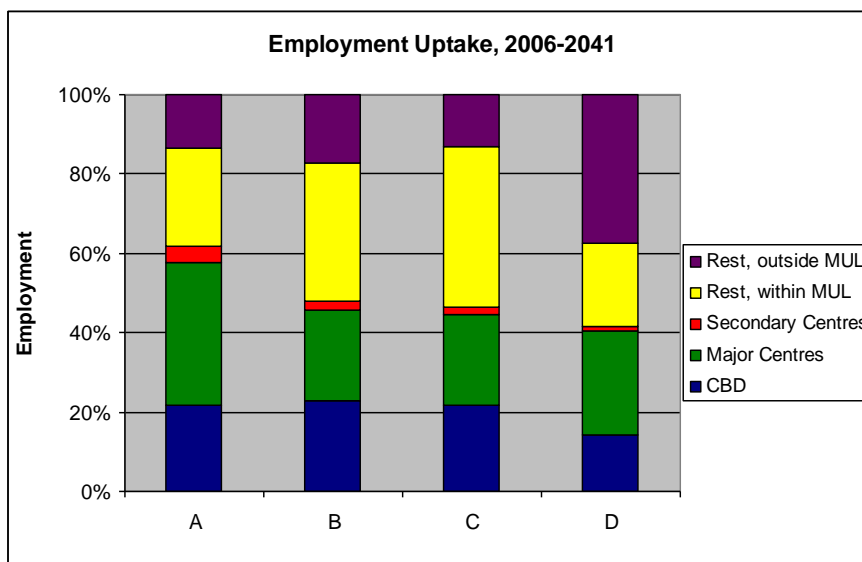
Employment growth in the CBD is greater in Scenarios A, B and C – around 65,000 making up just over 20 per cent of their total employment growth - than in Scenario D. In the centres, Scenario A has the highest growth, particularly in the major centres which makes up a quarter of its total growth, while the other scenarios have fairly similar growth in employment in centres, about 70 per cent that of Scenario A.

As with household growth, Scenarios B and C have the highest growth outside the centres but within the MUL. Scenario D has the highest employment growth outside the MUL, more than double that of the other scenarios, and over a third of its total growth.

**Figure 7 Employment growth by area category**



**Figure 8 Employment growth by area category, percentage**



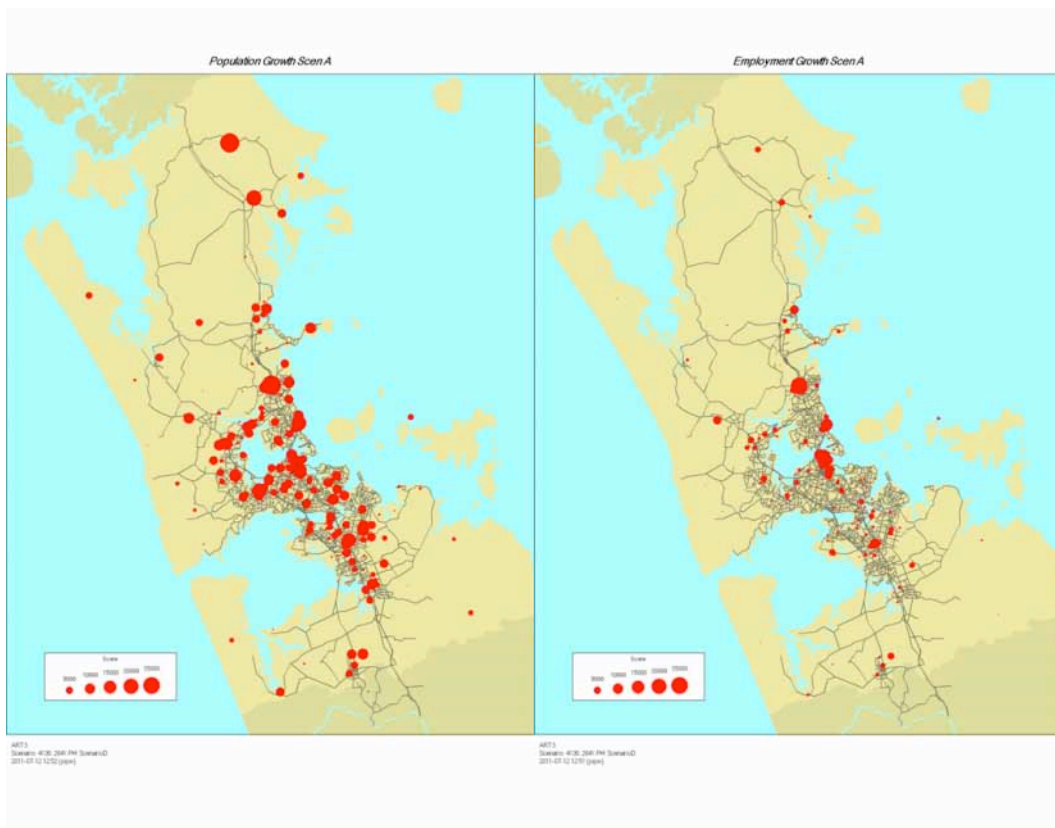
### 5.1.3 Population and employment growth by model zone

Map 5 to Map 8 show the growth in population and employment from 2006 to 2041 in each of the scenarios. The red coloured circles in the plots represent the growth in each model zone, with the size a measure of the magnitude of the uptake (note the legend in the bottom left of each plot).

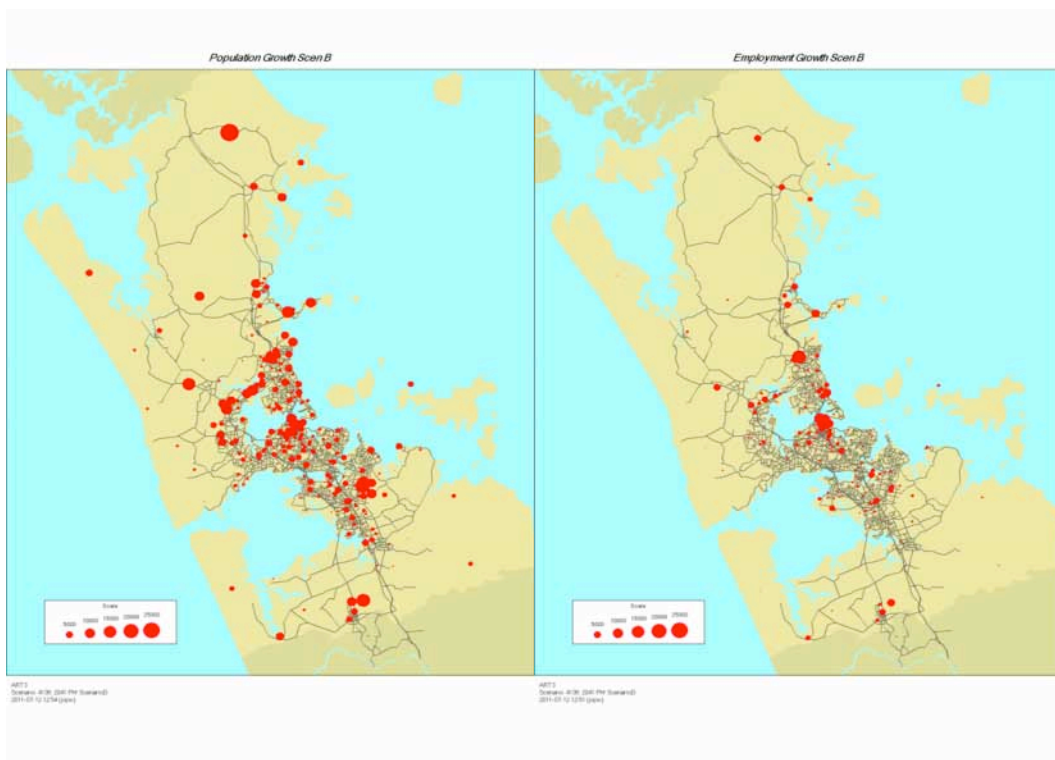
The most notable differences in population growth between the scenarios is in Scenario D, where the significant growth on the periphery of the current urban areas is evident.

Differences in employment growth are less obvious from the plots; the growth in CBD and CBD Fringe employment is clear as it is in some other specific locations such as Albany, Takapuna and at the Airport. Scenario D has more growth in the southern and northern areas of the region.

**Map 5 Scenario A population and employment growth 2006-2041**

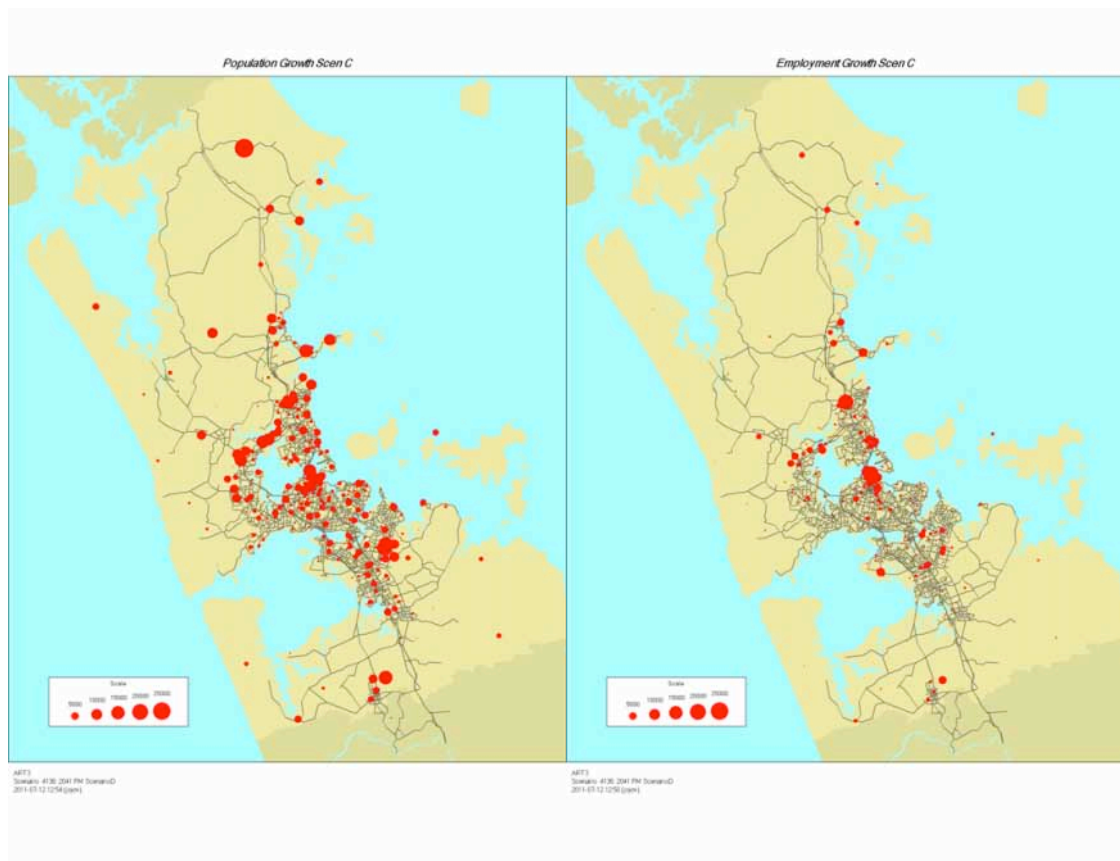


**Map 6 Scenario B population and employment growth 2006-2041**

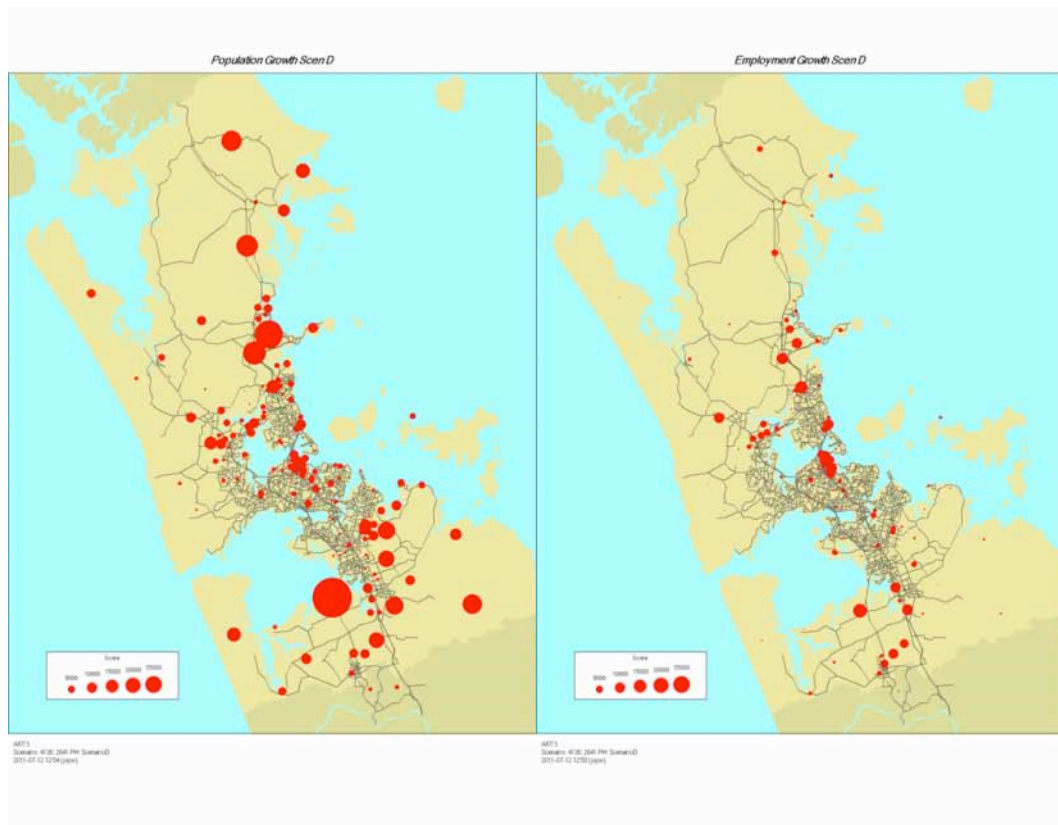




**Map 7 Scenario C population and employment growth 2006-2041**



**Map 8 Scenario D population and employment growth 2006-2041**



## 5.2 Transport outputs

The following sections present the results of key transport outputs which provide a contextual overview of the transport outcomes. The data is given for the base model year, 2006, and forecast years 2021, 2031, and 2041, hence indicating trends over time.

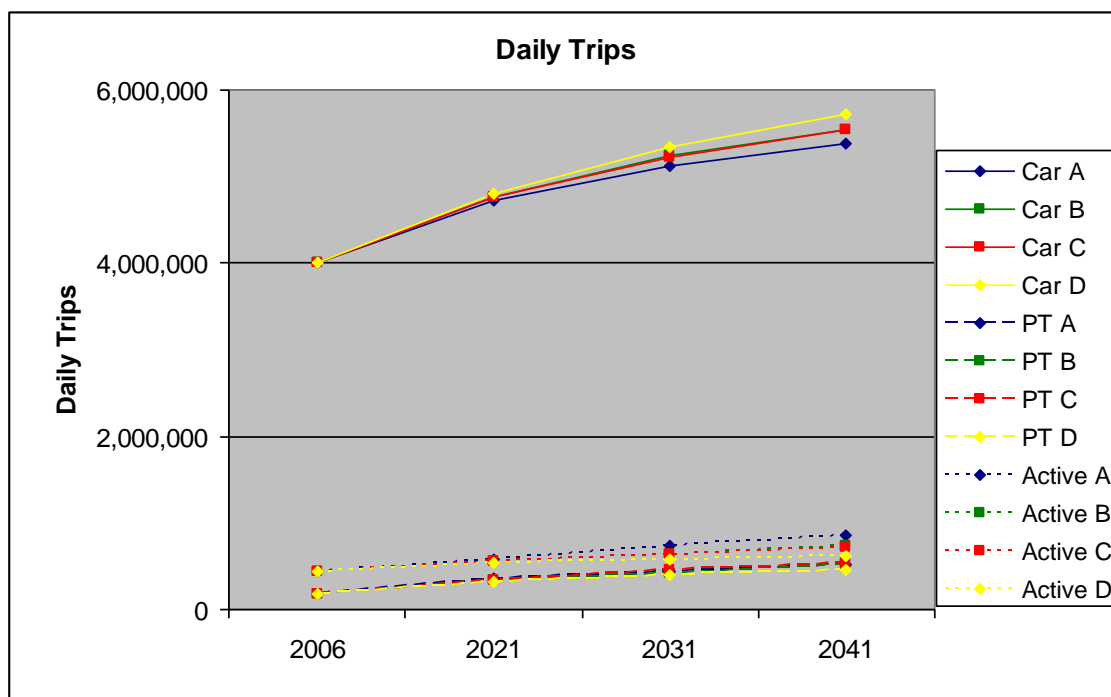
### 5.2.1 Daily trips and mode share

The daily person trips by mode, trips per capita and mode shares are presented in Figure 9 to Figure 12 respectively.

The daily person trips by mode, Figure 9, shows that the number of daily trips increases over time for all scenarios and all modes as population increases. The majority of trips are by car in 2006 and in the future, though the rate of increase in car trips declines over time and there is some variation between the scenarios. Scenario A has lower growth in trips by car than Scenarios B and C, while Scenario D has the highest growth.

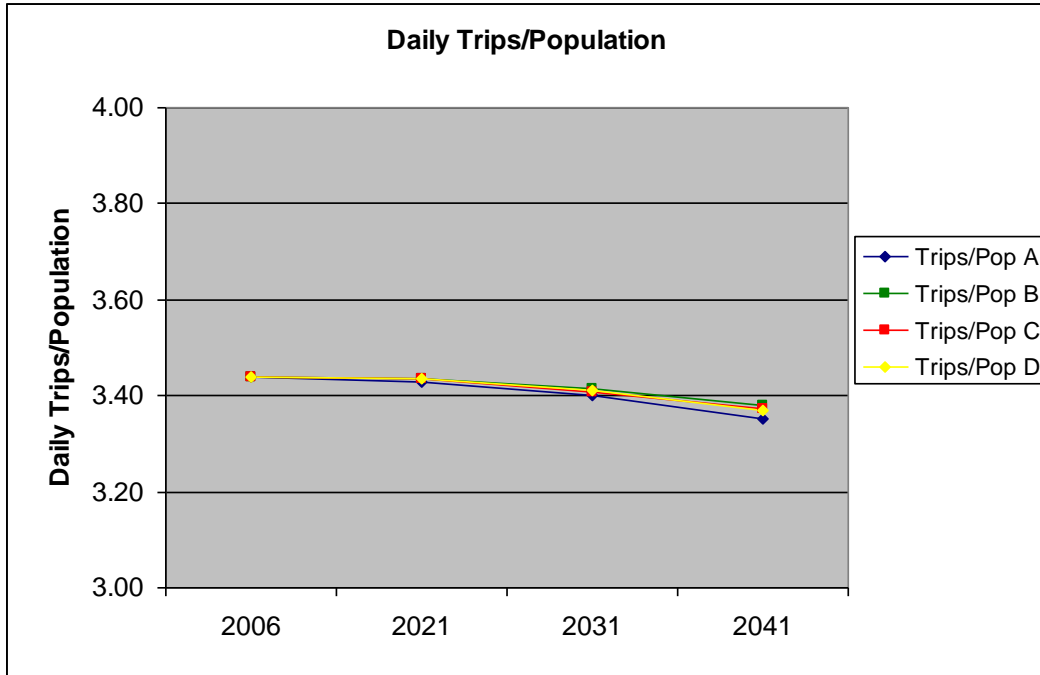
The numbers of PT and active (walk and cycle) trips also increases over time in all scenarios, with Scenario A having higher growth in active mode trips and Scenario D lower growth. Scenarios A, B and C have similar growth in PT trips, whereas this is lower in Scenario D.

**Figure 9 Daily trips**



Daily trips per capita (Figure 10) show slight declines over time for all scenarios. As trip rates are constant over time for the various person households segments in the model, the decline is indicative of a change in demographics, such as an ageing population incorporating more retirees with lower trip rates, and higher proportions of people working from home. The latter is one of the TDM non-pricing inputs that are applied to all scenarios.

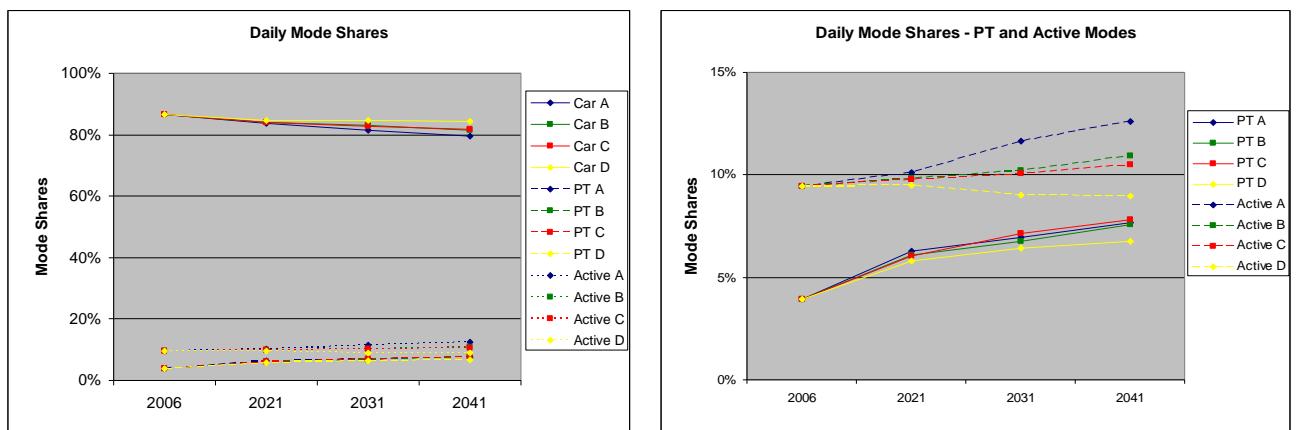
Figure 10 Daily trips per capita



The daily mode shares (Figure 11) show that trips by car are the dominant mode in 2006 and continue to be in the future. Nevertheless the car mode share declines over time in all scenarios, from 87 per cent in 2006 to 80-84 per cent in 2041. As with trips by car, Scenario A has the lowest car mode share (80 per cent) and Scenario D the highest (84 per cent).

PT and active daily mode shares (shown in more detail in the right hand graph in Figure 11) increase over time in all scenarios. Scenarios B, C and D have very similar PT mode shares in 2041 (8 per cent) while that for Scenario D is lower (7 per cent). With active modes, Scenario A has a higher mode share in 2041 than Scenarios B and C (13 per cent versus 11 per cent), while Scenario D has the lowest active mode share, 9 per cent, the same as in 2006.

Figure 11 Daily Mode shares

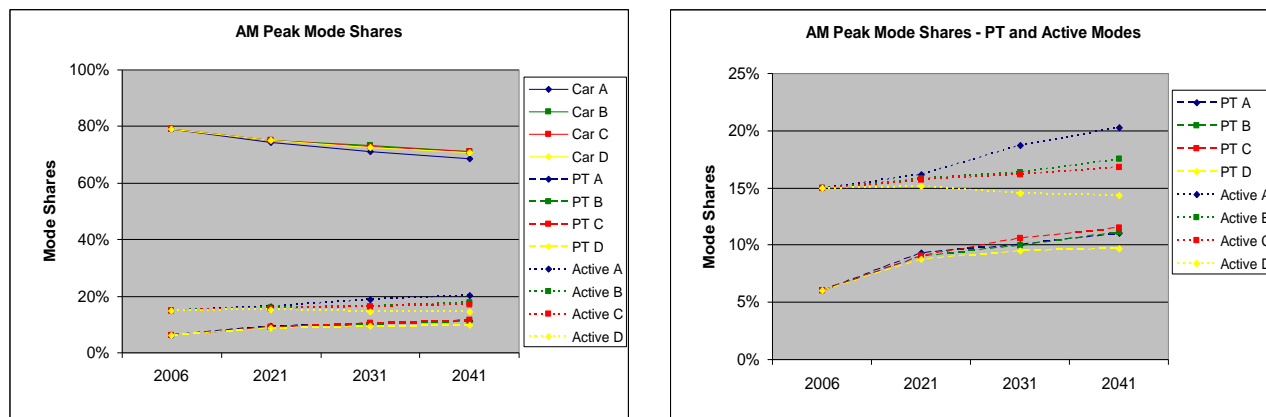


The AM peak mode shares (Figure 12) trends similar to the daily data but with lower car mode shares, greater decline in car mode shares, and higher PT and active mode shares. The car mode

shares decline from 79 per cent in 2006 to about 70 per cent in 2041, with Scenario A having a slightly lower share.

The PT mode shares increase from 6 per cent in 2006 to 11 per cent in 2041 for Scenarios A, B and C, and 10 per cent for Scenario D. The active mode shares increase from 15 per cent in 2006 to 20 per cent in 2041 for Scenario A, 17 per cent for Scenarios B and C, while that for Scenario D is slightly lower than in 2006.

**Figure 12 AM Peak Mode Shares**



### 5.2.2 Vehicle statistics

In this section key road network statistics are presented.

Vehicle kilometres travelled (VKT) is the total network wide distance travelled by vehicles. Figure 13 gives these for the AM peak and the 2-hour average interpeak periods, along with the daily VKT per capita. Note the scales on the vertical axes do not begin at zero for the purposes of showing the data more clearly.

VKT increases over time, with the growth in interpeak VKT greater than in the AM peak, so that by 2041 they are similar. The growth in Scenario D is greater than for the other scenarios, and this is also evident in the daily VKT per capita (the right hand graph) which increases from 2006 for Scenario D, but not for the other scenarios.

**Figure 13 Vehicle-kilometres travelled**

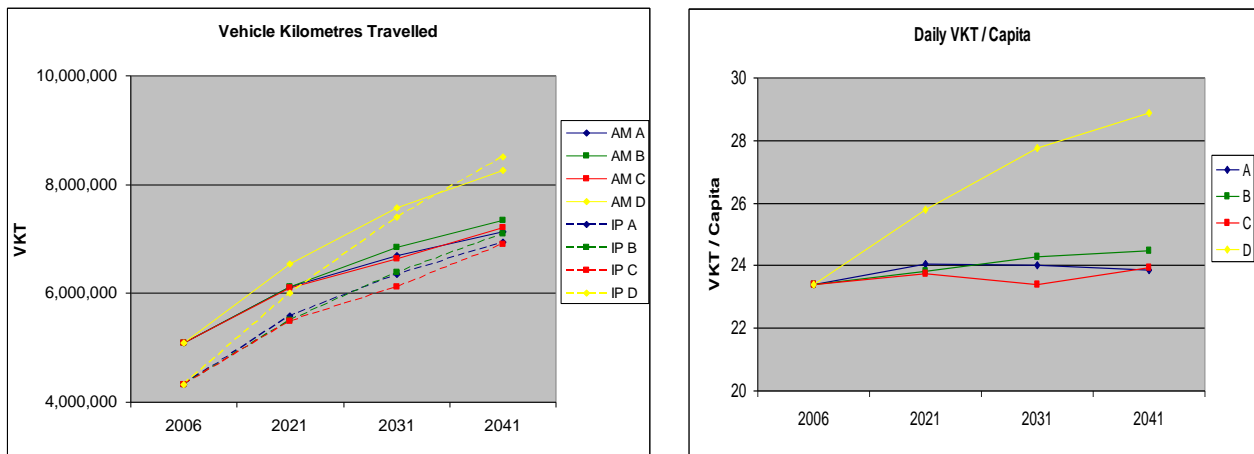
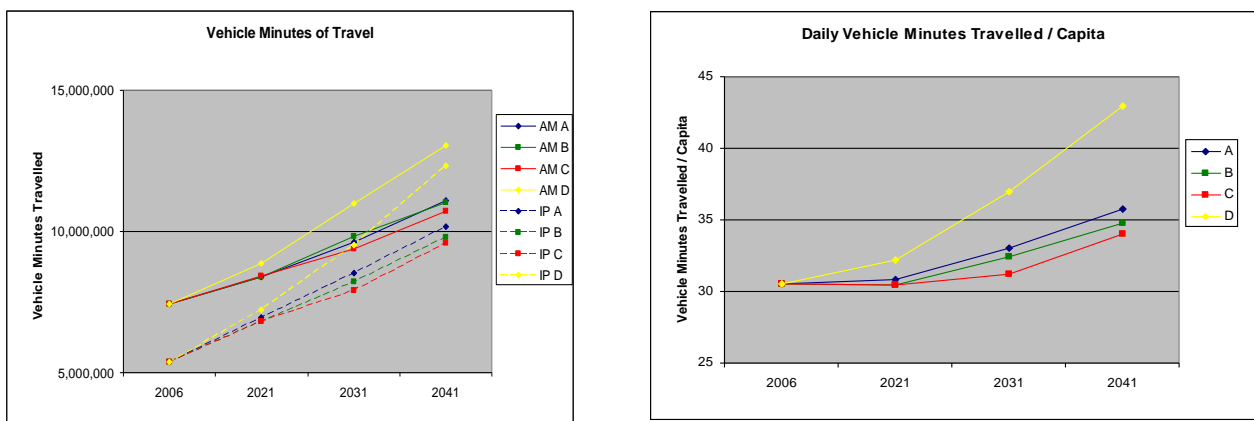


Figure 14 gives the total network vehicle travel time for the AM peak and interpeak periods and the estimated daily network vehicle travel time per capita. Note the scales on the vertical axes do not begin at zero for the purposes of showing the data more clearly.

As with the VKT data, all scenarios show increased network travel time over time, with Scenario D having the highest increases. The estimates of daily network travel time per capita also increase, though for Scenarios A, B and C this occurs after 2021, whereas this increases from 2006 for Scenario D.

**Figure 14 Vehicle travel time**



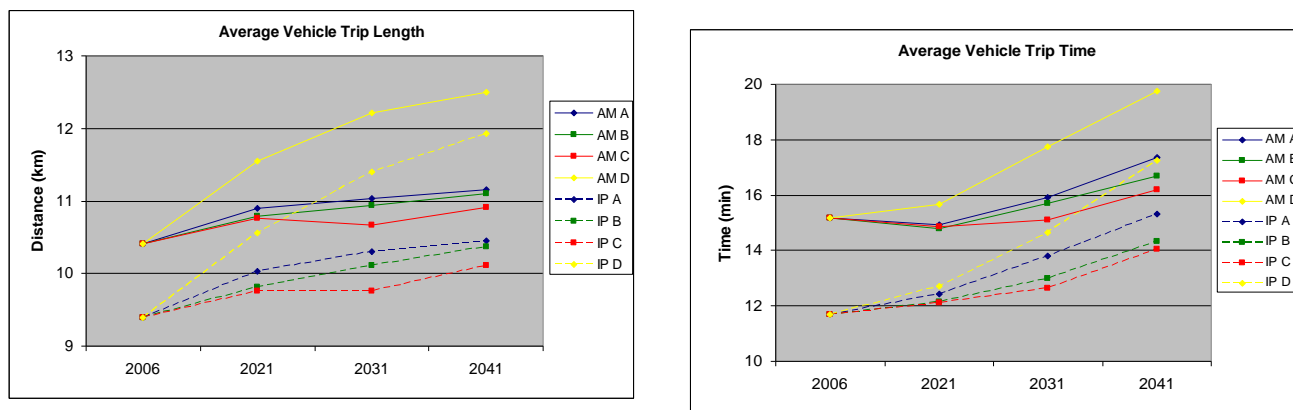
The average vehicle trip length and time for the AM peak and interpeak periods are presented in Figure 15. Note the scales on the vertical axes do not begin at zero for the purposes of showing the data more clearly.

Both statistics increase over time from 2006 to 2041 in all scenarios and in both time periods, though the rate of increase varies between both.

The average trip lengths for Scenarios A, B and C increase relatively slightly (5-10 per cent) over time compared with those for Scenario D (20-27 per cent). The same trends and relativities are evident with the average trip times; the times for Scenarios A, B and C increase by 7-14 per cent in the AM

peak and 20-30 per cent in the interpeak, whereas in Scenario D these are 30 per cent and 48 per cent respectively.

**Figure 15 Average Vehicle Trip Length and Time**

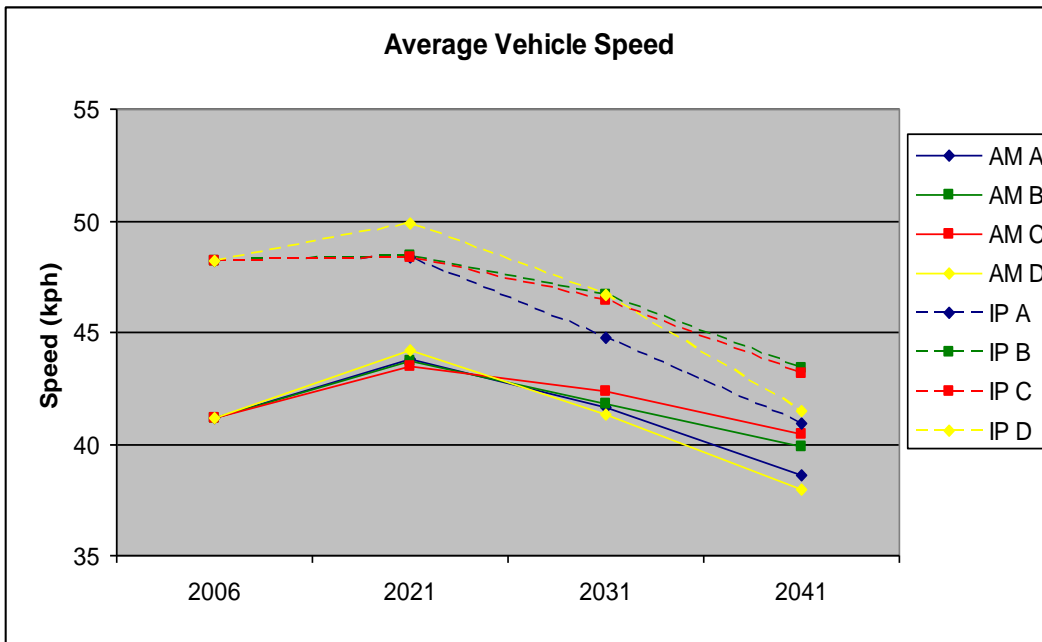


The average vehicle speeds for the AM peak and interpeak periods are presented in Figure 16. Note the scales on the vertical axis do not begin at zero for the purposes of showing the data more clearly.

Average vehicle speeds increase from 2006 to 2021 and then decline to be lower than in 2006 in all scenarios and both modelled periods. In the AM peak period, Scenarios B and C have similar and higher average vehicle speeds than Scenario A, which is slightly higher than in Scenario D. The trends are similar for the interpeak period, though in this case Scenario A has a slightly lower average speed in 2041 than in Scenario D.

The differences in roading improvements and infrastructure will be contributing to these differences. Scenario A does not include the Puhoi to Wellsford motorway extension and Scenarios A and B do not include an additional road crossing of the Waitemata Harbour, additionally Scenario A does not have widening of the Northern Motorway that is part of the other scenarios. Scenario D has additional road network and capacity for the new peripheral urban areas including the Karaka to Weymouth link.

Figure 16 Average Vehicle Speed

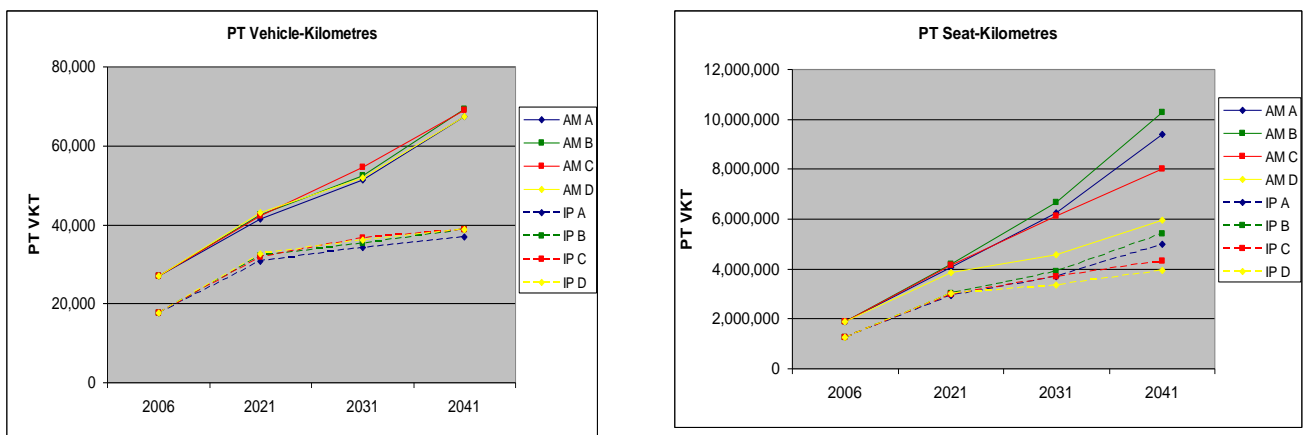


### 5.3 Passenger transport statistics

The capacity or supply of passenger transport is demonstrated in Figure 17 in terms of PT vehicle-kilometres and seat-kilometres. The first gives an indication of both the frequency and length of services, whereas the second also reflects the capacity of different PT modes (rail, ferry and bus).

The supply of PT increases markedly in all scenarios, and those with more rail network have higher seat-kilometres due to the much larger capacity of a train compared with a bus. All scenarios have in 2041 about 2.5 times the AM peak vehicle-kilometres of 2006. Scenario B, with North Shore rail, has the highest seat-kilometres, and Scenario D with the least rail network has the lowest.

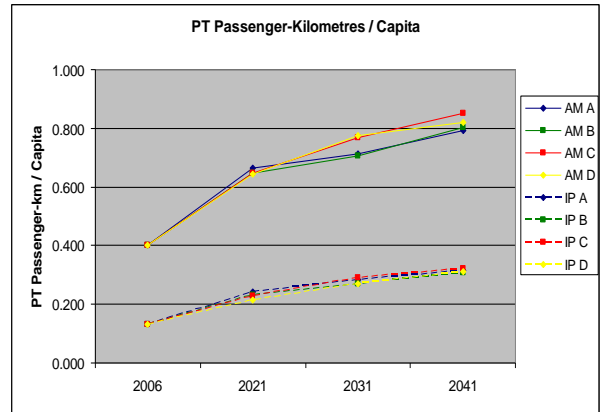
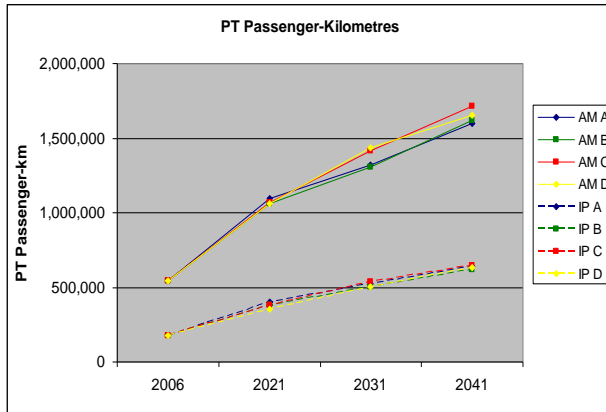
Figure 17 PT capacity (supply)



The amount of PT travel, represented as PT passenger-kilometres, is given in Figure 18 along with the passenger-kilometres per capita.

Passenger kilometres increase over time in all scenarios in both the AM peak and the interpeak periods; about three times 2006 in 2041 in the AM peak and 3.5 times in the interpeak. By 2041 there is little difference between the scenarios in both total and per capita terms, though in Scenario C these are slightly higher.

**Figure 18 PT demand**





## 6 Economic Wellbeing Evaluation

Economic wellbeing can be measured by the material standard of living, quality of life, or the long term sustainable prosperity of the community. Auckland's legacy strategy documents aimed to promote: more economic opportunities; more participation in the economy; and high quality economic activity<sup>7</sup>. A range of principles were identified for assessing regional growth alternatives and these principles are reflected in the criteria used to evaluate this wellbeing:

- Enable a range and quality of business locations to accommodate employment growth (eg industrial areas near motorway/rapid transit interchanges; a variety of mixed-use centres for offices and services outside the CBD),
- Enable a good local, cross-regional, inter-regional and international transport network, including passenger transport for ease of movement of goods and services, business traffic and commuter traffic; and
- Provide adequate and high-quality infrastructure to support business, residential and other opportunities in a timely manner<sup>8</sup>.

Land use can directly impact on economic performance in a number of ways, including affecting accessibility between strategic locations and providing appropriate land and infrastructure. This wellbeing has been assessed using a combination of model outputs, GIS analysis and workshops of economic and transport subject matter experts.

### 6.1 Summary

**Table 6 Economic wellbeing scoring summary**

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Improved travel reliability (road)</b>	<b>XX</b>	<b>X</b>	<b>X</b>	<b>XXX</b>
<b>Improved travel reliability (PT)</b>	<b>✓✓</b>	<b>✓✓</b>	<b>✓✓</b>	<b>✓✓</b>
<b>Improved accessibility to economic activity</b>	<b>XX</b>	<b>XX</b>	<b>XX</b>	<b>XXX</b>
<b>Improved access to labour pool (road)</b>	<b>✓</b>	<b>✓</b>	<b>✓</b>	<b>XX</b>
<b>Improved access to labour pool (PT)</b>	<b>✓✓</b>	<b>✓✓</b>	<b>✓✓</b>	<b>0</b>
<b>Increased productivity</b>	<b>✓✓</b>	<b>✓✓</b>	<b>✓✓</b>	<b>✓</b>
<b>Land extensive business sectors</b>	<b>X</b>	<b>✓</b>	<b>X</b>	<b>✓</b>
<b>Energy Resilience</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>X</b>
<b>Improved accessibility to productive rural areas</b>	<b>XX</b>	<b>X</b>	<b>X</b>	<b>XX</b>
<b>Protection of productive rural land</b>	<b>0</b>	<b>X</b>	<b>0</b>	<b>XX</b>

<sup>7</sup> Auckland Regional Council. (2002) Auckland Regional Economic Development Strategy.

<sup>8</sup> Auckland Regional Growth Strategy. (1999) Auckland Regional Council.

Travel reliability and accessibility to economic activity show an initial improvement in line with transport infrastructure investment and the effects of TDM non-pricing initiatives, but then begin to decline over time, with Scenarios A, B and C performing similarly and Scenario D performing worst. A more congested transport network especially beyond 2021 suggests that policy responses are not keeping up with the scale of growth. Other tools and investments will be needed to maintain accessibility.

In terms of accessibility to the labour pool, there is little difference between Scenarios A, B and C; they all show an increase in accessibility and provide businesses with better accessibility to the labour pool than Scenario D. A compact urban form will provide greater access to the workforce and the associated economic benefits, whereas an expansive urban form will have less accessibility to the workforce and be more vulnerable to underinvestment in the transport network.

Significant levels of Group 2 agglomeration in a strong CBD are evident in all scenarios, although to a lesser degree in Scenario D. The difference between Scenario D and the other scenarios could be a result of its expansive urban form, absence of a hierarchy of centres and poorer general accessibility. It has been established that Auckland requires additional greenfield land for Group 1 business activities. It is clear that this aspiration is most easily provided for in an expansive urban form which provides additional greenfield land at the urban periphery, as illustrated in Scenarios B and D.

All scenarios showed an initial increase in fuel use above 2006 before beginning to decrease from 2021 (Scenarios A, B and C) and 2031 (Scenario D) as a result of assumed improvements in the vehicle fleet. Despite the per capita decline in fuel use in all scenarios, Scenario D shows a greater reliance on fuel usage and, accordingly, has less energy resilience.

Scenario D would negatively affect rural productivity of the Auckland region with significant losses of productive soils. This is closely followed by Scenario B. Scenarios A and C had minimal impact on rural productive soils as they do not contain urban expansion beyond that which is already planned. Retaining growth within the existing urban area is beneficial to rural productive activities and economy, and the retention of productive soils.

Accessibility from key rural production areas to the airport and port decreases in all scenarios, particularly Scenarios A and D. For Scenario A this is likely due to a lack of roading upgrades in rural areas, while for Scenario D this can be attributed to an expansive urban form affecting traffic flow and traffic times.

Rural production systems require efficient and reliable transport links from farm gate to ports, airports, rail facilities and processing facilities. Future land use and transport planning needs to take into account the impact any future growth and associated transport infrastructure will have on Auckland's rural economy.

## 6.2 Improved travel reliability

This criterion measures the extent to which travel across the region is reliable using the level of congestion as a proxy.

Travel reliability is important for economic development because it directly affects the efficiency of movement of people, goods and services. Increased travel reliability can aid economic productivity by reducing congestion and delays, and improving accessibility to markets, labour force and other resources. A reliable transport network also brings benefits to the tourism industry by efficiently moving visitors between attractions.

## Evaluation

Travel reliability has been measured separately for roading and PT using congestion measures as proxies for reliability. For road reliability the measures are the average ratio of speed to free-flow speed and the percentage of congested vehicle kilometres travelled (VKT) in the road network. These are both for the AM peak period, plus the congested VKT measure has also been produced for the interpeak period to reflect the importance of this period for the movement of goods.

PT reliability was measured as the percentage of congested VKT on the Quality Transit Network (QTN) where buses mix with general traffic (ie without bus lanes), by geographical sector.

Figure 19 shows the percentage of congested VKT in the road network for the AM peak and interpeak periods; the lower the percentage the better the travel reliability. All scenarios have improved travel reliability in the AM peak period in 2021 compared with 2006, but this then declines to be worse than 2006 in 2041. This is similar in the interpeak period, except that the reliability in 2021 is the same as in 2006. There are differences between the scenarios; Scenario D has the least reliability in both periods, and Scenario C the best, while Scenarios A and B are inbetween, with Scenario A clearly worse than Scenario B in the AM peak.

Further graphs of congested VKT by road type and geographical sector are given in Appendix 5 (Figures 61 to 68). The road type data shows that the higher congested VKT (lower reliability) in Scenario D occurs on rural roads and motorways, and in Scenario A in the AM peak on the motorways. The congested VKT by sector indicates that Scenario A has higher levels in the central sector (isthmus), while Scenario D is higher in the south and west sectors. These are both reflections of the location of development in these scenarios; intensification in Scenario A and peripheral expansion in Scenario D.

Figure 20 presents roading reliability and shows the average ratio of speed to free-flow speed; the higher this ratio the better the travel reliability. The order of the scenarios and the trends over time are similar to that under the congested VKT measure.

**Figure 19 Percentage congested VKT, all roads**

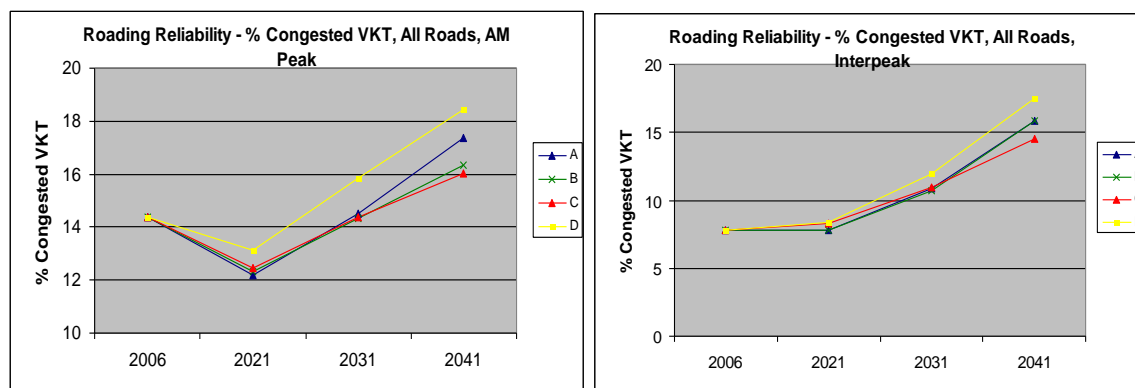
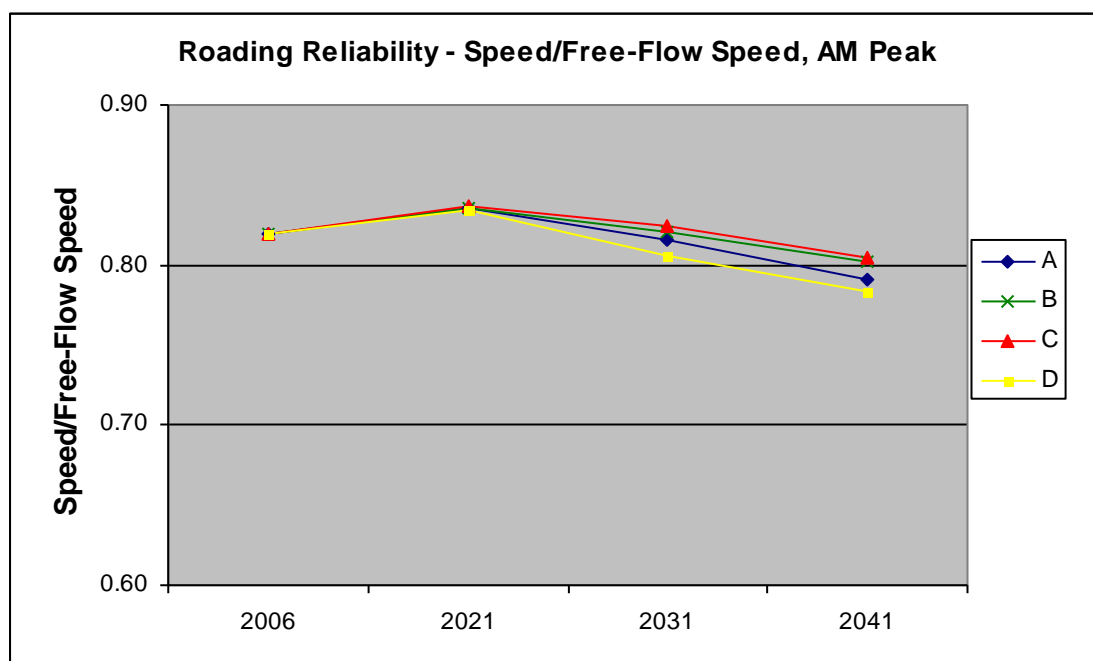


Figure 20 Ratio of Speed to Free-Flow Speed, AM Peak



PT reliability, measured as the percentage of congested VKT on the QTN where buses mix with traffic, is very similar for all scenarios (refer to Appendix 5). It improves markedly from 2006 to 2021, due to the implementation of bus priority measures, and is then fairly constant to 2041.

Due to the different trends exhibited, two separate scores were given, for road and PT. For road after an initial increase all scenarios decline in travel reliability. The scenarios can be distinguished between as follows: Scenario D has the least travel reliability, Scenario A has the next worst and Scenarios B and C are similar and show the least decline. For PT all scenarios are similar and show an improvement in travel reliability.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Improved travel reliability (road)</b>	XX	X	X	XXX
<b>Improved travel reliability (PT)</b>	✓✓	✓✓	✓✓	✓✓

### Conclusion

Travel reliability by road is worse in all scenarios in 2041 than in 2006. However, in all scenarios there is an initial improvement to 2021, prior to the overall decline. This is a reflection of both the lower transport infrastructure investment in later years and the large scale of projected population growth and subsequent growth in vehicle travel. This shows that planned improvements in the transport network and TDM initiatives do not keep pace with the projected population growth. However, conversely, for PT there is an improvement in travel reliability in all scenarios.

In the long term, reduced travel reliability by road would negatively affect economic performance. Greater investment in the transport network would be required in all scenarios in order to maintain

or improve current travel reliability. However, this investment would need to be more significant in an expansive urban form.

### 6.3 Improved accessibility to economic activity

This criterion measures the extent to which strategic economic locations across the region are accessible by road and passenger traffic. It comprises both traffic to these locations from elsewhere and traffic between them.

Efficient transport links to and between the region's most important business locations are fundamental to the effective movement of goods and services and important for commuters' access to them. Effective links to import and export gateways, such as Auckland International Airport and the Port of Auckland, are crucial to Auckland's ability to do business internationally.

#### *Evaluation*

The measures used are:

- average vehicle speeds and times to and between specified strategic economic locations in the interpeak period, which are aimed at the accessibility of goods and services movement, and
- average vehicle and PT speeds and times in the AM peak period, which is aimed at the accessibility of commuters to these locations.

The data has been considered for all economic locations combined, in which case the measures are weighted by the numbers of trips, and for the individual locations. The combined data is shown in the following figures and that for the individual sites is given in Appendix 5 (Figure 69 to 88).

Figure 21 shows the average vehicle (or road) and PT speeds to all specified economic locations in the AM peak. For all scenarios at 2041 the average vehicle speeds are about 10 per cent lower than in 2006 and there is little difference between the scenarios.

**Figure 21 Average vehicle (road) and PT speeds to economic sites, AM peak**

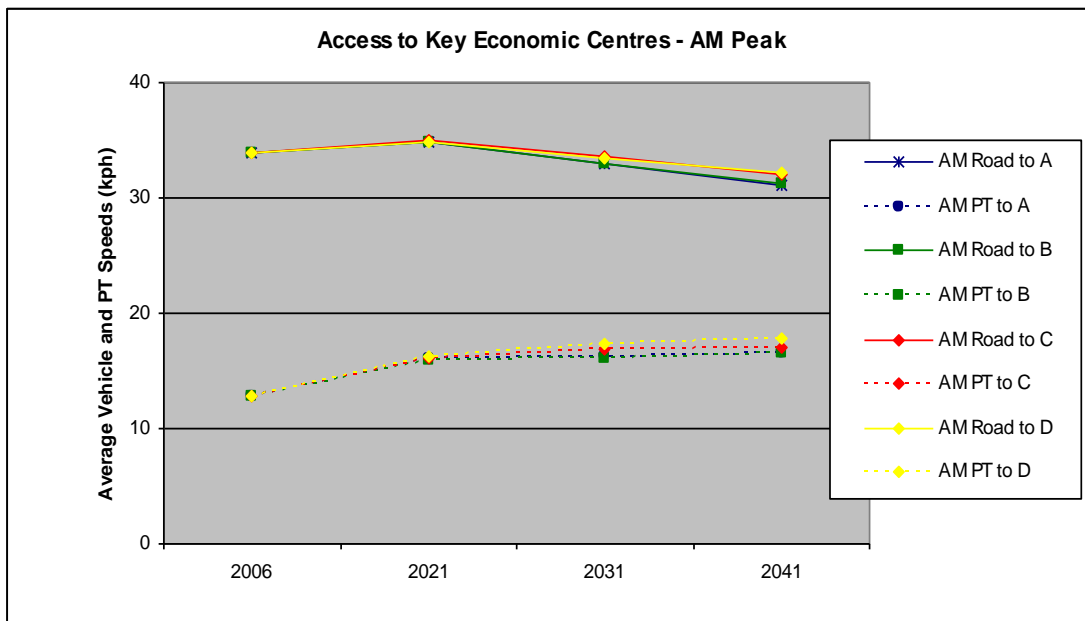
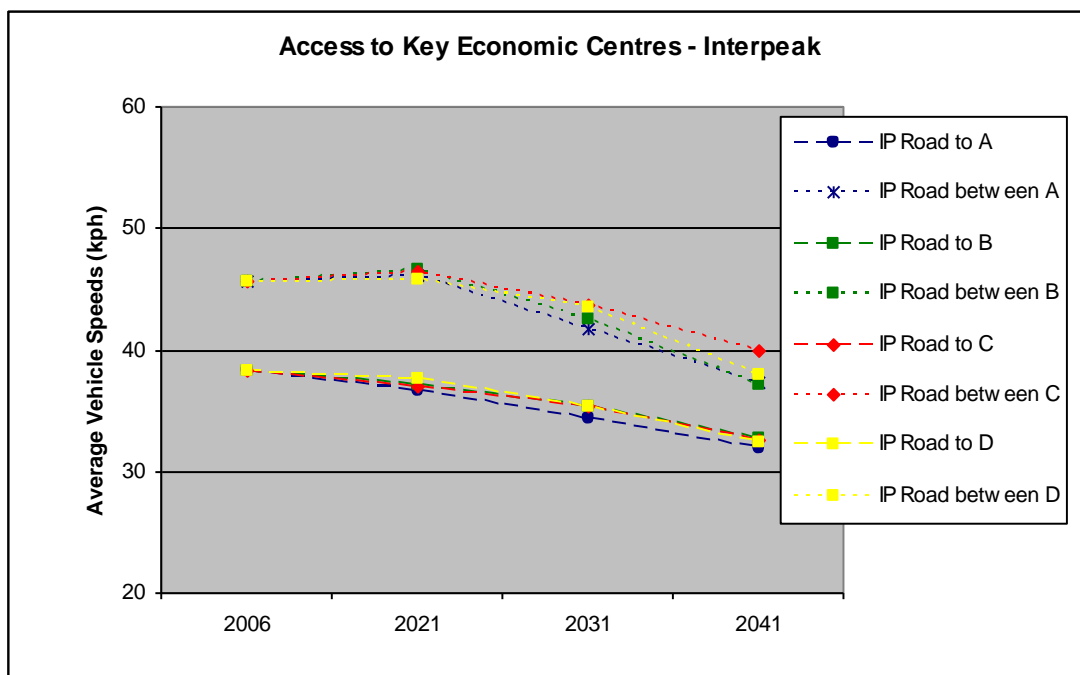


Figure 22 shows the average vehicle speeds to and between all specified economic locations in the interpeak. This aimed at the movement of goods to the locations in the interpeak period. For all scenarios the average speeds in 2041 are lower than 2006. Again, there is little difference between the scenarios for the average speeds to the sites, but for the average speeds between the sites Scenario C has a higher average speed than the other scenarios and Scenario D has a slightly higher speed than Scenarios A and B.

**Figure 22 Average vehicle (road) speeds to and between Economic Sites, interpeak**



The average speed measures do not take into account the distances travelled in the scenarios, which are, in part, associated with the location of development in each. Hence travel times are also used as a measure of this accessibility.

Figure 23 and Figure 24 show the vehicle and PT times to and between the economic sites that correspond with the average speeds in Figure 21 and Figure 22. The AM peak road times to the sites are lower in 2041 than in 2006 for Scenarios A, B and C, but markedly higher for Scenario D. The PT times in 2041 are similar to those in 2006, with the time in Scenario D slightly higher than the other scenarios. In the interpeak period the vehicle times are all higher than in 2006, with Scenario D having higher times to the sites than the other scenarios, whereas between the sites Scenario A has the highest times and Scenarios C and D the lowest.

**Figure 23 Vehicle and PT times to economic sites, AM Peak**

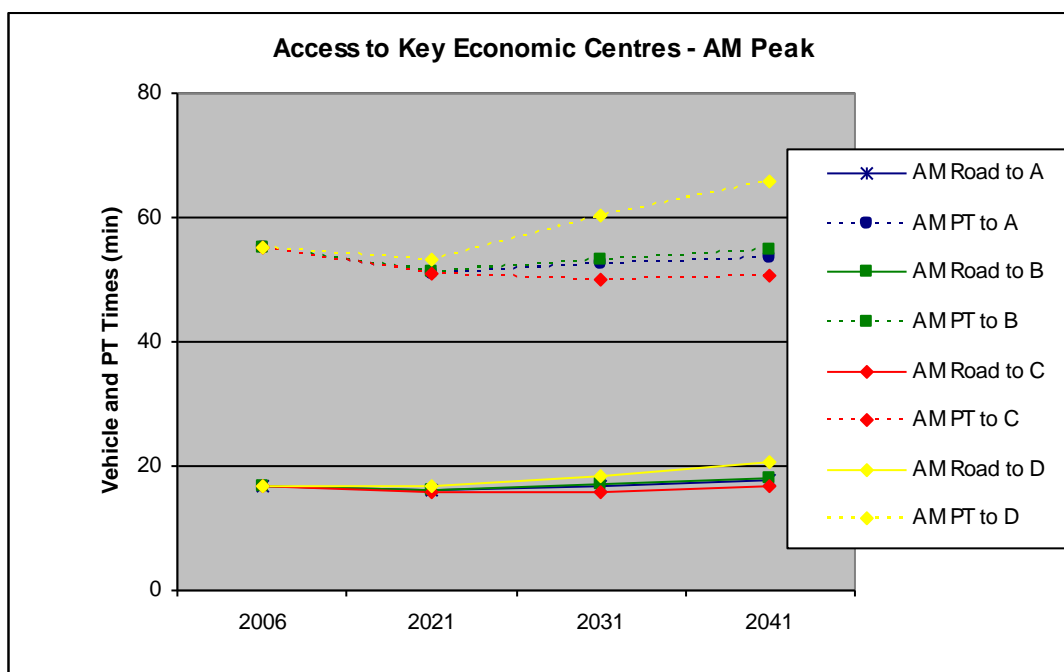
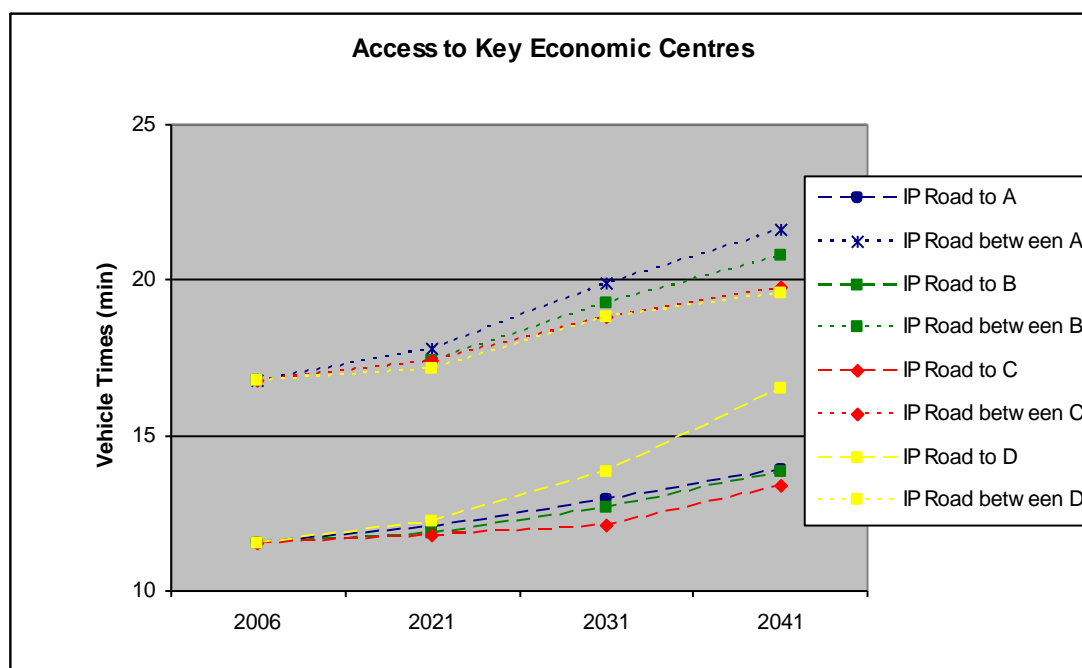


Figure 24 Vehicle times to and between economic sites, interpeak



The average speeds and times for access to individual sites are given in Appendix 5.

The scoring for this criterion is based on all data. For travel speeds there is little overall difference between the scenarios; the speeds decrease at a similar rate. The only exception to this is an increase to PT speeds in the AM peak. A greater decline is seen for road during the interpeak, when most economic benefits are achieved. Travel times generally increase, particularly in Scenario D which generally has greater travel speeds than the other scenarios and therefore scores more negatively.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Improved accessibility to economic activity</b>	<b>XX</b>	<b>XX</b>	<b>XX</b>	<b>XXX</b>

### Conclusion

Overall, accessibility to locations of economic activity declines over time for both AM peak and interpeak. The decline is greatest for interpeak and the average vehicle speeds get closer to those of the AM peak. In most cases the decline accelerates after 2021. As with Section 6.2 Improved Travel Reliability, this is perhaps a reflection of the front loading of transport infrastructure investment and the scale of population growth and vehicle growth. It is evident that planned improvements in the transport network and TDM initiatives do not keep pace with the projected population growth.

Decreasing accessibility to locations of economic activity will negatively affect economic performance. Greater investment in the transport network would be required in all scenarios in order to maintain or improve current travel reliability.



## 6.4 Improved access to labour pool

This criterion measures the extent to which employers and businesses have access to the labour pool.

Good access to an appropriately skilled workforce is an important consideration for businesses. The ability to better match employees' skills with the specific needs of firms will lead to greater productivity. Conversely, restricted access to the right workers can result in higher recruitment and training costs, more outsourcing and reduced productivity. In a spatial context, this can affect where a business might choose to locate while the quality and reliability of the transport network will influence workers' choices of employment locations.

### *Evaluation*

Access to the labour pool is measured as the number and percentage of working-aged adults within 30 and 45 minutes of employment in the AM peak period separately by car and PT. This has been considered at the regional level and for each geographic sector.

Figure 25 and Figure 26 show the number and percentage of working-aged adults within 45 minutes of employment by car and PT respectively. The graphs for 30 minutes and those showing the measures by geographical sector are given in Appendix 5 (Figures 89 to 102).

Accessibility to the labour pool in terms of the numbers of adults within 45 minutes by car increases over time for all scenarios but Scenario D, which increases initially and then declines to 2041 to be slightly below that in 2006 despite the increase in population over that time. There is a clear order to the other scenarios; Scenario C has the greatest number (some 35 per cent more than in 2006), followed by Scenario A (+29 per cent) and then Scenario B (+25 per cent).

With access by PT the number of working aged-adults increases in all scenarios, varying between 45 per cent for Scenario D and 135 per cent for Scenario A, though the absolute values are much less than those by car.

In percentage terms the access by car declines and by PT increases between 2006 and 2041 for all scenarios, except for Scenario D by PT which is much the same percentage as in 2006.

Figure 25 Access to labour pool - car (45 min)

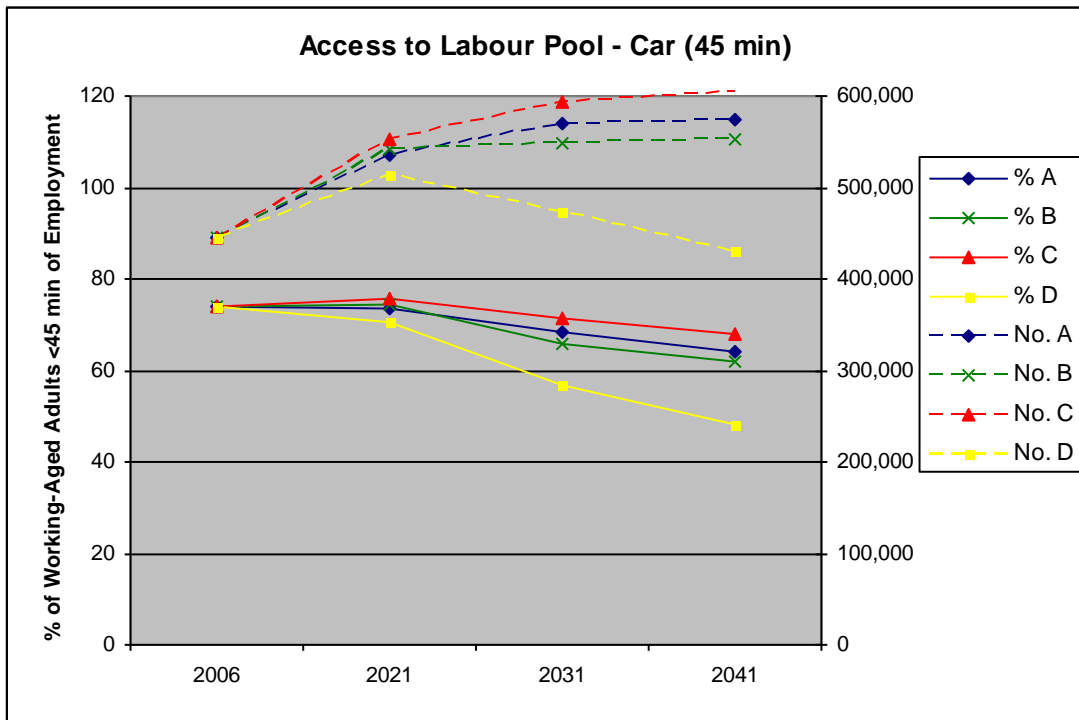
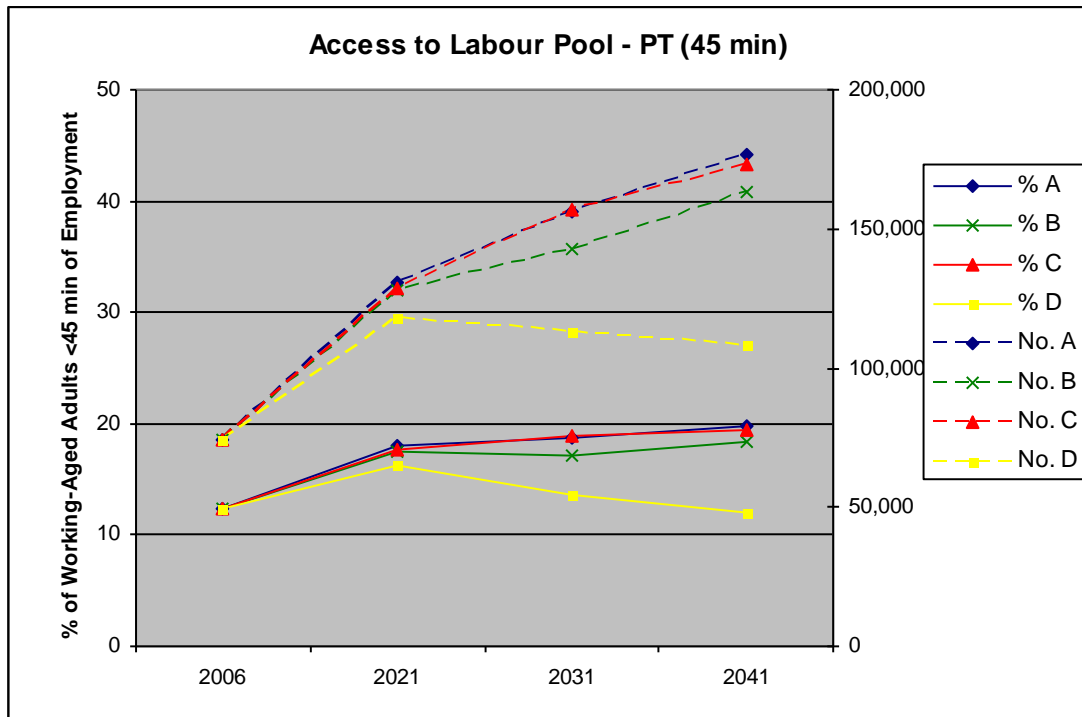


Figure 26 Access to labour pool - PT (45 min)



As with Section 6.2 Improved travel reliability, two separate scores are given, for road and PT. The scoring is based both on the number and percentage data, with the former considered the most important from the employers' perspective; that is the number of prospective employees within 45 minutes travel time of the employer. It is also acknowledged that the percentage data assists in understanding the proportion of the region's labour force that has a given level of access to an area.

In comparing the two sets of data, it is clear for both car and PT that there is improved access, shown by the increase in numbers (with the exception of car in Scenario D), but this accessibility level is not keeping pace with population growth (shown by the falling percentage).

For car, Scenarios A, B, C score positively because they show an increase in numbers and a relatively low decrease in percentage. Scenario D scores negatively because after initially increasing it then declines to 2041 to be slightly below that in 2006 despite the population growth, and it displays the greatest decrease of the scenarios.

For PT a similar situation is seen, although all scenarios show an increase in numbers (Scenario D having lowest increase), and, apart from Scenario D, also show an increase in percentage. Scenario D's percentage is the same at 2041 as it is at 2006 therefore, overall, it is scored neutrally.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Improved access to labour pool (road)</b>	✓	✓	✓	XX
<b>Improved access to labour pool (PT)</b>	✓✓	✓✓	✓✓	0

### *Conclusion*

There is little to choose between Scenarios A, B and C for this criterion; they all provide businesses with better access to the labour pool than Scenario D, for both car and PT. Generally, Scenarios A, B and C show an increase in accessibility from 2006 whereas Scenario D is either neutral or declines after an initial improvement. Again, as with the previous two criteria, this is a reflection of the lower transport infrastructure investment in later years and the large scale of the population growth. However, in this criterion it is less pronounced and affects Scenario D more significantly than the others.

A compact urban form will provide greater access to the workforce and the associated economic benefits, whereas an expansive urban form will have less accessibility to the workforce and be more vulnerable to underinvestment in the transport network.

## 6.5 Increased productivity

This criterion focuses on the extent to which urban form can impact on productivity levels. It measures the extent to which employment in the business services sector agglomerates in the higher order centres, and in particular the CBD and CBD Fringe, from which will arise productivity benefits.

Auckland is home to a third of New Zealand's people and generates a third of the country's income; the region's productivity is, therefore, vital to the nation's economy as a whole. More efficient and value-added production ultimately leads to improved quality of life through higher wages, lower prices and increased government spending on infrastructure, and social and environmental initiatives. It is widely agreed that grouping or agglomeration of like business sectors, particularly business services can lead to strong productivity gains. This is largely due to enhanced interactions between businesses leading to efficiency gains, improved knowledge base, symbiotic commercial partnerships, and improvements in supply chains etc.

## Evaluation

Total business services employment in a centre was used as a proxy for density of Group 2 business activities<sup>9</sup>. The greatest returns from further agglomeration are likely to be realised in areas which have high concentrations of economic activity and good accessibility for people such as the CBD, CBD Fringe and possibly Newmarket. Other centres can still be expected to benefit from intensification of employment but to a lesser degree<sup>10</sup>.

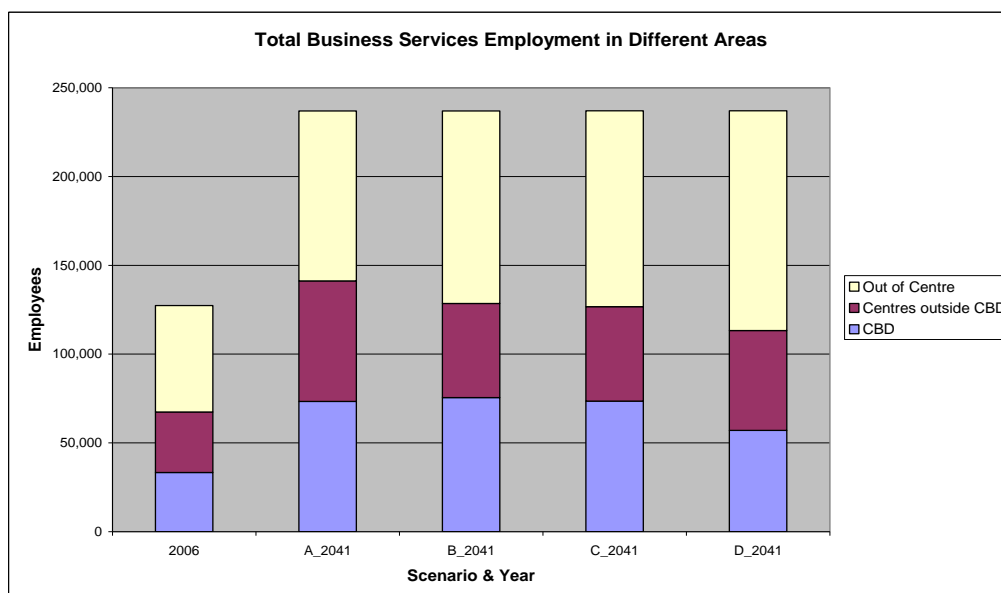
A number of statistics were considered and the scoring was based on the overall amounts of business services employment in centres throughout the scenarios, but more specifically the agglomeration observed in the CBD and CBD Fringe.

Figure 27 gives the total business services employment in the CBD, in other centres and out of centres. The other centres, outside the CBD, are: CBD Fringe, Newmarket, Albany, Henderson, Manukau City Centre, Takapuna, New Lynn, Onehunga, the Airport (and surrounds), Highbrook, Ellerslie/Penrose, Sylvia Park, and Westgate/Massey North.

Figure 27 shows that all scenarios have positive agglomeration effects compared with 2006 as they have a greater number of business services employees in the CBD and other centres. Scenarios A, B and C have, in 2041, similar levels of employment in the CBD while Scenario D has less employment, but higher than in 2006. Scenario A has the most employment in other centres giving it the highest employment in all centres (including the CBD), and the other scenarios have similar levels of employment in other centres.

The percentage of business services employees in each of these areas, in Appendix 5 (Figure 103), gives the same ranking of the scenarios and shows that Scenario A has a higher percentage of employment within centres than in 2006, Scenarios B and C have similar percentages, and Scenario D has a lower percentage.

**Figure 27 Total group 2 employment by area**

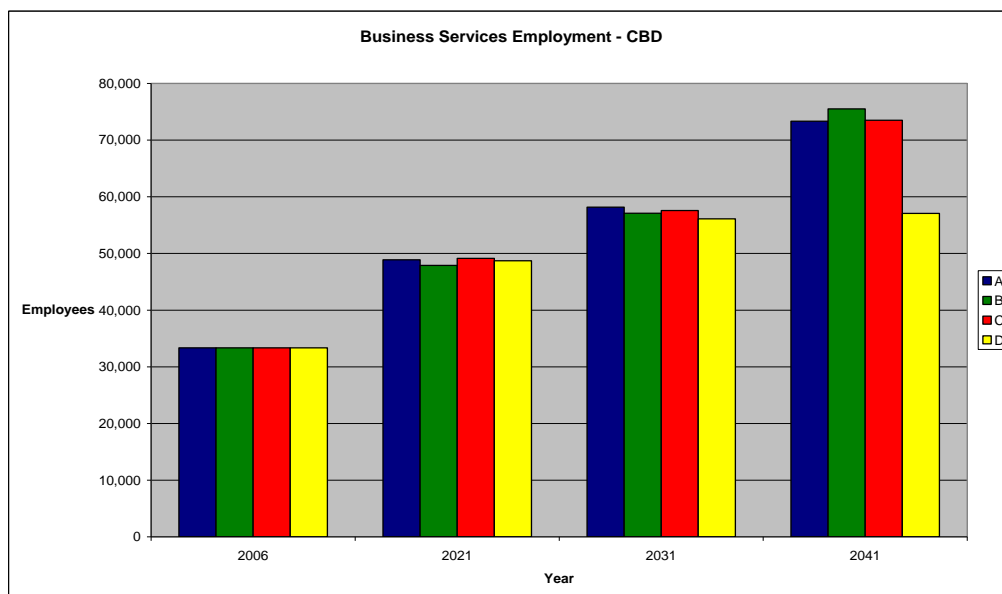


<sup>9</sup> Group 2 business activities include office based business services including professional and financial services, as defined by the Business Land Strategy, October 2006.

<sup>10</sup> Ascari Partners, 2007, report for Auckland Regional Council, Intensification within the Metropolitan Urban Limit (MUL) – Residential and Commercial impacts, by John Williamson, Richard Paling and David Waite.

Figure 28 shows the number of business services employees in the CBD by scenario and over time from 2006 to 2041. As noted above, by 2041 Scenarios A, B and C have the greatest number of business services employees in the CBD, with more than double the 2006 number. Scenario D has similar numbers of employees to the other scenarios in 2021 and 2031, but lower numbers by 2041.

**Figure 28 Total group 2 employment in CBD**



Information on the numbers of employees for other centres, including the CBD fringe, are given in Appendix 5 (Figure 103). All scenarios have similar numbers of employees in the CBD Fringe in 2041 and this is also very similar to the 2006 level; that is, none of the scenarios shows growth in business Group 2 employment in the CBD Fringe.

Within the other individual centres the numbers vary between the scenarios as does their order. Scenario A has the highest numbers of employees in Albany, Henderson, Manukau City Centre, New Lynn, and Takapuna, and Scenario D has the lowest in each case except Takapuna. In Newmarket Scenario D have the highest numbers of employees (some 16,000 in 2041), with Scenario A next (14,000) and Scenarios B and C much lower (8,000 to 9,000). For some centres, such as New Lynn, Sylvia Park, and Onehunga, the growth in business services employment is low, and the numbers of employees in 2041 relatively low.

In scoring the scenarios the uptake in the CBD takes precedence as it has by far the greatest number of Group 2 employees of any centre and is likely to have the most agglomeration opportunities. All scenarios show greater number of business services employees in the CBD and all centres, therefore, score positively. Scenarios A, B and C have significantly greater numbers than Scenario D.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Increased productivity</b>	✓✓	✓✓	✓✓	✓

## *Conclusion*

Significant levels of agglomeration and a strong CBD are evident in all scenarios, although to a lesser degree in Scenario D. The difference between Scenario D and the other scenarios could be a result of its expansive urban form, absence of a hierarchy of centres and poorer general accessibility (see accessibility related criteria). The policy implication here could be that in order to provide agglomeration opportunities a clear centres hierarchy, with a strong CBD and supported by an efficient transport network is required.

## 6.6 Land extensive business sectors

This criterion measures the extent to which a scenario provides for the growth of Group 1 business activities (manufacturing, construction, wholesale trade, transport and storage).

Group 1 business activities have specific locational requirements which depend on access to suppliers, consumers, ports and airports (for export and import) and are often land extensive with relatively low number of employees per hectare. This is very different from Group 2 business activities which are most often office based, more land intensive, located in commercial centres, and tend to have a higher numbers of employees per hectare.

Providing sufficiently for Group 1 business activities is important to Auckland's economy. While the region's economy continues to grow and diversify, it still relies heavily on the core sectors of manufacturing, construction, wholesale trade, transport and storage<sup>11</sup>. The manufacturing sector alone was the largest employer in the region in 2008 with 82,000 employee counts, and contributed 13.5 per cent to Gross Regional Product, the second highest contributor after business services<sup>12</sup>.

### *Evaluation*

This criterion involved an assessment of the provision for Group 1 business activities and was scored based on the scenarios themselves rather than any modelling results.

Scenarios B and D provide approximately 2000 hectares of additional greenfield land for Group 1 activities in five locations: Silverdale, Whenuapai, the Airport, Drury and Paerata. Scenario A and C provide some small capacity for Group 1 activities in the various centres, but the majority of Group 1 activities are expected to intensify in existing Business Areas and in Future Urban Areas that provide for this type of employment, ie Takanini, Hobsonville Peninsula and Massey North.

Given the anticipated growth of Group 1 business activities in the region and the dearth of sites available to accommodate such growth, the provision of additional greenfield land contained in Scenarios B and D clearly means they score more positively than the other scenarios. In this sense the scoring is straightforward; Scenarios B and D provide additional greenfield land for Group 1 activities so score positively, Scenarios A and C do not provide additional land and, therefore, score negatively.

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<sup>11</sup> Business Land and Economy Group. (2007) *Auckland Region Greenfield Business Land Report*: Page 2

<sup>12</sup> Auckland Regional Council. (2009) *Industry Snapshot for the Auckland Region: The Manufacturing Sector*. Page 3

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Land extensive business sectors</b>	<b>X</b>	✓	<b>X</b>	✓

While this evaluation does reinforce the need for additional greenfield land for Group 1 sectors it does not address where an appropriate area may be located. This has been discussed in detail in the Auckland Plan Business and Employment Growth Technical Report. While not used in this evaluation, there are some model outputs relating to Group 1 locations which can inform the wider discussion. They relate to the take-up of employment capacity, accessibility to Group 1 areas and accessibility from Group 1 areas to the ports, and can be seen in Appendix 5 (Figure 104 and 105).

### *Conclusion*

It has been established that the Auckland region requires additional greenfield land for Group 1 business activities<sup>13</sup>. It is clear that this aspiration is most easily provided for in an urban form which provides additional greenfield land at the urban periphery, as illustrated in Scenarios B and D.

## 6.7 Energy resilience

This criterion is aimed at providing a measure of the resilience of energy sources in response to concerns about Auckland's reliance on fossil fuels, particularly in relation to transport, and the region's ability to function if there was a disruption to the city's energy supplies.

Auckland relies heavily on energy sourced from outside the region, whether this is fuel for transport or electricity for running factories and houses. In the past Auckland has fallen victim to breaks in the supply of energy, these have been to the detriment of the regional economy and the lifestyles of residents.

Two aspects of energy resilience are relevant to this assessment:

- Transport (fuel use).
- Domestic energy – household electricity use.

The issues relating to reducing greenhouse gas emissions will be discussed in Section 7.2, but it is also relevant to reflect upon this reliance on fossil fuels as part of consideration of the energy resilience criterion. It is noted that transport accounts for 56 per cent of energy usage in the Auckland region<sup>14</sup>. Potentially, Auckland's reliance on imported oil makes us vulnerable to price volatility and security of supply. Given this significance, this aspect of the criterion was used as the basis for the scoring.

The other aspect of this criterion that is noteworthy for consideration is domestic energy (electricity) usage and how the scenarios perform in terms of minimising consumption (or reliance) on energy sources. No specific feedback was sought on domestic energy usage as part of this evaluation,

<sup>13</sup> Business Land and Economy Group. (2007) Report on the findings of the Business Land and Economy Group.

<sup>14</sup> Auckland Regional Council. (2008) *Regional Energy Database*.

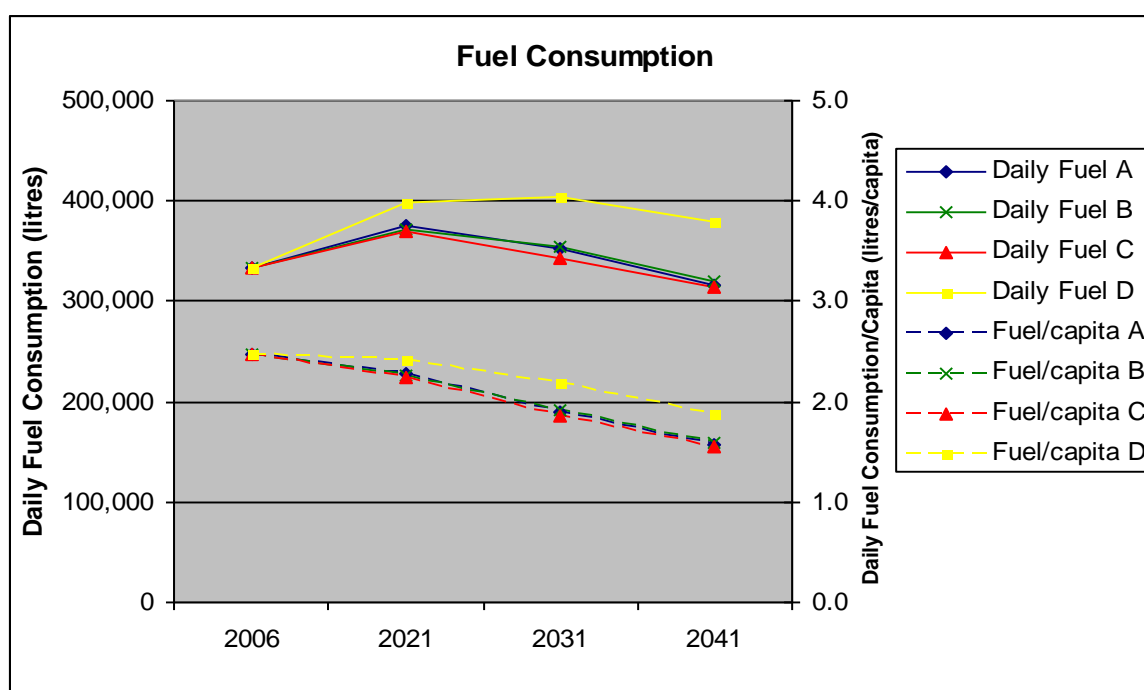
however relevant discussion contained in the ARC's Futures Project (2010) is included within the discussion.

### Evaluation

For the transport component of energy resilience, daily fuel use by vehicles and fuel use per capita has been estimated from model outputs and fuel use rates<sup>15</sup> for each of the scenarios from 2006 to 2041 (Figure 29). This provides an indication of the relative dependence each of the scenarios has on fuel usage for transport.

All scenarios show increases in fuel use from 2006 initially and then declines, while fuel use per capita shows marked reductions from 2006 levels. The declines in both measures is due to reductions in fuel use rates over time arising from technology improvements. The daily fuel use in total and per capita are lower for Scenarios A, B and C than Scenario D, reflecting the higher car mode share and average trip length in Scenario D.

**Figure 29 Energy resilience – daily fuel use by vehicles**



There are a number of factors that contribute to domestic energy use, these include: urban form, embodied energy in infrastructure design, dwelling typologies and construction. The Futures Project (2010) notes that a more intensive scenario provides greater energy efficiency opportunities through co-location and intensification of services. There were energy efficiencies in the building typologies that are associated with a more intensive scenario, including less embodied energy and heating costs because of design and construction.

Energy usage in all housing, both attached and detached typologies, could be designed to be more energy efficient than the current housing stock. While it is acknowledged that attached housing typologies have a propensity to be inherently more energy efficient, largely because of thermal

<sup>15</sup> Fuel use rates are from Auckland Council's Vehicle Emissions Projections Model (VEPM v4.0), noting that as this version has just been released it is still a beta version. The emissions rates vary by speed and vehicle type (car, categories of heavy commercial vehicle) and fuel type (diesel, petrol), and decline over time to year 2040 to reflect improving technology, and are constant thereafter.



mass, detached housing can be designed to be more energy efficient. Therefore any differences between new attached and detached housing typologies in terms of energy efficiency are considered marginal<sup>16</sup>.

The scores, below, are based on total fuel use therefore Scenarios A, B and C score neutrally because fuel use is the same at 2041 as it is at 2006, and Scenario D scores negatively as it has higher fuel use at 2041.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Energy Resilience</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>X</b>

### Conclusion

All scenarios showed an initial increase in fuel use above 2006 before beginning to decrease from 2021 (Scenarios A, B and C) and 2031 (Scenario D) as a result of assumed improvements in the vehicle fleet. Despite the per capita decline in fuel use in all scenarios, Scenario D shows a greater reliance on fuel usage and accordingly has less energy resilience.

A number of areas are identified as potentially contributing to a decrease in domestic energy usage including city form, embodied energy in infrastructure design, dwelling typologies and construction. This is an area where policy related to infrastructure provision as well as design and construction standards could make an impact for all scenarios. For more intensive scenarios the redevelopment of comprehensive sites in centres could provide exemplars of good design and sustainability, similarly more sustainable and liveable design solutions are possible for lower density greenfield development.

## 6.8 Improved accessibility to productive rural areas

This criterion is aimed at providing a measure of the accessibility of rural areas in the region, and particularly key productive areas, to the port and airport.

Rural areas have future needs for efficient transport infrastructure that improves accessibility for people and businesses, thereby supporting rural people and economy. Evidence shows that the number of vehicle trips generated by rural sites in Auckland is almost identical to that of urban sites and that rural trips are significantly longer both of which have significant implications for managing commuting and providing for transport demand. The average trip distance for rural areas is around 10 kms while urban areas have an average trip distance of around 6.7 kms (52 per cent lower). Rural households generate the same number of trips per day (8.76) as urban properties (8.92)<sup>17</sup>.

The measures used are vehicle times and average speeds in the interpeak period. Three key rural areas of Matakana (in the north), Kumeu (north-west) and Franklin (south) were used for this assessment.

<sup>16</sup> Auckland Regional Council. (2010) Future Land Use and Transport Planning Project

<sup>17</sup> Rutherford, R. (2009) Transport Planning Solutions: *Auckland Regional Rural Transport Issues, Regional Land Transport Strategy Working Report No.10*, Auckland Regional Council.

Evaluation

Figure 30 and Figure 31 show the interpeak travel times from the key rural areas to the port and airport.

Figure 30 Access from key rural areas to the Port, interpeak travel times

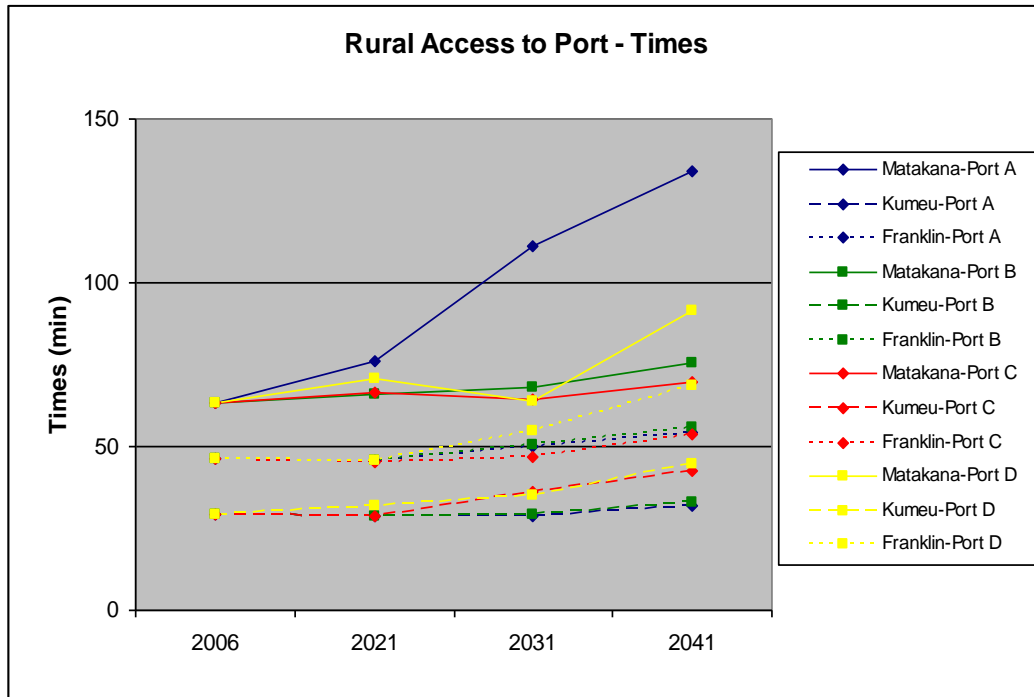
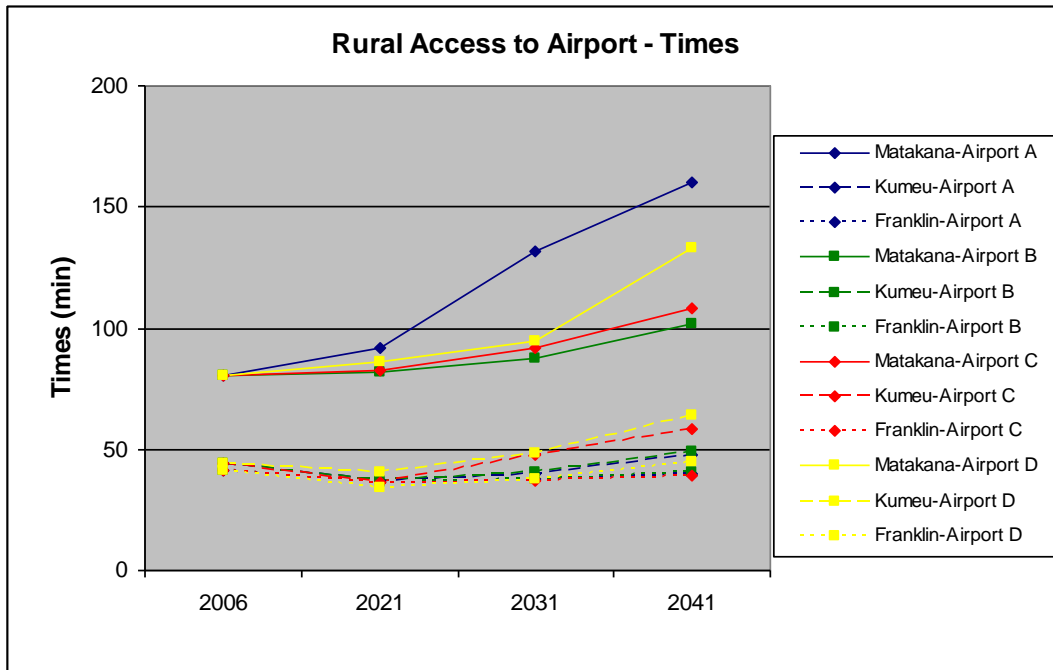


Figure 31 Access from key rural areas to the Airport, interpeak travel times



In all cases the travel times in 2041 are greater than in 2006, but this varies between rural areas and scenarios.

From Matakana, Scenario A has the highest time and is more than double that in 2006; the higher times in Scenario A are due to likely to be a consequence of less roading infrastructure and improvements than the other scenarios, namely, the Puhoi to Wellsford realignment, and widening of the Northern Motorway. By 2041 the Matakana-Port/Airport times are also noticeably higher, which is due to greater traffic volumes associated with the peripheral development in this scenario.

Scenario D also shows higher times than the other scenarios from the south, the Franklin rural areas, particularly to the port, but also to the airport. Again this will be associated with higher traffic flows from the expansive development in southern parts of the region.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Improved accessibility to productive rural areas</b>	XX	X	X	XX

### *Conclusion*

The assessment shows that while all scenarios decrease in accessibility to 2041, this is worst in Scenarios A and D. In particular, for Scenario A this is likely due to a lack of roading upgrades in rural areas, while for Scenario D this can be attributed to an expansive urban form affecting traffic flow and traffic times.

Rural production systems require efficient and reliable transport links from farm gate to ports, airports, rail facilities and processing facilities. This assessment considered access from three key rural production areas to the ports and airports as a proxy for overall rural accessibility. In reality, supply and process chains are more complex than this and further investigation would be required in order to fully gauge rural accessibility in the scenarios. Future land use and transport planning needs to take into account the impact any future growth and associated transport infrastructure will have on Auckland's rural economy.

## 6.9 Protection of productive rural land

The protection of productive rural land criterion aims to determine the degree to which the scenarios avoid loss of productive rural soils through urban development.

The loss of productive soils to greenfield expansion can have far reaching impacts on the region's rural production base. This assessment is therefore critical in that it analyses the potential impacts of different patterns of urban expansion on Auckland's agricultural land resources.

### *Evaluation*

The criterion assessment comprises two components. Firstly, a quantitative GIS analysis of the loss of Land Use Capability (LUC) soil types in each of the scenarios. Secondly, a qualitative analysis involving assessment of the Auckland Council Rural Advisory Panel's (RAP) submission on the Auckland Plan Discussion Document, and comments from a recent RAP workshop on the scenarios. Combined, these assessments allow for an overall assessment and scoring of each of the scenarios.

LUC is the hierarchical classification system used in assessing the capability of certain land areas to sustain continuous production (Landcare Research, 2000). The land is assessed in terms of versatility for productive use; factors that limit the land’s capability for productive use; and characteristics that determine productive use (eg erosion, soil and landform, etc).

The New Zealand Land Resource Inventory states that 25 per cent of the land area within the Auckland region<sup>18</sup> is listed as LUC Classes 1, 2 and 3<sup>19</sup> (“land of moderate to high value for primary production” and referred to as “prime agricultural land”)<sup>20</sup>. This is a higher percentage than for New Zealand as a whole, however, approximately a quarter of this prime rural land in Auckland has already been urbanised and lost for production. It is important to note that while LUC classes 1, 2 and 3 are considered highly important for agricultural and other production (particularly for horticulture, and sheep and beef farming); LUC classes 4 to 8 also serve a critical role in agricultural production where activities do not require high quality soils, such as forestry and glasshouses.

The scenario concept maps showing urban expansion areas were used as the basis for the evaluation. These were overlaid with existing data of the LUC soil categories.

Table 7 shows the relative percentage of loss of LUC soils 1, 2, 3 and combined LUC soils of 4 to 8. Also see maps in Attachment 1 loss of productive soils for each scenario.

**Table 7 Percentage of productive rural land lost**

LUC Class Code	Scenario A	Scenario B	Scenario C	Scenario D	Total Across Region
<b>1</b>	2.37%	4.93%	2.37%	6.61%	4172
<b>2</b>	6.09%	12.65%	6.09%	26.91%	50698
<b>3</b>	2.01%	2.68%	2.01%	9.83%	62946
<b>4 to 8</b>	0.19%	0.49%	0.19%	4.29%	316,971
<b>Total (LUC 1 – 8)</b>	1.16%	2.27%	1.16%	7.75%	434787
<b>Total (LUC 1 - 3)</b>	3.78%	7.05%	3.78%	17.07%	117816

\*Note: Data does not include land areas of LUC soils lost prior to 1999 MUL, but does include Future Urban Areas (MUL shifts) since 1999 – hence why Scenario A and C have loss of productive soils.

It is evident that Scenario D results in significant amounts of highly productive land lost with some 17.07 per cent, of LUC soils 1, 2 and 3 converted to urban land. In total, Scenario D results in a region wide loss of 7.75 per cent of land (LUC 1 – 8). Scenario B has the next most significant impact on productive soils. This scenario results in a loss of 7.05 per cent of LUC soils 1 to 3 and a region wide loss of 2.27 per cent of rural land (LUC 1 – 8). Scenarios A and C have the same urban footprint and represent a compact urban form (no expansion beyond the MUL); these two scenarios have the least impact with a loss of 3.78 per cent LUC soils 1 to 3 and region wide a loss of 1.16 per cent (LUC 1-8).

Containing urban growth within the MUL was supported by the Rural Advisory Panel<sup>21</sup>, where significant release of land for housing was considered detrimental to the protection of productive

<sup>18</sup> Based on the regional area prior to the amalgamation.

<sup>19</sup> *Auckland Regional Policy Statement, 1999.* (1999) Auckland Regional Council. Chapter 12, page 1.

<sup>20</sup> *Auckland Regional Policy Statement, 1999.* (1999) Auckland Regional Council. Appendix D, page 39.

<sup>21</sup> The Rural Advisory Panel is represented by the following representative groups of the rural sector: Horticulture New Zealand, Federated Farmers, Fonterra, New Zealand Winegrowers, New Zealand Forest

rural land. However, the panel acknowledged that pockets of development are present in the rural area, and if future growth was to occur in the rural area, that this would be best based around existing rural towns and settlements.

The scoring reflects a combined assessment of both qualitative and quantitative data discussed above.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Protection of Productive Rural Land</b>	<b>0</b>	<b>X</b>	<b>0</b>	<b>XX</b>

### *Conclusion*

Scenario D would negatively affect rural productivity of the Auckland region with significant losses of productive soils. This is closely followed by Scenario B. Scenarios A and C had minimal impact on rural productive soils as they do not contain urban expansion beyond that which is already planned. Retaining growth within the existing urban area is beneficial to rural productive activities and economy, and the retention of productive soils for the future.

## 7 Environmental Wellbeing Evaluation

Environmental wellbeing is defined by the environmental outcomes the community wants to achieve. This includes the protection and enhancement of Auckland’s natural environment, including, water quality, freshwater and coastal environments, air quality, biodiversity and habitat values.

The importance of environmental wellbeing is described in the Resource Management Act 1991 which promotes the “sustainable management of natural and physical resources” this is to be achieved by “managing the use, development, and protection of natural and physical resources in a way, or at a rate which enables people and communities to provide for social, economic and cultural wellbeing”<sup>22</sup>. Environmental wellbeing has important correlations and implications with the three other wellbeings.

Urban development has a direct impact on the region’s receiving environments through discharges to air (transport, industry, domestic fires) and discharges to water through stormwater runoff carrying (contaminants and sediments). Urban development can also affect terrestrial environments through loss of ecosystem connectivity and integrity as regenerating bush, forest remnants, wetlands, estuaries and streams are modified, fragmented and/or degraded.

The model does not provide specific information on environmental impacts (with exception on GHG emissions). Therefore, assessment of the environment is based on qualitative analysis provided for each of the criteria by environmental experts. This analysis is based on the expert’s knowledge of urbanisation impacts on receiving environments and applying quantitative data where this is available (see Attachment 1 for full qualitative assessments).

The environmental assessment of scenarios focuses on sensitivity or risk from development on receiving environments (air, streams, harbours, estuaries and terrestrial) and potential impacts from natural hazards. The emphasis of the evaluation is on the effects of urbanisation, recognising that the most significant effects on the environment occur during development particularly in areas that are currently undeveloped.

### 7.1 Summary

**Table 8 Environmental wellbeing scoring summary**

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Reduced greenhouse emissions</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>X</b>
<b>Protection of or enhancement of marine values</b>	<b>X</b>	<b>XX</b>	<b>XX</b>	<b>XXX</b>
<b>Protection of or enhancement of stream corridors</b>	<b>X</b>	<b>XXX</b>	<b>XX</b>	<b>XXX</b>
<b>Identify, protect and enhance terrestrial ecosystems</b>	<b>✓</b>	<b>XX</b>	<b>✓</b>	<b>XXX</b>
<b>Avoidance of existing hazards</b>	<b>X</b>	<b>XX</b>	<b>X</b>	<b>XX</b>

<sup>22</sup> Resource Management Act, 1991, page 52, part 2

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Avoidance of new hazards</b>	<b>0</b>	<b>X</b>	<b>0</b>	<b>XX</b>
<b>Exposure to existing hazards</b>	<b>XX</b>	<b>X</b>	<b>XX</b>	<b>X</b>

### *Conclusion*

The environmental evaluation assumes good quality urban design, and best practice approaches in all new developments, across all scenarios. However, the impact on environmental criteria worsens or remains neutral across the majority of criteria compared with 2006 because of the scale of growth and assumptions that current policy and practice would continue.

Scenario D, the most expansive of all the scenarios performs worst with consistent negative scores across all criteria. Additionally, Scenario B scores poorly across a number of the criteria, primarily due to growth in a number of greenfield areas and growth in satellite centres. Scenario A tends to be the more preferred urban form, followed by Scenario C.

Best practice would require greater investment in infrastructure to manage effects of stormwater runoff into marine and freshwater receiving environments, and would need to include policy responses around Low Impact Urban Design. Scenarios A and C are likely to incur further impacts on sensitive receiving environments already affected by urban activities by intensification within the existing urban area. However, the impacts from urban expansion into previously undeveloped areas, as that in Scenarios B and D, were seen to have the worst impact on freshwater and marine environments.

Concentration of development within the current urban boundary (Scenario A and C) will increase population and infrastructure vulnerability, particularly for low frequency hazard events (eg volcanic eruption or earthquake). The scenarios which expand the urban footprint (B and D) will disperse risk from both low frequency hazard events and localised frequent events (eg flooding). However, Scenarios B and D will also expose development to new hazards such as flooding in the south and land instability and coastal hazards in the north. Different growth patterns create different risks to hazards, extensive research on hazards and their risks should be undertaken and a long term management approach for hazards and their consequences needs to be implemented for new growth areas.

The subject matter experts suggested that where possible it is best to avoid development in catchments and areas that are not currently developed and are still of good quality. In general terms, it is concluded that more intensive development of an already degraded catchment is preferable to developing in an otherwise undamaged or highly valued area. Urbanisation should be avoided in the most highly valued and sensitive areas in order to protect coastal and natural environments from the impacts of human land use activities.

For the achievement of some criteria, non-land use policy interventions will be more effective. For example, climate change targets cannot be met through land use policy alone. Additional policy interventions, such as emission controls on cars are likely to have more impact. However, the ability to deliver these interventions would be severely undermined through less intensive land use approaches that favour greater urban expansion.

None of the scenarios achieves the Mayor's target of a 40 per cent reduction in net GHG emissions by 2031 on 1990 levels. Total CO<sub>2</sub> emissions from vehicles are similar in scenarios A, B and C, all

three being significantly less than Scenario D. However, all scenarios show a decline in CO<sub>2</sub> emissions per capita, as a result of assumed technological advancements in the vehicle fleet.

## 7.2 Reduced greenhouse gas emissions

Reduced GHG emissions relates to managing human induced effects on climate change. Transport is responsible for the vast majority of GHGs in the region, 47 per cent of all Fine Particulate (PM<sub>10</sub>) emissions, 83 per cent of Nitrous Oxide (NO<sub>x</sub>), 85 per cent of Carbon Monoxide (CO), 52 per cent of Volatile Organic Compounds (VOCs), 65 per cent of Sulphur Dioxide (SO<sub>2</sub>) and 48 per cent of Carbon Dioxide (CO<sub>2</sub>)<sup>23</sup>.

Responding to climate change is a key outcome of Auckland Council's legacy plans (including: ASF; RPS; Regional Plan: Air, Land and Water Plan; RLTS; and the Civil Defence Emergency Group Plan. In addition the Majors target of 40% in CO<sub>2</sub> emissions by 2031 reflects a commitment to a reduction in GHG emissions. These outcomes reflect New Zealand's commitment under the Kyoto Protocol to reduce its transport related greenhouse gas emissions with national targets identified in the RLTS for 2040:

- to halve per capita GHG emissions from domestic transport (relative to 2007),
- to reduce total tonnes of CO<sub>2</sub> equivalent emissions from domestic transport to below 1990 levels.<sup>24</sup>

The rate of climate change over the last century has accelerated. Intergovernmental Panel on Climate Change scientists have concluded that it is very likely that the rapid rate of change over the last century – faster than any observed in the recent paleoclimatic record – is due to human activity, in particular, increased emissions of GHGs<sup>25</sup>.

The emphasis of evaluation is on transport related greenhouse gas emissions, measured in CO<sub>2</sub> equivalents.

### *Evaluation*

Total CO<sub>2</sub>, and per capita CO<sub>2</sub> emissions from vehicles have been estimated using outputs from the transport model and emissions rates<sup>26</sup> as shown in Figure 32. Total emissions are a function of the amount of vehicle travel, the levels of congestion and the extent to which the emission rates reduce over time.

Total emissions increase from 2006 to 2021, but then decline slightly in Scenarios A, B and C to be just higher than the 2006 level by 2041. In Scenario D, CO<sub>2</sub> emissions increase more to 2021 than the other scenarios and are then fairly constant to 2041 to be some 25% higher than in 2006. Hence in Scenarios A, B and C the greater amount vehicle travel in the future is balanced by reduced emission

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<sup>23</sup> Auckland Regional Council. (2010) State of the Environment report for the Auckland region.

<sup>24</sup> Ministry of Transport Monitoring Framework TMIFv2 Indicator ref E1001.

<sup>25</sup> Auckland Regional Council. (2009) *Issues and Options: Climate Change*. Page 12.

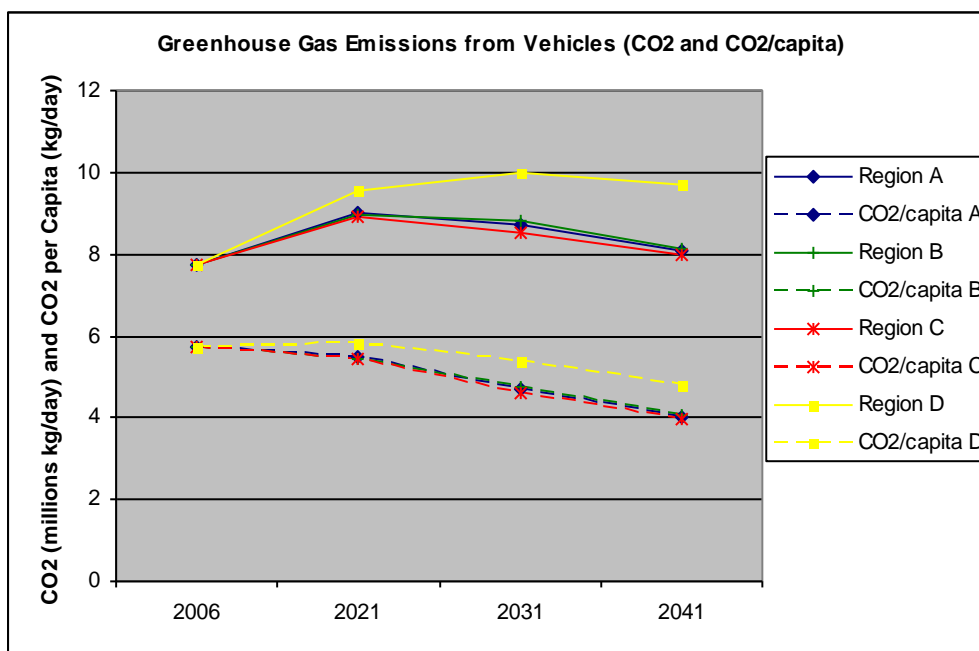
<sup>26</sup> CO<sub>2</sub> emission rates are from AC's Vehicle Emissions Projections Model (VEPM v4.0), noting that as this version has just been released it is still a beta version. The emissions rates vary by speed and vehicle type (car, categories of heavy commercial vehicle) and fuel type (diesel, petrol), and decline over time to year 2040 to reflect improving technology, and are constant thereafter.



rates, whereas in Scenario D this is not the case; the higher CO<sub>2</sub> emission level reflects the higher vehicle mode shares and longer average distances travelled compared with the other scenarios.

The emissions per capita decline in all scenarios; to around 70 per cent of the 2006 level in 2041 for Scenarios A, B and C, and 85 per cent for Scenario D.

**Figure 32 CO<sub>2</sub> emissions from vehicles**



In addition to the above model outputs a separate analysis of the potential GHG emissions produced by the scenarios was undertaken by Arup (an independent environmental and engineering consultancy), which compared the scenarios against a baseline ‘business as usual’ scenario<sup>27</sup>. This assessment compares GHG emissions across a number of sectors including residential, commercial, manufacturing and industrial, private transport, and non-private transport. This assessment found that Scenario A, B and C resulted in reduced total GHG emissions compared to the business as usual case, while Scenario D showed an increase. The increase in emissions under Scenario D was found to be entirely due to an increase in private transport emissions, which offsets reductions in other sectors. This reinforces that Scenario A, B and C are similar and have a better result than Scenario D, as shown in the model output in Figure 32.

The analysis by Arup is ongoing and is yet to be finalised, therefore, the scoring reflects the model outputs of transport related CO<sub>2</sub> (Figure 32).

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Reduced Greenhouse Emissions</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>X</b>

<sup>27</sup> ARUP, (2011). *Potential Policy Options to reduce greenhouse gas emissions: Technical Report (Draft)*. Client Report for Auckland Council. Auckland, New Zealand.

### *Conclusion*

On a region wide basis, Scenarios A, B and C do not result in a significant decrease in CO<sub>2</sub> emissions at 2041. Between 2006 and 2041 there is a significant increase, however this reduces to 2006 levels by 2041. Scenario D, the most expansive urban form results in a significant increase in CO<sub>2</sub> emissions.

None of the scenarios, with supporting transport networks, will be able to achieve targets set by the Mayor and central government for reducing GHG emissions. However, the more compact scenarios had the least impact, with no increase in GHG emissions.

Land use policy alone will not deliver required reductions in GHG emissions. Travel demand by private vehicle will continue to increase with a growing population; the consequences of this growth will depend on the development of effective transport policy at a national, regional and local level.

## 7.3 Protection of or enhancement of marine values

Protection of or enhancement of marine values aims to determine the degree to which land use scenarios avoid risks to areas of high ecological value within the coastal environment; this includes harbours, estuaries and terrestrial habitats adjacent to the coast.

Assessment of this criterion is based on sensitivity or risk from development proposed to the marine receiving environment. The emphasis of the evaluation is on the effects of different urban growth forms, locations and intensities on marine values, recognising that the most significant effects occur during development, particularly in areas that are currently undeveloped.

### *Evaluation*

Potential risks to marine receiving environments and ecological values are derived from qualitative consideration of information on relative coastal/marine values, potential sources of threats/stressors, overall sensitivity/vulnerability, and scale of exposure on the marine receiving environment to those threats. Risks to coastal natural character and landscape values are considered in terms of the location of existing development and identified areas or sites of significance.

All marine ecosystems contain elements that are vulnerable to the threats of urban development. In general, estuarine ecosystems and other sheltered and lower energy areas will be more exposed to the threats of sedimentation and increased stormwater contamination than more open and exposed coastal areas.

Potential threats from urbanisation include increased risk of sediment release (particularly during development), increased contaminant release via stormwater runoff, and heightened risk of human sewage discharges into sensitive receiving environments. Urbanising catchments also increases the level of usage and disturbance of the coastal edge and near shore, often resulting in manmade structures (ie seawalls, marinas) that can alter local hydrodynamics leading to increased sedimentation, loss of sandy habitat, shift to muddy habitat, mangrove expansion, loss of wading bird roosting areas etc. This may accelerate adverse effects of urbanisation on these receiving environments, or may cause environmental degradation even without associated urbanisation.

All scenarios result in development that would increase risks to highly valued marine environments. Therefore, all scenarios are scored negatively.

The more compact scenarios, A and C, which focus most growth within the existing urban area would increase risks to marine environments already degraded by the current urban form. These existing developed areas would need additional mitigation techniques to remedy any future impacts of intensification. However, Scenario C allows further growth in low flushing areas, such as the inner Waitemata and Manukau Harbours, and scores slightly worse than A.

While scenario B contains the majority of growth within the existing urban area, there is provision of additional areas for intensive greenfield and satellite centre growth along with intensification in high amenity (coastal) areas, this presents additional risks to marine environments. In particular, areas close to low flushing estuarine environments such as Warkworth and Helensville.

Scenario D, the most expansive scenario is scored worst because it represents significant urban growth into new and previously unaffected areas of the region, exposing new areas to increased risk – including areas exhibiting particularly high marine ecological values and important receiving environments.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Protection of or enhancement of marine values</b>	<b>X</b>	<b>XX</b>	<b>XX</b>	<b>XXX</b>

### *Conclusion*

All scenarios result in development that would increase risks to highly valued marine environments; hence, all scenarios are scored negatively. The more compact scenarios of A, and C have the least impact on marine values by avoiding urbanisation within areas not currently affected by development. However, Scenario C provides intensification in areas of important marine values and scores slightly worse. Scenario B scores more poorly than A due to additional areas for intensive greenfield and satellite growth, and high amenity areas, some of which may have significant impacts on sensitive marine environments. Scenario D focuses new growth around coastal locations and in low energy and vulnerable environments and is deemed to have the worst impact on marine values of all the scenarios. Even with best practice and mitigation of effects (which increases development costs) risks to marine receiving environments will increase in this scenario. For the full assessment of this criterion, see Attachment 1, Section 2.1.

## 7.4 Protection of or enhancement of stream corridors

Protection of, or enhancement to stream corridors aims to determine the degree to which land use scenarios avoid risks to areas of high stream-water quality.

The increase in impervious surfaces as a result of urbanisation, and the contaminant runoff from transport (increased kilometres travelled and speed) are considered some of the most relevant indicators of impact on stream corridors. The emphasis of the evaluation is on the extent of land urbanised as a proxy for increasing impervious surface area and associated increased levels of contaminant and sediment runoff into freshwater receiving environments.

## Evaluation

With a growing population, Auckland must ensure values for freshwater are upheld. The National Policy Statement for Freshwater (NPS: FW) states that we must “safeguard the life-supporting capacity of water and associated ecosystems; and sustain its potential to meet the reasonably foreseeable needs of future generations” (New Zealand Government, 2011). Implementing growth scenarios needs to give effect to the NPS: FW.

The four growth scenarios were assessed based on key spatial layers related to environmental quality and management areas. The evaluation of this criterion involved the assessment of each growth scenario on the following components:

### Current state of the land:

- land cover;
- surrounding land-use;
- current impervious surface;
- ecological state;
- ARP: ALWP management areas, and the presence of;
- lake and wetland catchments;
- current wetlands;
- lakes;
- high ecological value catchments; and
- bores.

### Threats of development to water:

- erosion risk to freshwater;
- consented stream works; and
- earthworks.

### Water based threats to development:

- flood-risk; and
- historical wetland.

In general, urban development has negative effects on surface water, stormwater and groundwater quality. Increasing impervious surface area and contaminant runoff has significant impacts on stream corridors. With further development planned in the Auckland region, these can be used as indicators to estimate the likely effects of proposals.

Current impervious surface cover is 42 per cent of the urban region<sup>28</sup>. All scenarios will lead to increased impervious surfaces, thus water quality is expected to decline and all scenarios score negatively. The effects of this decline can be minimised based on where the development takes place, and how it is undertaken. Best practice incorporating low impact design would reduce the negative impacts; however, they cannot be avoided altogether.

The pressure on urban streams in Scenarios A and C is likely to increase, although the impact is likely to be minimal as many urban streams are already in a degraded state. Mitigation techniques will be crucial to ensure further degradation does not occur. However, in high intensification developments, there will be further pressure to pipe urban streams, which would reduce the natural value of these waterways. Streams outside the existing urban area are protected under these scenarios, by not allowing development. The compact scenarios score the best.

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<sup>28</sup> Auckland Regional Council. (2010) State of the Environment report for the Auckland region.

Scenarios B and D also have impacts on freshwater environments within the current urban area, with likely increases in impervious surface area. Furthermore, they also provide additional growth in satellite and greenfield areas outside of the existing urban area. A number of good quality streams currently in rural areas are likely to be affected. Scenario B places limits on the proposed expansion, while D allows for extensive growth.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Protection of or enhancement of stream corridors</b>	<b>X</b>	<b>XXX</b>	<b>XX</b>	<b>XXX</b>

### *Conclusion*

Growth in the more expansive scenarios of D and B will affect new stream corridors, not already degraded by urban development. If growth could be avoided in areas with sensitive stream corridors the potential impacts may be lessened.

The compact scenarios of A and C generally avoid stream corridors identified as excellent or good quality with growth contained within the existing urban areas. However, adequate management and mitigation to stop further degradation in areas already impacted by urban development will be required as these areas undergo intensification.

Best practice would require greater investment in infrastructure to manage effects of stormwater, including Low Impact Urban Design. However, this would not avoid the significant adverse effects from land disturbance on stream corridors that would be considerable under the more expansive scenarios and less so in an already impacted urban environment under more compact scenarios. For the full assessment of this criterion, see Attachment 1, Section 2.2.

## 7.5 Identify, protect and enhance terrestrial ecosystems

Identify, protect and enhance terrestrial ecosystems aims to determine the degree to which land use scenarios avoid risks to significant natural areas.

Land use has a direct impact on terrestrial ecosystems through the encroachment of development and clearance of vegetation and habitat. The emphasis of this evaluation is on the likely risk that development will have on significant natural areas and whether they can be mitigated.

### *Evaluation*

The assessment of this criterion included the evaluation of the following measures for each of the urban form scenarios:

- Location relative to significant geological sites;
- Location and nature of development relative to outstanding natural landscapes;
- Location and impact of development relative to priority sites for management;
- Location & impact of development related to scheduled sites in council plans;
- Location and impact of development relative to threatened species habitats;

- Location, impact and nature of development relative to ecotones, sequences and corridors;
- Location of development relative to key community projects.

In general, urban development (intensification within existing urban areas and new greenfield development) have potential adverse effects on terrestrial ecosystems which include:

- Loss of ecosystem integrity and connectivity as ecological resources such as forest remnants, regenerating bush areas, wetlands, streams etc are modified, fragmented and/or degraded;
- Reduction in habitat size, quality and food sources for native fauna, particularly for fauna susceptible to noise disturbance;
- Increased predation of native fauna from domestic pets;
- Degradation of natural areas and geo preservation sites through increased public use;
- Decline in water quality and aquatic habitat values due to increased sediment, contaminant and nutrient inputs, and altered hydrological regime as stormwater peak flow rates change in response to increased impervious surface areas within catchments.

These effects are considered greater in areas that are not currently developed.

Areas of high ecological value are protected in every scenario but with more growth, the pressure on these areas will continue to increase.

The more compact growth approaches of Scenario A and C allow the protection of natural ecosystems and values located areas outside the existing urban area. However, there are natural features and ecosystems within the existing urban areas that require protection and enhancement as they face increasing pressure from urban intensification. These two scenarios score the best.

Scenario B locates significant growth in 'market attractive' locations. These areas are primarily 'attractive' due to their natural values and amenity, such as that of coastal, water and bush locations. Growth in these areas is likely to put pressure on these natural ecosystems and potentially result in their degradation. Sustainable development, large buffer zones areas and avoidance of some areas would be required in order to help mitigate potential impacts. Additionally, this scenario includes intensive greenfield and satellite centre growth with likely impacts on terrestrial ecosystems, however, the impact of this growth outside of the existing urban area will not be to the same extent as Scenario D.

The most expansive Scenario (D) presents the highest risks as many of these areas identified for growth are in close proximity to sensitive terrestrial environments of important native and coastal bush remnants and wetlands. Some of these areas include:

- The southern shores of the Manukau Harbour, which have significant ecological values for Maui dolphin and numerous international and local shorebirds. Development will affect water quality and, therefore, habitat quality for these birds. It will also remove roosting sites and increase predator pressure.
- The northern eastern beaches (Omaha expansion, Leigh expansion, Mahurangi East expansion); There are high biodiversity values including a marine reserve, several regional parks, islands, threatened plants and animals in these areas which are highly sensitive to pressure from development.
- The Hauraki Gulf Islands – these are not appropriate for further urban development, outside of the existing urban environments on Waiheke Island.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Identify, protect and enhance terrestrial ecosystems</b>	✓	XX	✓	XXX

### *Conclusion*

The compact scenarios perform better than the scenarios with growth beyond the existing urban areas (Scenarios B and D) because they avoid urbanisation of significant natural areas currently protected from intensive urban activities. In general, more intensive development of a smaller area, where known areas of ecological value are avoided (adequately buffered), is preferable to less intensive development over a larger area. This is assuming that there are adequate environmental controls in place to manage impacts of sediment, stormwater, wastewater, etc, for the proposed level of intensification. For the full assessment of this criterion, see Attachment 1, Section 2.3.

## 7.6 Avoidance of hazards

This criterion looks at the extent to which hazards can be avoided within areas identified for development. This relates to the exposure of people to hazards, particularly future sea level rise, storm surges, flooding, earthquake and land instability.

The coastal environment is particularly susceptible to natural hazards. Within the Auckland region the primary natural hazards arising from coastal processes include erosion, inundation of low lying areas, land instability, rising mean sea level and tsunamis. These natural hazards may occur individually, or combine to create a cumulatively more significant natural hazard.

### *Evaluation*

This evaluation examined a number of natural hazards in the Auckland Region (flooding, land instability, coastal erosion, coastal inundation, earthquake, volcanism and drought). When assessing the scenarios the level of risk posed by each of these hazards contributed to the overall score. The effects of climate change on some natural hazards were taken into account when assessing the level of risk. The greater the risk to people and property, the lower the score.

Significant areas of Auckland's urban and rural land are at risk to natural hazards which occur in varying severity, in location and in time. The most commonly occurring natural hazards in the region are flooding and land instability. The coastal environment is particularly susceptible to natural hazards. Within the Auckland Region the primary hazards arising from coastal processes include erosion, inundation of low lying areas, land instability and tsunamis. The least frequently occurring natural hazards include earthquakes, volcanism, tsunamis, various meteorological effects (cyclones, tornadoes, drought) and fire. While of regional significance these hazards are not easily dealt with through land use control strategies. Potential impacts are currently dealt with by contingency controls such as civil defence and insurance. Natural hazards act as an environmental constraint to the future development of the Auckland region and if future growth goals are to be met it is crucial that risk to people, development and infrastructure from natural hazards is reduced.

Natural hazards are difficult to control but land use activities that alter the existing environmental conditions can sometimes exacerbate the impact of events. An improved understanding of each type of hazard and its impacts, coupled with effective planning to avoid or mitigate their adverse effects, can reduce the risks to communities. Intensification of development within the current urban limits

will increase vulnerability, particularly for low frequency hazard events. For example, in an earthquake, high-rise buildings will be more vulnerable than low-level structures.

The compact scenarios (A and C) increase the risk of more people being exposed to existing hazards because development is concentrated within the existing urban area, however, the probability of a new or existing hazard threat is not likely to increase. Increasing density and infrastructure significantly increase the consequences of a hazard event, with smaller events causing greater consequences.

Expansion (Scenario D and to a lesser extent, Scenario B) will increase exposure of residential development and infrastructure to new hazard threats outside the existing urban area. However, risk will be dispersed as many hazards are localised events that will affect smaller populations. Increased coastal development means an increased number of people at risk from coastal hazards (ie coastal erosion and flooding). Low-lying eastern shorelines will be at risk of tsunamis, particularly if significant sea level rise occurs in the future. New developments allow for best practice mitigation techniques to be put in place to reduce risk from natural hazards. Expansion north of Auckland will increase risk due to increased exposure of people and property to land instability and coastal hazards. Expansion south of Auckland will increase risk due to increased exposure of people and property to earthquake hazards (liquefaction and fault rupture) and flooding in low-lying areas. Dispersion of people and property decreases vulnerability in regard to regionally significant infrastructure as it allows for greater spatial separation (increased redundancy capacity).

Due to the varying methods to assess hazards, the criteria were split into three in order to provide an accurate evaluation on the avoidance/exposure to new and existing hazards.

	<b>Scenario A</b>	<b>Scenario B</b>	<b>Scenario C</b>	<b>Scenario D</b>
<b>Avoidance of existing hazards</b>	<b>X</b>	<b>XX</b>	<b>X</b>	<b>XX</b>
<b>Avoidance of new hazards</b>	<b>0</b>	<b>X</b>	<b>0</b>	<b>XX</b>
<b>Exposure to existing hazards</b>	<b>XX</b>	<b>X</b>	<b>XX</b>	<b>X</b>

### *Conclusion*

The compact scenarios increase the risk of exposure to existing hazards within the current urban area. The risk of exposure to new hazards would increase in the scenarios with growth outside the current urban areas. However, benefits derived from an expansive urban form include that with the dispersion of people and property, there is a decrease in the vulnerability in regard to regionally significant infrastructure as it allows for greater spatial separation (increased redundancy capacity).

Extensive research on hazards and their risks should be undertaken and a long term management approach for hazards and their consequences needs to be implemented for new growth areas. For a full assessment see Attachment 1, Section 2.4.



## 8 Social Wellbeing Evaluation

Social wellbeing is defined by the Ministry of Social Development as “*those aspects of life that society collectively agrees are important for a person’s happiness, quality of life and welfare*”<sup>29</sup>. It also refers to the sense of belonging that affirms people’s dignity and identity and allows them to function in their everyday roles<sup>30</sup>.

The social wellbeing criteria focus on accessibility and housing as fundamental aspects of social wellbeing, in which access to housing, employment, retail, social infrastructure, health, education and physical activity is critical to improving Auckland’s social outcomes.

Providing greater housing choice is important for meeting housing demand, this reflects that people’s preferences for housing types and locations vary. By 2031, the average household size is projected to decline from 2.9 to 2.6<sup>31</sup> people per household. Among household types, the highest growth rate is projected to occur in one-person households and couples without children, mainly due to the ageing population. It is, therefore, important to provide greater housing choice for a growing population to enable people to have housing options that suit their lifestyles and preferences.

Accessibility is a fundamental criterion within the evaluation of social wellbeing, this is assessed through a number of criteria including: improved accessibility, accessibility for deprived households, accessibility to local employment opportunities and improved levels of physical activity. Improved accessibility is included as a social wellbeing criteria as it provides a measure of how the population is able to participate in society by accessing employment, services and facilities. Improved accessibility has many facets to consider including different transport modes available and different user groups with varying demographic profiles and needs. Accessibility has strong interconnections to other criteria that are part of the evaluation including those from the economic wellbeing.

The services and facilities that provide for social wellbeing are often referred to as social infrastructure, and are provided by a range of agencies including council, government and community groups. Provision of and accessibility to social infrastructure is important as it underpins social inclusion, participation and wellbeing. Under the Local Government Act 2002, councils are to consider the provision of education, housing, open spaces and other social infrastructure.

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<sup>29</sup> Ministry of Social Development. (2008) *Social Report*. As reported in Royal Commission on Auckland Governance, Volume 1, Part 3 Vision for Auckland.

<sup>30</sup> Royal Commission on Social Policy (1988) *The April Report* Royal Commission on Social Policy: Wellington.

<sup>31</sup> Statistics New Zealand Household Projections.

## 8.1 Summary

**Table 9 Social wellbeing scoring summary**

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Greater housing affordability</b>	0	0	0	X
<b>Greater housing affordability for deprived households</b>	✓	✓	✓	X
<b>Greater housing choice</b>	0	✓✓	✓	X
<b>Improved Accessibility</b>	✓	✓	✓	0
<b>Improved accessibility to deprived households</b>	0	0	0	X
<b>Improved Accessibility to Social Infrastructure</b>	X	0	X	XX
<b>Improved access to local employment opportunities</b>	0	0	0	XX
<b>Improved levels of physical activity</b>	✓✓	✓	✓	0

### *Conclusion*

The model outputs indicate that Scenario D has the least affordable housing of all the scenarios; this is emphasised further when transport costs are considered. In addition, Scenario D is more unaffordable for lower income households than for the region as a whole, with the 45 per cent benchmark for affordable living being exceeded. This reaffirms that lower income households are more vulnerable to increases in housing and transport costs. This suggests that the market demand for houses in an expansive scenario would not deliver affordable housing, particularly in desirable greenfield locations. This is reinforced by the more compact and intensive scenarios, A, B and C, having housing costs that are considerably lower than Scenario D, and also lower than at 2006, in the lower income zones.

Housing choice was seen to be the greatest in Scenario B, as it would provide a wide range of housing typologies in a wide range of locations including within the existing urban area and across a range of coastal and rural locations. However, it was noted that there is always a degree of choices provided by each scenario, as they do not necessarily foreclose other options. For example, Scenario A can still provide expansion and the housing choices provided by that option in future if necessary. Equally, Scenario D can intensify more within centres.

Accessibility was assessed through the three criterion: improved accessibility; improved accessibility for deprived households; and improved accessibility to local employment opportunities. For all these criteria accessibility for the more compact scenarios of A, B and C showed either improved or maintained existing 2006 levels of accessibility. However, Scenario D resulted in either decreased or maintained levels of accessibility (from 2006), but consistently, scored worse than the other three

scenarios. This shows that an urban form which takes a compact approach to growth results in improved accessibility.

Providing communities with good access to social infrastructure into the future is critical, and needs to occur regardless of urban form growth patterns. However, urban form can affect the accessibility, and ease of provision of social facilities. A compact scenario with intensive development may assist in providing efficient service delivery and provide thresholds to support specialist regional facilities. However, with a growing population, additional land may be required, and finding sites large enough for social facilities may be challenging in a compact urban form. Scenarios B and D, which allow for some development beyond the existing urban area, may allow opportunities for additional social infrastructure. However, the expansion allowed within Scenario D was seen to present issues of accessibility and acquiring high enough population thresholds for investment in infrastructure.

Improved opportunities for physical activity were found in Scenario A, B and C with higher active and PT mode shares than in 2006, indicating increased physical activity as part of daily travel routines into the future. Scenario A has the most significant increase in active mode shares. Scenario D did not have improved levels of physical activity. Additionally, Scenarios A, B and C (which have a higher share of short trips, less than 3 km), provide a stronger basis for increasing the percentage of active trips undertaken in future. These results shows likely benefits of a compact urban form on physical health within the Auckland region's communities.

For a number of criteria, urban form may only play a minor role, but can create the preconditions to enable activities that facilitate social wellbeing (accessibility to education, services, employment and suitable housing). However, greater benefits to social wellbeing are evident in a more compact urban form, whereas the most expansive urban form, Scenario D, failed to show any improvement across any of the criteria.

## 8.2 Greater housing affordability

This criterion measures changes in housing affordability for households compared with 2006. In this evaluation, housing affordability is viewed in the wider context of 'affordable living' which considers both housing and transport costs. The separate Auckland Plan housing workstream technical paper notes that households paying more than 30 per cent of household income on housing costs are considered to be living in unaffordable housing or to be experiencing housing stress. Furthermore the benchmark for affordable transport costs is 15 per cent, resulting in an overall 'affordable living benchmark' of 45 per cent<sup>32</sup>.

### *Evaluation*

The evaluation has considered rent costs (from the land use model) and transport costs (from the transport model). The rent costs are the costs of housing, while transport costs are those associated with homes within each model zone. These are presented for the region as a whole and then for the 20 per cent of zones with the lowest incomes; these lower income zones vary over time and between scenarios.

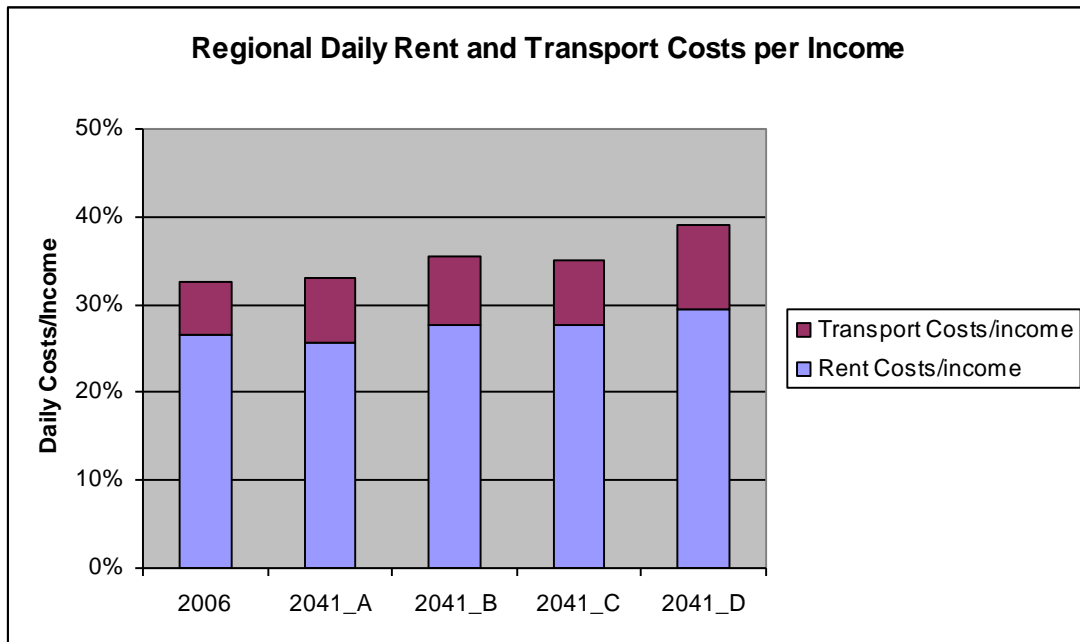
These costs have been considered in several ways: in total, in per capita terms and as a percentage of household income.

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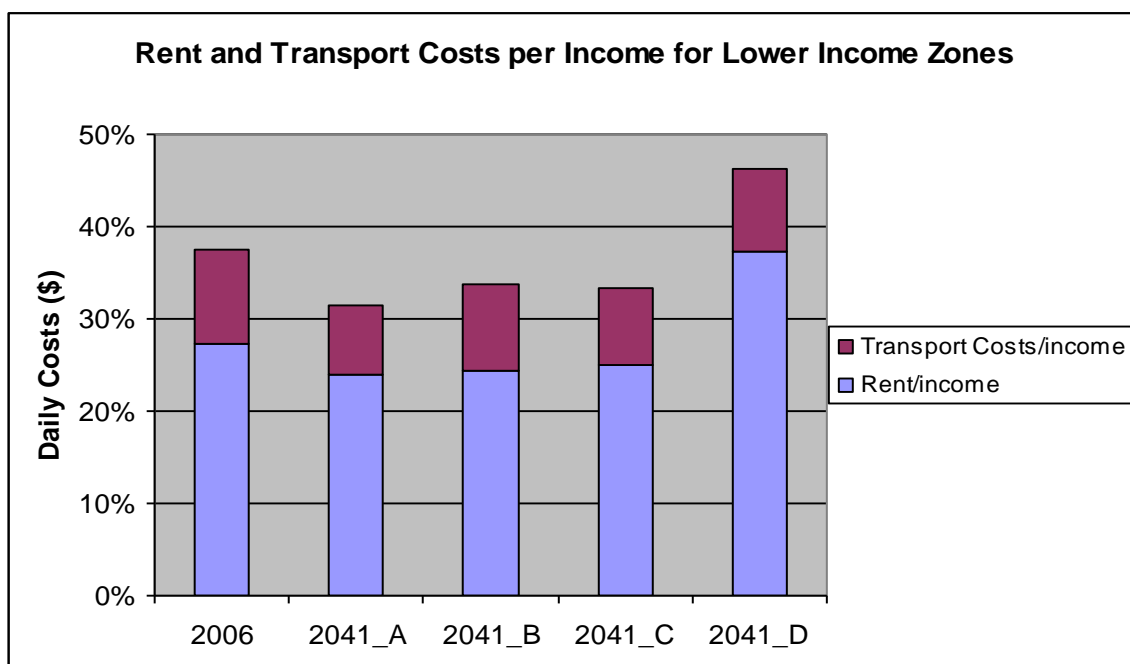
<sup>32</sup> Auckland Council. (2011) Technical Workstream Draft Auckland Plan: Housing.

Figure 33 presents the daily rent and transport costs for the region as a percentage of household income, and Figure 34 present the same measure for the 20 per cent of zones with lower incomes. The region-wide data shows that in 2041 combined rent and transport costs as a proportion of income are slightly higher for Scenarios A, B and C than in 2006 (33-36 per cent versus 32 per cent), and more so for Scenario D (39 per cent). For lower income zones, Figure 34, the proportions in 2041 are lower than in 2006 for Scenarios A, B and C, but is some 23 per cent higher for Scenario D. The other graphs produced for this criterion are given in Appendix 5 (Figures 107 to 112).

**Figure 33 Rents and transport costs as a percentage of income (region)**



**Figure 34 Rents and transport costs as a percentage of income (lower income zones)**



Two separate scores are given for this criterion, one for Auckland as a whole, the other for the most deprived households, defined in this case by the 20 per cent of zones with the lowest incomes. This is done in order to highlight the affect of the scenarios on low income households, which are most vulnerable to increases in housing and transport costs.

For the region as a whole, housing and transport costs combined in Scenarios A, B and C are similar to 2006 and, therefore, score neutrally. Scenario D costs are higher and therefore score negatively. None of the scenarios have housing costs greater than 30 per cent of income (although Scenario D is close at 29 per cent); neither does any scenario have housing and transport costs combined of over 45 per cent. It is noticeable that all scenarios show increased transport costs over 2006, this being greatest in the two most expansive scenarios, D and B.

For the lower income zones, the housing and transport costs combined in Scenarios A, B and C are lower than 2006, and therefore, these scenarios score positively. Scenario D costs are significantly higher and scores negatively. In this case the costs for Scenario D are not only greater than for the region as a whole, they are also greater than the 45 per cent benchmark for affordable living. In contrast to the data for the region as a whole, the travel costs for all scenarios are all less than at 2006, further highlighting the greater difference in housing costs.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Greater housing affordability</b>	0	0	0	X
<b>Greater housing affordability for deprived households</b>	✓	✓	✓	X

### *Conclusion*

The model outputs indicate that Scenario D has the least affordable housing of all the scenarios; this is emphasised further when transport costs are considered. Scenario D is more unaffordable for lower income households than for the region as a whole, with the 45 per cent benchmark for affordable living being breached. This reaffirms that these households are more vulnerable to increases in housing and transport costs.

While increased transport costs in a more expansive scenario may be expected, an increase in housing costs is perhaps counterintuitive. This suggests that the market demand for houses in an expansive scenario would not deliver affordable housing, particularly in desirable greenfield locations. This is reinforced by the more compact and intensive scenarios, A, B and C, having housing costs that are considerably lower than Scenario D, and also lower than at 2006, in the lower income zones.

While it is argued that constraining land supply for new homes may push up housing prices, intensification can reduce the land costs per unit (and possibly lower rents) and provide affordable options within centres that have good access to transport (lower transport costs). The affordability of new greenfield housing in an expansive scenario would be dependent on the quality and size of the housing and the rate of supply, it will also have higher transport costs with further distances to travel to work.

In considering the data presented above, it is important to note that there are many variables that will impact on future housing affordability and a number of these, including incomes, interest rates and the availability of credit are not related to land use.

### 8.3 Greater housing choice

Greater housing choice relates to whether or not a scenario would provide for a greater range of housing types than is currently the case.

The purpose of trying to provide greater housing choice is to better meet housing demand, reflecting that people's housing preferences for housing types and locations vary. It is important to provide greater housing choice for a growing population to enable people to have housing options that suit their lifestyles and preferences.

The emphasis of evaluation was on the range of housing types and locations available to choose from. It does not include affordability as this has been addressed in Section 8.2 Greater Housing Affordability, nor does it reflect that some people do not necessarily live in the type or location that they prefer.

#### *Evaluation*

This evaluation is based on qualitative research on housing demand to identify the mix of housing likely to be required for the future population, and assess this against the different scenarios. The model does not produce outputs that illustrate different types of housing, but allocates capacity in a range of locations. The two key pieces of evidence used in the evaluation are as follows:

- Future Land Use and Transport Planning Project: Future Housing Demand Study (ARC, 2010)
- Auckland Region Housing Market Assessment (Darroch, 2010)

Housing demand has been addressed through a number of recent research papers, all of which indicate that there will continue to be strong demand for detached housing. However, studies also indicate that in order to meet the demand for housing there will need to be a greater reliance on more multi-unit housing for a number of reasons<sup>33</sup>.

The ARC study (2010) on future housing demand illustrates how housing preferences have begun to change over the past ten years, with an increasing proportion of multi-unit dwellings being constructed. Part of this shift in housing preferences reflects changing demographics and decreasing household size, but also changing lifestyles and expectations.

Research shows that, in general, different types of housing suit people at different stages in their lives. Therefore people are likely to transition through different housing types; families with children will tend to favour detached housing; whereas singles and couples without children are more likely to choose to live in multi-unit housing. In addition, people will make trade-offs depending on what is most important to them, often resulting in a different type of housing.

Based on demographic projections and current housing preferences the ARC study identified the mix of housing types needed to meet future housing demand in the region (Table 10). A range is

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<sup>33</sup> Beacon Pathway Ltd. (2010) *The determinants of tenure and location choices for 20-40 year old households in the Auckland Region*. Centre for Housing Research Aotearoa New Zealand

DTZ New Zealand. (2005) *Housing Tenure Aspirations and Attainment*. A report for the Centre of Housing Research Aotearoa New Zealand, Wellington.

CHRANZ. (2006) Fact Sheet: Affordable Housing in New Zealand, prepared for the National Summit – Affordable Housing. Wellington.

illustrated to reflect that there may be a higher demand for multi-unit housing in the future than currently the case, as a result of increasing costs for fuel, energy, transport and infrastructure.

**Table 10 Mix of future housing stock**

Housing type	Proportion (2006)	Proportion (2051)	Additional dwellings
Detached	76	64-71	268,000 – 330,000
Low rise apartments (1-3 storeys)	22	27-29	149,000 – 172,000
Mid-high rise apartments (4 storeys +)	2	2-7	18,000 – 51,000

While it is acknowledged that demand will remain strong for detached housing, meeting future demand for multi-unit housing will require a significant shift in housing preference and provision. Further work is required to ensure that multi-unit housing provides the attributes of housing that people desire, and in appropriate locations to achieve the trade-offs necessary to make it attractive.

The Darroch housing assessment (2010) identifies 14 Housing Market Areas (HMAs) throughout the region and determines the existing capacity within these and the demand through to 2026 (see Attachment 1, Section 3.1). The study also considers the future demographics of these areas to determine the type of housing demand (detached versus multi-unit). A number of areas are identified through this research as running out of capacity by 2026, either of detached or multi-unit housing.

Scenario B's increased capacity would meet demand in over half of the HMAs, therefore, it is scored positively. These HMAs are also well located further improving housing choice. The expansive growth in Scenario B (both contiguous and in satellite towns) is easier under current policy settings and generally favoured by developers.

In contrast Scenario C has growth focused within the existing urban area and no additional capacity is provided in rural areas. Additional capacity for detached housing is provided through extensive infill within the existing urban area which is likely to meet people's desire for housing in these areas. Scenario C's increased capacity would meet demand in most of the HMAs, therefore, Scenario C scores positively for housing choice. However, the locations of housing would not be more widely dispersed in Scenario B and, therefore, Scenario C is not scored as positively as Scenario B.

In Scenario A the regional level housing choice would be increased, but it would be difficult to meet demand for detached housing in this scenario. Scenarios A's increased capacity would meet demand in half of the HMAs therefore it is scored neutrally for housing choice.

Scenario D has additional capacity focused in greenfield expansion in the rural areas. This development would be largely detached, but would need to also provide for multi-unit development around new centres and transport nodes. Scenario D's increased capacity meets demand in almost half of the HMAs, therefore, insufficient capacity is provided for over half of the HMAs. As such Scenario D is scored negatively.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Greater housing choice</b>	<b>0</b>	✓✓	✓	<b>X</b>

### *Conclusion*

In terms of greater housing choice, Scenario B is considered to perform best because its capacity would meet demand in over half of the HMAs and it also has the potential to provide the widest range of housing types in the widest range of locations.

However, the ability to provide greater housing choice may not meet the housing demands of the future population. Demographic changes are expected to see an increase in demand for smaller dwellings, especially attached housing. There will be a need for specific policy responses to ensure housing supply meets demand (including affordable housing).

Notwithstanding the scoring above, a degree of choice is provided by each scenario, they do not necessarily foreclose other options. For example, Scenario A can still provide expansion and the housing choices provided by that option in future if necessary. Equally, Scenario D can intensify more within centres.

## 8.4 Improved accessibility

The ability for people to move around the city easily, to access a wide range of services, is fundamental to achieving a fair and connected society.

Two measures of accessibility have been extracted from the ART3 model. The first is on the opportunities for travel, the statistics being the percentage and number of opportunities, for both PT and car, within 30 and 45 minutes of residential locations. The opportunities are:

- Employment opportunities - using employed persons and calculated for the AM peak period, when most commuting from home occurs,
- Retail and health opportunities - calculated for the interpeak period when these services are most likely to be accessed,
- Tertiary opportunities - using young adults and calculated for the AM peak.

The second accessibility measure is general accessibility measured as the generalised costs of travel, where generalised costs are the combination of monetary and time costs combined into a common unit (in this case minutes). Car costs include travel time, vehicle operating costs (fuel), parking and any tolls. PT generalised costs include in-vehicle, walk, wait and transfer times and fares. The measure is the trip-weighted average of car and PT generalised costs of travel in the AM peak and the interpeak periods.

The evaluation focused on employment and retail opportunities as these were seen as factors that would lead growth, whereas education and health were seen as activities that were more likely to follow development.

### *Evaluation*



Figure 35 and Figure 36 show the number of employment opportunities in the AM peak period within 30 and 45 minutes, by car and PT. They show that the number of opportunities increase over time initially, but then tend to remain constant or decline, depending on the scenario and the time threshold.

Scenarios A and C provide the most opportunities by car, with Scenario B slightly less; the differences between Scenarios A and C and Scenario B are greater under the 30 minute threshold. Scenario D provides the least number of opportunities by car and under the 45-minute threshold, this is less than in 2006.

Access to opportunities by PT are, as expected, much lower than by car, and increase over time in all scenarios. Scenarios A, B and C provide similar access to employment opportunities, while Scenario D gives noticeably lower access.

**Figure 35 Employment opportunities within 30 minutes by car and by PT**

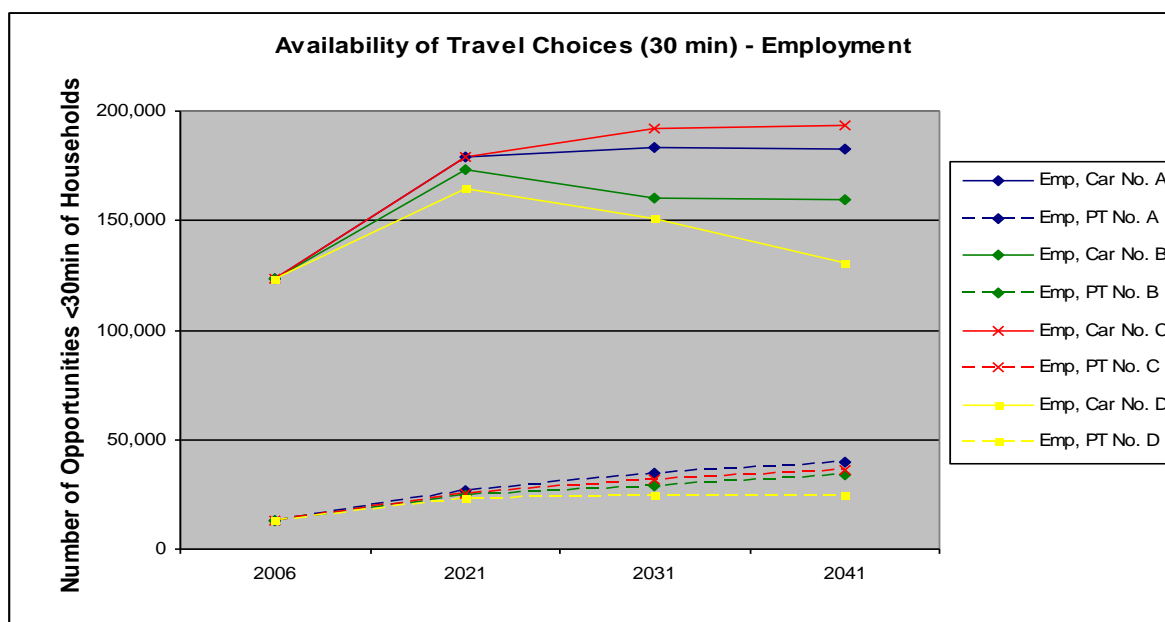


Figure 36 Employment opportunities within 45 minutes by car and by PT

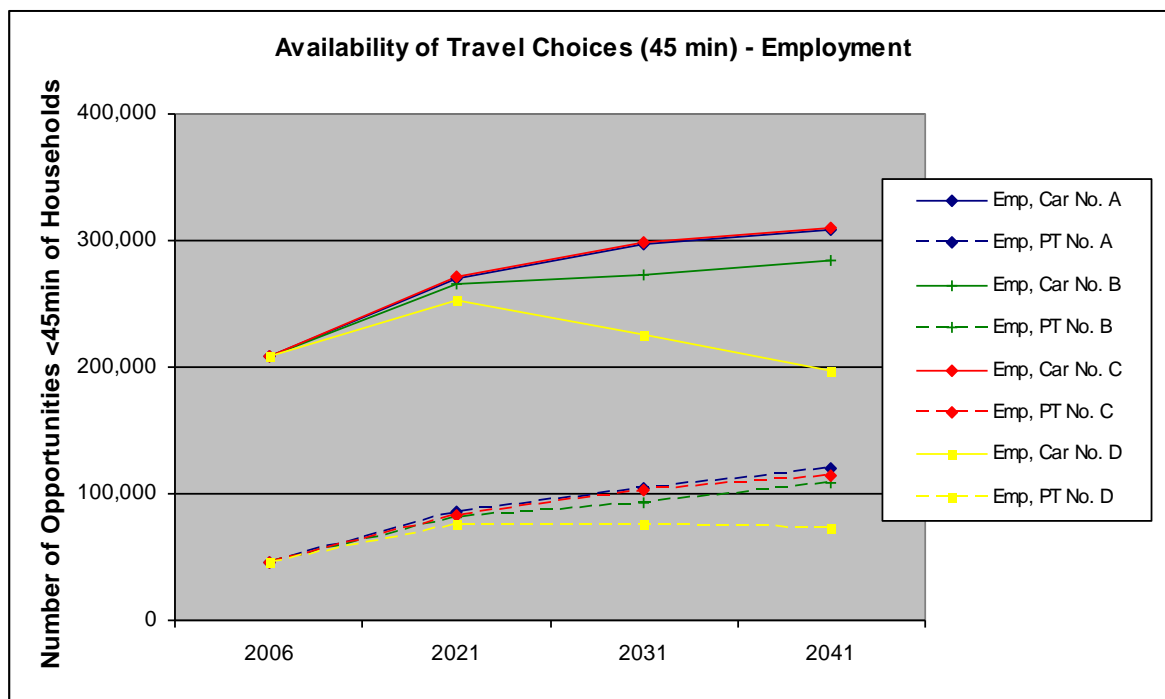


Figure 37 shows the number of retail opportunities in the interpeak period within 30 minutes by car and PT.

The scenarios all show an increase in the number of opportunities over 2006 levels, except for Scenario D by car – in this case the access to retail opportunities, the number opportunities within 30 minutes, is slightly lower than in 2006. Of the other scenarios, Scenario A has better accessibility by car than Scenarios B and C, and in all three there are only slight increases in the numbers of opportunities after 2021.

Accessibility by PT improves over time in all scenarios, and as with accessibility by car, Scenario A provides access to the most retail opportunities, with Scenarios B and C slightly less, and Scenario D the least.

Figure 37 Retail opportunities by car and PT – within 30 minutes



Information on accessibility to retail within 45 minutes, and regional health and tertiary education facilities within 30 and 45 minutes is contained in Appendix 5 (Figures 113 to 117). This data show similar trends to the above; that in 2041 Scenarios A, B and C have more opportunities than Scenario D, though the order of and difference between the first three can vary. The number of tertiary opportunities in 2041 is greater than in 2006 in all cases, while the number of health opportunities by car declines over time and by PT increases<sup>34</sup>.

Information on general accessibility as measured by weighted average car and PT generalised costs of travel are given in Appendix 5 (Figures 118 to 120). Car costs increase over time in all scenarios and in both the AM peak and the interpeak periods. Scenarios A, B and C have the lowest costs in 2041 and are relatively similar, while Scenario D has markedly higher costs. The average PT generalised costs also increase in the interpeak period, but not in the AM peak. Scenario D has higher PT costs in 2041 than the other scenarios, and more so in the interpeak.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Improved Accessibility</b>	✓	✓	✓	<b>0</b>

<sup>34</sup> It is important to note the scenarios did not include new tertiary or health facilities which is an unlikely occurrence into the future.

## Conclusion

Improved accessibility is an important criterion within the evaluation. It is included within social wellbeing as it provides a measure of how people are able to participate in society by accessing work, services and facilities. Improved accessibility has many facets to consider including different transport modes available and different user groups with varying demographic profiles and needs.

The criterion also has strong interconnections to other criteria. For instance, accessibility can be linked to improved physical health criterion local employment opportunities criteria, as well as economic wellbeing. Improving accessibility could improve the performance of other aspects of city life.

The evaluation points to the better performance of Scenarios A, B and C. All of which take a compact approach to growth (with some exception for Scenario B with growth in greenfield and satellite centres). While all scenarios show an increase in opportunities to employment and retail, scenario A, B and C provide the greatest increases. This will be related to both the urban form being more compact, with population located closer to jobs, and better accessibility, as shown by higher average vehicle speeds. The most expansive scenario, D, with its dispersed form clearly provides the lowest increase in accessibility. Additionally, when looking at accessibility to regional health facilities and tertiary education Scenario A, B and C show increased accessibility whereas for Scenario D the opportunities to access these facilities decreases over time indicating the effects of congestion in the more dispersed scenario.

In terms of generalised costs, all the scenarios show increases in car costs with the most significant cost increases being for the most expansive Scenario, D.

There are many policy initiatives that could complement an urban form that provides improved opportunities and costs for accessibility. Future policy initiatives may include new models that recognise the role of social infrastructure in shaping communities and places, require less land, co-locate facilities on one site, provide a greater degree of forward planning and incorporate better integration with PT infrastructure.

## 8.5 Improved accessibility for deprived households

This criterion is concerned with accessibility for households that are defined as deprived. Deprivation can be measured in a number of ways, the most robust snapshot being provided by the New Zealand Deprivation Index<sup>35</sup>.

Aside from urban form, accessibility for deprived households is dependent on a number of factors, such as availability of a private car, modal choice, trip times, affordability and user disability. Of these factors the availability of a good passenger transport system for these deprived households is a key factor as it provides travel options; an alternative to reliance on vehicle ownership. For these reasons PT accessibility was used as the evaluation measure for this criterion.

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<sup>35</sup> The New Zealand Deprivation Index reflects aspects of social and material deprivation. The index combines nine variables from the Census of Population and Dwellings, including income threshold and income source, employment, qualification, and family type. The index scale ranges from 1 to 10, where 1 represents the least deprived areas and 10 represents the most deprived areas. A value of 10 indicates that the area is in the most deprived 10 per cent of areas in New Zealand. It is important to note that deprivation scores apply to areas rather than individual people, and not all residents within a certain area will share the same characteristics in terms of deprivation. StatsNZ.

Map 9 below, shows the most deprived areas (Deprivation Index 8 to 10) from the Deprivation Index in 2006. This shows concentrations of deprivation particularly in the South West (Manukau), the outer isthmus and West (Waitakere). Those zones with the lowest average household incomes are illustrated in Map 10.

For the purposes of this exercise, low income has been used as a proxy for identifying deprived areas. This approach was chosen as the Deprivation Index is only able to give a snapshot and it is not possible to project how the spatial picture of this measure may change over the modelling period, whereas income is able to be forecast over the modelling period.

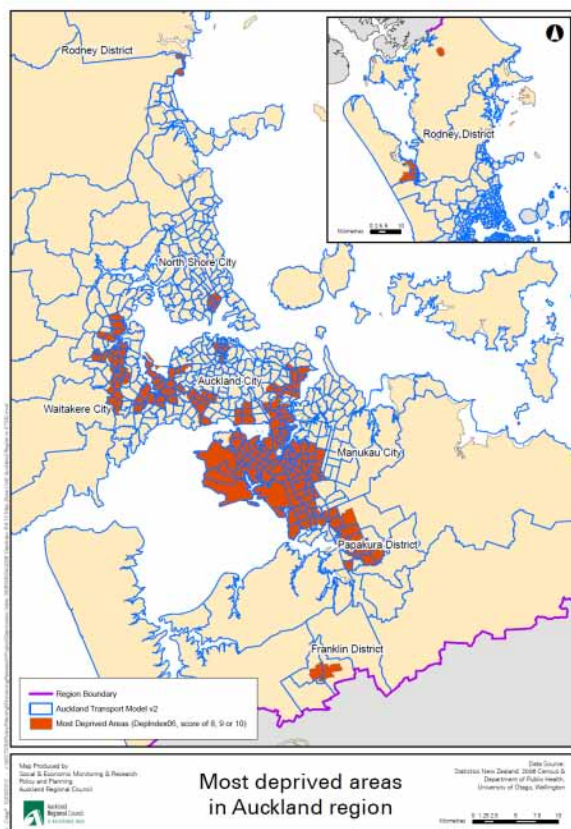
The specific proxy measure relating to income was:

- 30 per cent of zones with the lowest average household income, determined for each year and scenario.

PT accessibility is measured in terms of generalised cost which is time and monetary costs combined into a common unit (in this case minutes). For PT it includes in-vehicle, walk, wait and transfer times and fares.

The definition of “good” PT accessibility used in assessing access from and to these zones was the 33<sup>rd</sup> percentile level in the year and scenario being evaluated (ie the top one third in the forecast year). For comparison purposes, analysis was made of those households that did not fit the definition of deprived (ie the balance of households) to understand whether there were any differences in the way that accessibility improved or declined over the modelling period between the two groups.

**Map 9 Most deprived areas, deprivation index 2006**



**Map 10 Lower income households 2006**

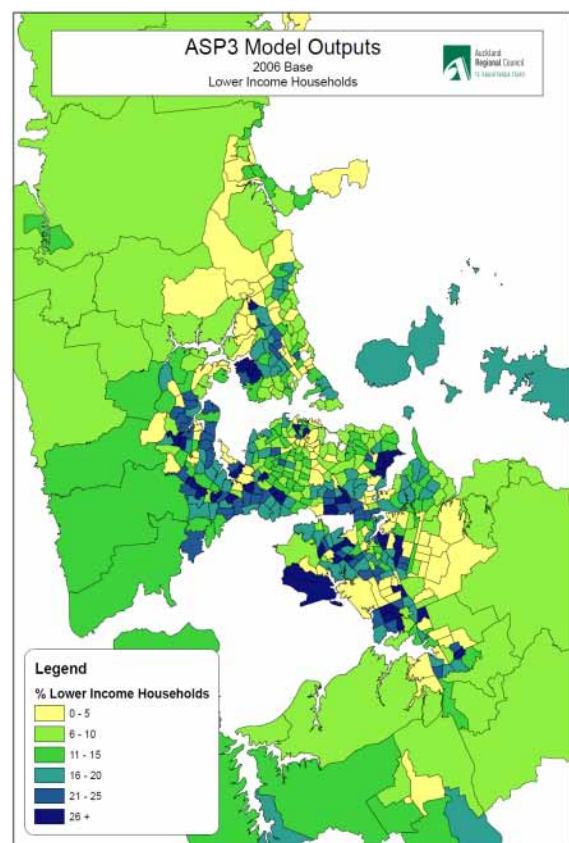


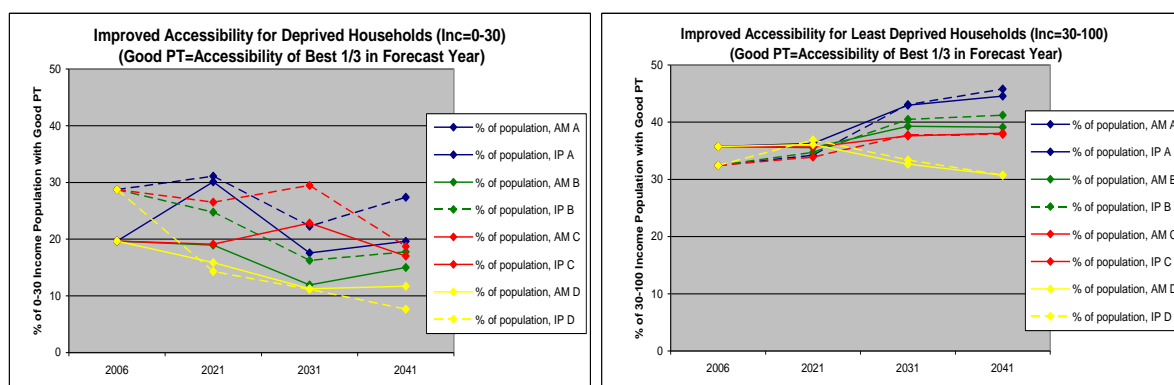
Figure 38 shows the percentage of deprived population with good PT accessibility, where:

- the deprived population is defined as the 30 per cent of zones with the lowest average income per household in the modelled year, and
- Good PT accessibility is defined as the 33<sup>rd</sup> percentile level of average zonal PT generalised costs in the modelled year and scenario being evaluated (ie the top third in the forecast year).

The data shows that the proportion of low income population with good PT access varies over time and between scenarios, though Scenario D has the lowest accessibility in each year and modelled period. By 2041 the accessibility is similar to or lower than in 2006 for all scenarios with Scenario A having the best accessibility in both the AM peak and the interpeak, followed by Scenario C, Scenario B and the Scenario D.

Comparing these results with those for least deprived households indicates that deprived households have lower accessibility to PT and that the accessibility for the least deprived households improves over time, apart from in Scenario D which declines slightly. This suggests that the improvements in PT in conjunction with the location of households have benefitted higher income households more than lower income households. From this it can be inferred that people who can afford to live close to good PT services will do so and this trend continues into the future.

**Figure 38 Accessibility for deprived households (lowest income in forecast year) with comparison information for least deprived households**



### Conclusion

For deprived households the two most compact scenarios, A and C have the best outcome for improved accessibility, while the most expansive scenario, D, had the worst.

While the issues relating to general accessibility, discussed in the previous section are relevant to deprived households, access to PT is particularly important for this group of the population as it provides an alternative to vehicle ownership and providing links to employment, education and community services that are essential within the region. There is also a correlation with other criteria within the social wellbeing outcome including local employment opportunities and improving physical activity.

The distribution of deprived households in 2041 has some uncertainty including housing for the elderly/ageing in place and the role that greenfield land may have in providing affordable housing.

Looking at the current pattern of areas with deprived households shows that many of the low income areas are relatively distant from the CBD. The strength of the larger centres and smaller centres, therefore, becomes very important for this group of the population.

Policy development that would improve general accessibility would also provide benefits to those within the deprived households definition. However, siting of facilities in association with growth centres and on PT routes would be particularly relevant. Local employment opportunities could also improve outcomes.

Safe, convenient, accessible passenger transport also requires attention to urban design of PT infrastructure, growth centres, business areas, residential areas and the location of community services and facilities to ensure that this group is able to engage fully in the community.

## 8.6 Improved accessibility to social infrastructure

The term “social infrastructure” covers a wide range of facilities and services that are provided by council, government and community groups to support and sustain the wellbeing of communities<sup>36</sup>.

Provision of, and investment in social infrastructure is essential to the health, wellbeing and economic prosperity of communities. It plays an important role in bringing people together, developing social capital<sup>37</sup>, maintaining quality of life, and developing the skills and resilience essential to strong communities.

### *Evaluation*

Social infrastructure refers to a system/network of facilities and associated services that people need to access in their day to day life. It includes schools, healthcare, shops, childcare and early education, emergency services, leisure recreation, open space, children’s playgrounds, community halls and libraries etc.

The previous sections’ discussion on improved accessibility serves as a proxy for accessibility to social infrastructure in the Auckland Region. Specifically, accessibility to health facilities (major hospitals) and tertiary education providers, of which it was found that the number of tertiary opportunities in 2041 was slightly greater than in 2006 in all cases, while the number of health opportunities by car declines over time, and by PT increases. However, this evaluation was undertaken where no new facilities are introduced into the model over time. In reality, new facilities are likely to be built as services are required to meet the demands of the increasing population and so this picture may be the worst case in terms of accessibility to social infrastructure. This evaluation will assess how different urban form growth options affect the provision of additional social infrastructure.

Regardless of the form of growth, additional social infrastructure will need to be provided to service the local community; however, urban form may influence the ease of provision for new facilities. Social infrastructure tends to follow development (there are some exceptions such as tertiary education providers), rather than shape it, as providers have to wait until they see the shape of the community in an area, before determining what services are required. It is not just about the numbers of people, but also their incomes, age, work status and ethnic make-up that determines

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<sup>36</sup> Social Infrastructure Planning Framework for Waitakere City, 2007. (2007) Waitakere City Council.

<sup>37</sup> Social capital is a concept that describes the resources available within a community that are used to support wider wellbeing goals

what services need to be provided<sup>38</sup>. Difficulties are subsequently encountered during growth planning, particularly in the identification and allocation of land for different land uses, and how much would be required for social infrastructure<sup>39</sup>.

The more compact scenarios of A and C are seen to work well from an accessibility perspective due to their intensive form and increased capacity allowing for co-location opportunities and public transport. However, depending on facilities or service needed, when it came to increasing capacity and provision of new facilities, these scenarios would present issues around acquiring appropriate land (location and size) under an intensive urban form. Scenario B and D both allow greenfield growth which presents opportunities for additional facilities. However, Scenario B takes a more intensive approach to growth (even in greenfield land) and allows increased opportunities for accessibility and critical capacity (population) for social infrastructure provisioning and funding. Scenario D's expansive growth is seen to hinder accessibility and restrict the ability to reach critical capacity numbers for investment in infrastructure, therefore was scored worst of all the scenarios.

Scoring is based upon a qualitative assessment of both general accessibility and capacity/provision of social infrastructure into the future.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Improved Accessibility to Social Infrastructure</b>	<b>X</b>	<b>0</b>	<b>X</b>	<b>XX</b>

### *Conclusion*

Provision of social infrastructure into the future is critical, regardless of urban form patterns, however, urban form can affect the accessibility, and ease of provision. A compact scenario with intensive development may assist in providing efficient service delivery and provide thresholds to support specialist regional facilities. However, with a growing population, additional land may be required, and finding sites large enough for social facilities may be challenging in a compact urban form. Scenarios B and D, which allow for some development beyond the existing urban area, may allow opportunities for additional social infrastructure. However, the expansion allowed within Scenario D was seen to present issues of accessibility and acquiring high enough population thresholds for investment in infrastructure.

## 8.7 Improved access to local employment opportunities

This criterion provides some understanding as to whether people are able to find employment close to home and how access (commuting distances) may vary across the region. This is taken as the average of car and PT distances weighted by the trips made in each case and are considered for the region as a whole and for four geographical sectors: north, west, central (isthmus) and south.

Two main measures have been used in the evaluation, one a more-detailed version of the other:

- the average commuting trip length for the region and by sector; and

<sup>38</sup> Auckland Council. (2011) Technical Workstream Draft Auckland Plan: Social Infrastructure.

<sup>39</sup> Social Infrastructure Planning Framework for Waitakere City, 2007. (2007) Waitakere City Council.



- commuting trip length distribution for the region and by sector.

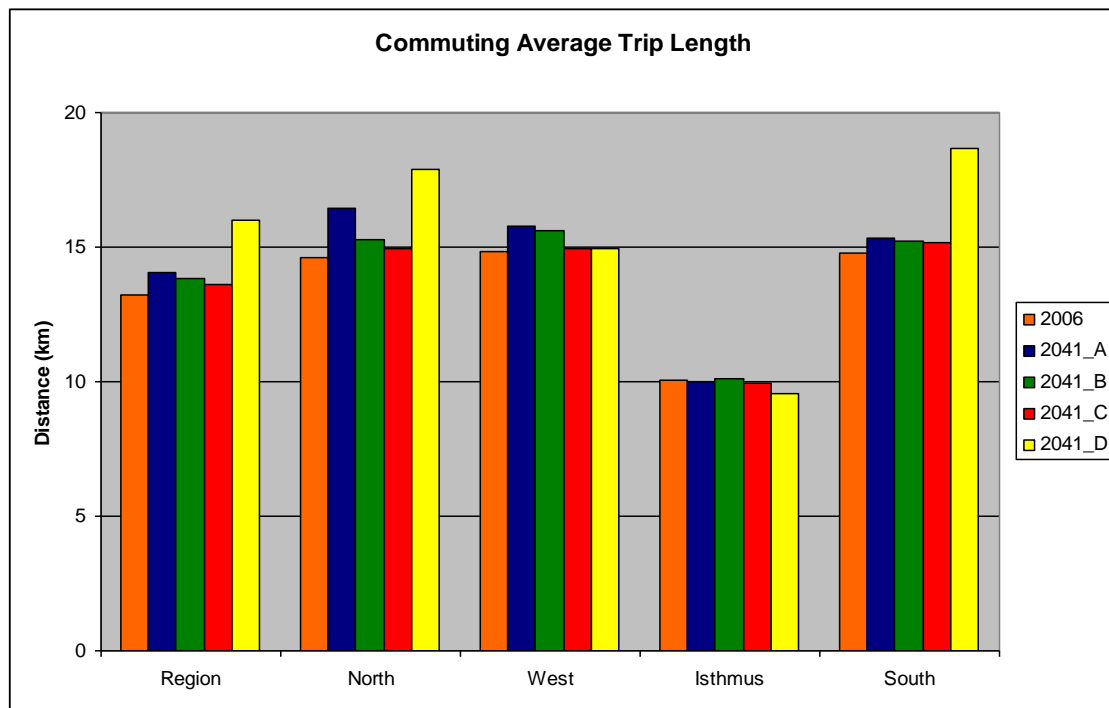
*Evaluation*

Figure 39 presents the average commuting distances in 2006 and the four scenarios in 2041 for the region and the four sectors. The average commuting<sup>40</sup> trip length for the region in 2006 is similar to those in Scenarios A, B and C at around 13-14km, and is longer for Scenario D (16km).

The average distances for each sector in Scenarios A, B and C in 2041 are also similar to those in 2006, except for Scenario A in the north sector which is longer by around 2km. Scenario D has longer average commuting trip distances in the north and south sectors which corresponds with the location of its expansive peripheral development.

The second measure for this criterion, the trip length distributions, are given in Appendix 5 (Figures 121 to 125). These show the higher proportions of longer commuting trips and lower proportions of shorter trips in Scenario D compared with 2006 and the other scenarios. These trends are evident for the region as a whole and also for trips originating in the north and south.

**Figure 39 Improved access to local employment opportunities - average commuting trip length by sector**



	Scenario A	Scenario B	Scenario C	Scenario D
<b>Improved access to local employment opportunities</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>XX</b>

<sup>40</sup> These commuting trips from home to work and back are referred to as home based work trips (HBW) within the model.

### *Conclusion*

Scenarios A, B and C predominantly maintain similar access to local employment opportunities as the 2006 baseline (except for scenario B north sector). However, the Scenario D produces longer commutes both regionally and for the north and south geographical sectors. These trends are consistent with the more compact scenarios consolidating growth in centres, thereby providing local employment and greater accessibility.

While agglomeration may have regional productivity advantages, relevant to economic wellbeing, access to opportunities for local employment is concerned with social wellbeing outcomes. Local employment provides residents with options; working closer to home means shorter commuting trips and the potential to access other facilities and services within the local area. It also may provide opportunities to make short trips by active modes, supporting improved physical activity (see Section 8.8).

In common with other accessibility related criteria effective integration of land use and transport planning, particularly the provision of PT, will be crucial to improving access to local employment opportunities.

## 8.8 Improved levels of physical activity

The potential to incorporate regular physical exercise into our daily lives is seen as an important way to maintain or improve physical health.

Data for two measures have been extracted from the model to evaluate this criterion:

- Share of trips by active modes (walking and cycling) and by PT.
- Share of vehicle trips which are less than three kilometres, as these trips are seen as having the potential to switch to walking and cycling, thereby, increasing the active mode share.

This criterion focuses on the ease of incorporating active transport modes into daily travel routines, for instance walking to work or school. It does not take into account the impact that the provision of recreation facilities and open space may have on physical activity opportunities, nor does it have any allowance for other factors that may influence the level of physical activity in a person's daily life including, social and cultural norms and trends, income and time availability.

### *Evaluation*

Figure 40 presents the shares of trips by active modes and by PT. The active mode share increases in Scenarios A, B and C, with Scenario A clearly having a greater share. This is related to the greater intensification in centres in Scenario A, which leads to more trips made by walking and cycling. Scenario D, on the other hand, has an active mode share similar to that in 2006.

The PT mode shares all increase from 2006 over time and in 2041 are similar for Scenarios A, B and C (8 per cent), and lower in Scenario D (7 per cent).

Figure 40 Share of trips by active modes

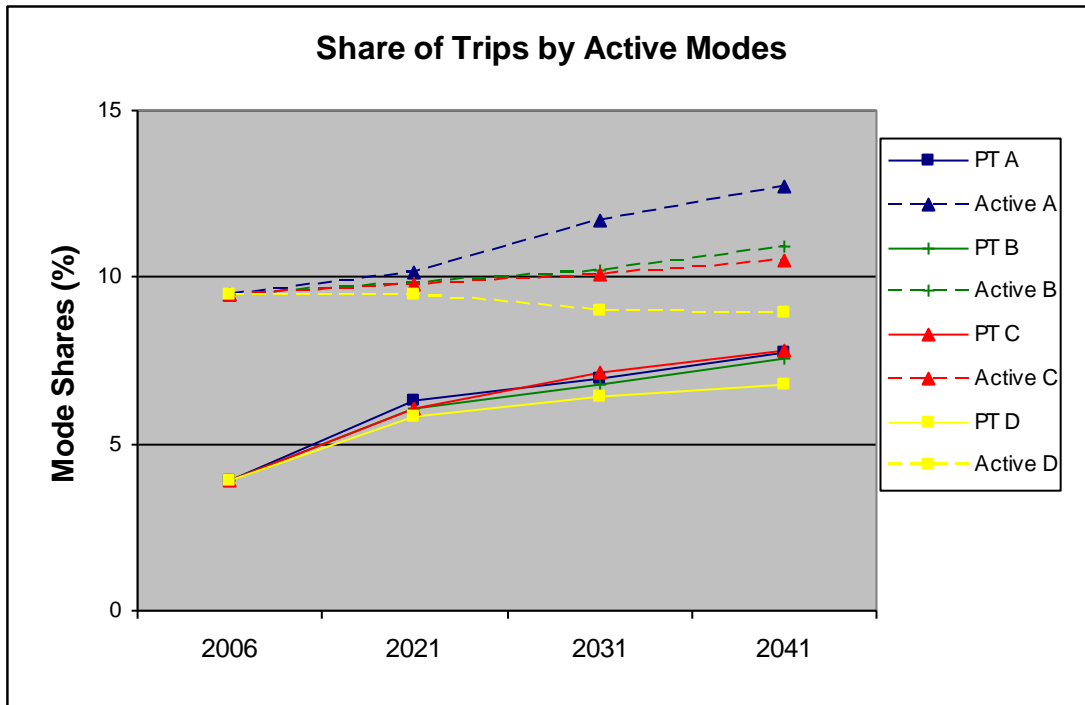


Figure 41 shows the share of short trips (less than three kilometres) by car and PT. The shares for Scenarios A, B and C are similar and all increase slightly from 2006, whereas that for Scenario D is lower in 2041 than both the other scenarios and the 2006 level. This indicates that Scenarios A, B and C have a greater potential for switching car and PT trips to active modes than Scenario D.

Figure 41 Improved levels of physical activity – share of trips shorter than 3 kilometres



	Scenario A	Scenario B	Scenario C	Scenario D
<b>Improved levels of physical activity</b>	✓✓	✓	✓	0

### Conclusion

All scenarios, except for Scenario D, gave higher active and PT mode shares than in 2006, indicating increased physical activity as part of daily travel routines into the future. Scenario A has the most significant increase in active mode shares. Additionally, Scenarios A, B and C (which have a higher share of short trips, less than 3 km), provide a stronger basis for increasing the percentage of active trips undertaken in the future.

Incorporating more physical activity into daily routines serves a number of purposes as well as potentially improving health outcomes it can also reduce the number vehicle trips thereby reducing energy use and congestion. These outcomes could be encouraged by complementary policy approaches. This criterion has some synergy with the accessibility criteria. In particular, the policy on development and siting of facilities and services (eg schools, health centres, community facilities) close to the communities they will serve could increase opportunities for making short trips by walking or cycle.

## 8.9 Improved air quality (impact on public health)

Improved air quality relates to the extent to which the population is exposed to harmful air emissions that affect public health.

The main sources of air contaminants in Auckland include motor vehicles and domestic fires. These sources emit contaminants such as, Nitrogen Dioxide (NO<sub>2</sub>), and Fine Particulates (PM<sub>10</sub> and PM<sub>2.5</sub>) and Volatile Organic Compounds (VOC). The RLTS's main target for protecting and promoting public health is to reduce the number of exceedences<sup>41</sup> of health standards for Nitrogen Oxide (NO<sub>x</sub>), and Particulates (PM<sub>10</sub> and PM<sub>2.5</sub>).

Air quality levels are currently degraded within the Auckland region and frequently do not meet regional particulate (PM<sub>10</sub> and PM<sub>2.5</sub>) and nitrogen dioxide (NO<sub>2</sub>) air quality targets in Auckland Council's Regional Plan: Air, Land, and Water. The National Environmental Standards for Air Quality (AQNES) for PM<sub>10</sub> and NO<sub>2</sub> are also regularly breached<sup>42</sup>. In addition, the annual average concentration of Auckland PM<sub>10</sub> has not reduced in the past few years.

As Auckland currently has a growing population, only a slowly declining emission profile, and little evidence of reducing concentrations in recent years, this potentially exposes a greater number of people to greater risk from air pollution. In addition, a greater population density can also increase the likelihood of reverse sensitivity due to incompatible activities being located adjacent to each other.

<sup>41</sup> Refers to exceedences of the National Environmental Standards.

<sup>42</sup> Note Ministry for the Environment (MfE) have indicated compliance with the standard will be a priority for the Minister

Evaluation of this criterion included both estimates of emissions from vehicles using model outputs and emissions rates, and a qualitative assessment by Auckland Council's Air Quality Team. The emphasis of scoring was on exposure to poor air quality of the greatest number of people.

### *Evaluation*

The quantitative assessment takes into account the changing vehicle emissions over time based on the four scenarios, but does not allow for other emissions sources such as industry and domestic sources. Model outputs and emission rates<sup>43</sup> are used to estimate daily vehicle emissions of volatile organic compounds (VOC), nitrogen oxide (NO<sub>x</sub>), and particulates (PM), both from tyres and brake wear, and from exhausts.

All the scenarios show significant improvements (ie declines) compared to 2006 in the quantity of emissions to air from vehicles by 2041 (Figure 42). Information on emissions by sector for the individual pollutants are given in Attachment 1 additionally, the Air Quality Team also provided expert feedback with the full report also able to be found in Attachment 1, Section 3.2.

The reductions in emissions are due to decreasing emissions rates over time as a result of technology improvements and the uptake of alternative fuels as well as some effect of reducing car mode share and improvements to the roading networks. There is one exception to this – tyre and brake wear particulates increase over time as the emission rate for these do not reduce but are assumed to remain constant.

The majority of the reductions in emissions occurs between 2006 and 2021, and after 2021 the reductions lessen and the emissions are close to constant between 2031 and 2041. Hence after 2021 the technology and network effects have lesser impact and the effects of population growth and increased vehicle travel predominate.

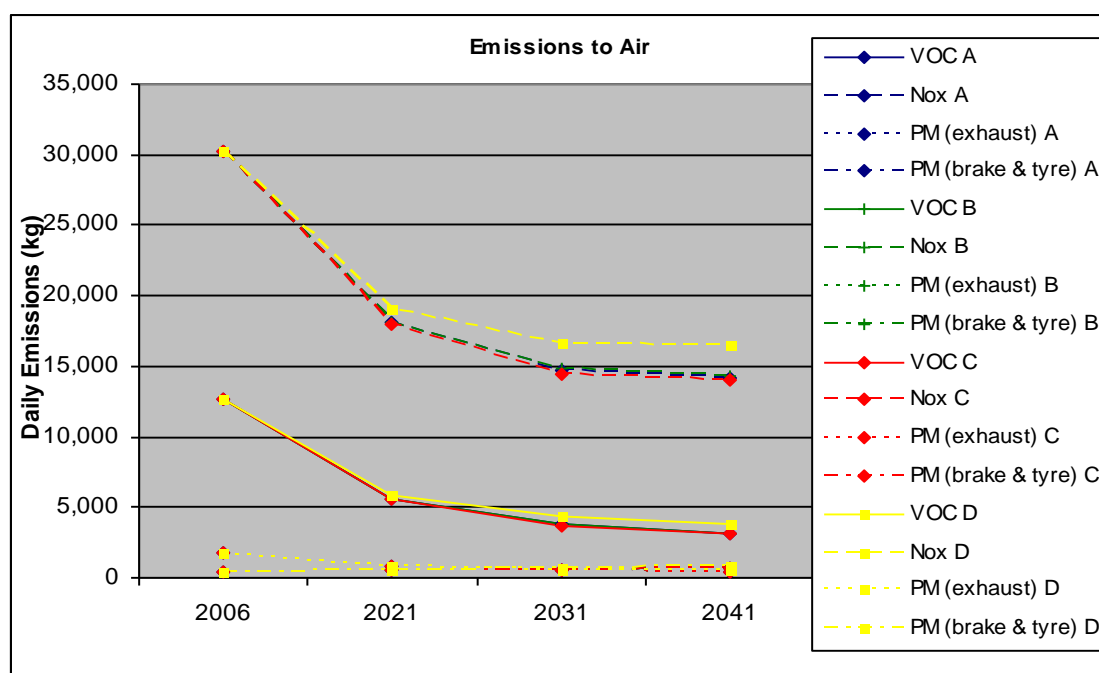
Scenario D is worse than the other scenarios in terms of total air emissions and fuel consumption/energy resilience terms. Scenario D would not be recommended as a suitable scenario from an air quality perspective in the long term as it has higher vehicle emissions, and greater increases in VKT and fuel use, with consequently decreased energy resilience, relative to other scenarios. A more dispersed city will also make it more difficult to further reduce transport emissions (in future) than a compact urban form. Scenario C may lead to localised air quality issues depending on the nature of activities established on the road corridors signalled for intensification.

While the emission estimates indicate that total pollutants generally are better than in 2006 (in 2041 for example), this does not take into account increased exposure by a larger population.

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<sup>43</sup> Emission rates are from Auckland Council's Vehicle Emissions Projections Model (VEPM v4.0), noting that as this version has just been released it is still a beta version. The emissions rates vary by speed and vehicle type (car, categories of heavy commercial vehicle) and fuel type (diesel, petrol), and decline over time to year 2040 to reflect improving technology, and are constant thereafter.

Figure 42 Emissions from vehicles



While modelling shows that all scenarios result in a reduction of emissions, further conversations with the Air Quality Team were held with regards to the scoring of each scenario. All scenarios were scored negatively, for two key reasons. Firstly, domestic home heating is a more significant source of particulate matter than transport (currently) and based on trends up until the 2006 census the emissions were reducing more slowly than transport. Secondly, despite the scenario modelling results, monitoring is showing that in fact there has been barely any change in annual concentrations of some of the pollutants (and some international and local experience is suggesting the emissions reductions from transport are not as good as the models predict). Therefore, based on the existing policies, it appears unlikely that there will be significant changes unless domestic heating emissions are reduced.

In addition, the reason that Scenario D was not scored more negatively than Scenarios A, B and C, even though emissions were consistently more is attributed to the fact that there is little difference in the transport emissions results. Furthermore, even though emissions are higher Scenario D, once these are distributed over the region the per area emissions are probably similar and thus the exposure is similar. The difference may then be down to exposure to domestic home heating emissions. A compact form is worse from an exposure perspective due to domestic home heating, but on balance, all the scenarios were similar.

	Scenario A	Scenario B	Scenario C	Scenario D
Improved air quality (impact on public health)	X	X	X	X

## *Conclusion*

Air pollution in some areas of the Auckland region is already exceeding acceptable levels for health and amenity. Contrary to the model outputs (for the whole region) the Air Quality Team considers it likely that exposure to poor air quality within the Auckland airshed may worsen as a result of population growth under the current policy framework. The NES for Ambient Air Quality and the Auckland Regional Air Quality Targets will not be achieved unless there are significant reductions in emissions from domestic fires and mobile sources (in particular motor vehicles).

While a range of initiatives may lessen the impacts of growth on the Auckland airshed, it will continue to be very difficult to obtain acceptable air quality at all times. The more expansive scenario, D, reduces the effect because people are dispersed to other areas, but modelling results show that there would be a higher level of total emissions from the transport sector due to the greater need to travel. A more dispersed city will also make it more difficult to further reduce transport emissions (in future) than a compact urban form.

## 8.10 Improved water quality (impact on public health)

This criterion relates to the extent to which scenarios reduce the ability to swim safely at bathing beaches and collect shellfish, due to water pollution.

This criterion was assessed on the scale of stormwater effects in terms of exposure to the greatest number of people. The focus of the evaluation was on the risk to human health of exposure to poor water quality (from contaminated stormwater run-off) at recreation bathing beaches, which could cause illness. The impacts on known shellfish collection areas were also considered.

### *Evaluation*

Population growth can lead to a large population gaining quality of life benefits from access to local beaches. However, increasing impervious surfaces and the impacts of development will mean that water quality will worsen for all scenarios compared with 2006.

All scenarios are scored negatively because of their increased impact on water quality within the Auckland region.

The more compact scenarios, A and C have the smallest region-wide extent of stormwater effects on water quality and the smallest level of effects on receiving environments not presently affected by stormwater runoff. This is because growth is concentrated within the existing urban area, with the smallest increase in impervious surface area/person (including roofs, roads, paved surfaces) and limited vacant site subdivision, resulting in the lowest sediment and chemical load per person. However, the maximum additional effect would occur on already affected urban streams and estuaries, with minimum options for mitigation due to limited land availability.

The main shellfish collection areas are outside the MUL new growth along the coast. Scenarios B and D provide additional growth outside of the existing urban area. Scenario B places limits on the proposed expansion, while D allows for extensive growth. These scenarios have the greatest region-wide spatial extent of stormwater effects on water quality and the greatest level of effects on receiving environments not presently affected. Impervious surface area per person (roofs, roads, paving) would be increased to the largest extent because of greenfield development in existing rural areas, resulting in the highest sediment and chemical loads per person. These scenarios are, therefore, scored the worst.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Water quality and human health</b>	<b>X</b>	<b>XXX</b>	<b>XX</b>	<b>XXX</b>

*Conclusion*

Due to the scale of growth, all scenarios increase the risk to human health of exposure to poor water quality from contaminated stormwater runoff at bathing beaches and shellfish collection areas. Scenarios A and C which represent a compact urban form will have additional effects on already affected urban streams and estuaries, but will have limited effect on receiving environments beyond the existing urban area. Conversely, Scenario B and D, which allow growth outside of the existing urban area will have the greatest region-wide spatial extent of stormwater effects on receiving environments, but some potential for mitigation in new areas.

The outcome for all scenarios is likely to be more to do with investment in infrastructure than urban form. Restricted use or closures to beaches may result in greater pressure on council to protect and improve beach amenity by investing in appropriate infrastructure.



## 9 Cultural Wellbeing Evaluation

Cultural wellbeing is defined by the Ministry for Culture and Heritage as being:

*“The vitality that communities and individuals enjoy through:*

- *participation in recreation, creative and cultural activities; and*
- *the freedom to retain, interpret and express their arts, history, heritage and traditions”<sup>44</sup>.*

This is prefaced on the basis that councils will have to identify what this means for their communities; for the purposes of this report six criteria have been used to evaluate this wellbeing. Four specifically Māori criteria have been identified: protection of Māori heritage and areas of cultural significance; enabling economic opportunities for Māori; promoting Māori culture and preserving the Mauri. The other criteria focus on the provision of open space and the protection of historic heritage.

Feedback has been sought from subject matter experts in the evaluation of the cultural wellbeing. Auckland Council’s Māori Policy and Strategy, and Built and Cultural Heritage Teams have provided scoring and background reports for the relevant criteria (refer to Attachment 1 for full reports). The open space criterion was assessed at a workshop involving relevant open space experts from within Auckland Council.

### 9.1 Summary

**Table 11 Cultural wellbeing scoring summary**

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Protection of Māori heritage and areas of cultural significance</b>	0	0	0	XX
<b>Enabling economic opportunities for Māori</b>	X	✓	✓	✓✓
<b>Promoting Māori culture</b>	0	X	XXX	X
<b>Preserving the Mauri</b>	✓	X	XXX	XX
<b>Provision of open space</b>	✓✓	✓	XX	XXX
<b>Protection of historic heritage</b>	X	XX	✓	XXX

#### *Conclusion*

The impacts of the different scenarios on specifically tangata whenua values are difficult to quantify. It will be important for Auckland Council and Māori to have an on-going dialogue at all levels of planning from strategic to local, to ensure that the effects of different growth scenarios on the

<sup>44</sup> Te Manatu Taonga Ministry for Culture and Heritage. (no date) *Cultural Wellbeing - What is it?* [online] <http://www.culturalwellbeing.govt.nz/what-cultural-well-being>.

aspirations of Māori are understood. In evaluating the potential impact of the scenarios on Māori, it is important to consider a number of key points which have been applied to the evaluation of each criterion, namely:

- Māori are an important part of the social fabric of the region and it is important these values are given priority.
- Māori values range from iwi-to-iwi and region to region. There is no one way to categorise Māori values nor is it useful to put blanket concepts across Māori.
- Māori society is ever-changing and there are a number of factors that influence Māori values. Understanding these potential catalysts for change will help to ensure that we continue to move with the needs of Māori and the wider region.
- Assessing the impact on Māori values requires an ongoing working relationship with Māori at all stages of the planning process.
- Māori values span social, cultural, economic and environmental well-beings and must be considered in a holistic manner.
- Issues that pertain to Mana Whenua cannot be assessed at a regional level. Mana Whenua are very local and these issues must be given due consideration despite the regional impact.

Large centres and a compact urban form (as of Scenario A, B and C) allow greater opportunities for open space provision from an investment and comprehensive planning perspective, this is due to the ability to target resources where required. However, dispersed centres and infill growth in Scenario C would not allow the concentration of planning and investment required to achieve the required open space provision. The expansive scenario, D, while allowing greater opportunities for new open space areas (in greenfields) this would come at a cost to existing open space values of Auckland's rural and natural landscapes. It was seen that, central to meeting the challenge of protecting, securing and extending our open space network over the coming decades, it is essential that we have a well co-ordinated and planned open space network that expands with our growing population.

All scenarios present risks and opportunities in the protection of built heritage values. Intensification and infill in Scenarios A, B and C increase risks for built heritage through redevelopment within the existing urban area, this is of particular concern for Scenario B where intensification of high amenity areas (which are often areas of cultural and heritage significance) may result in pressure or even loss of these values due to urban development. In contrast Scenarios B and D pose risks to landscape amenity, archaeological sites and wāhi tapu with their expansion into greenfield areas. Additionally, the tendency for major arts, cultural, recreational, and to a lesser extent religious facilities, to locate in central areas could lead to capacity constraints and competition in an intensive urban environment, while in a dispersed urban form, accessibility issues may arise.

## 9.2 Protection of Māori heritage and areas of cultural significance

This criterion focuses on preventing further loss and the desecration of Māori heritage and areas of cultural significance to Māori including wāhi tapu. There is no one way to promote the protection of these areas eg protection of these areas does not just mean conservation or not developing but can include policies which promote the enhancement and appropriate use of these areas.

A key method for ensuring protection or the appropriate use of these areas is to embed Māori in the decision-making process that concerns the management of these areas. Such involvement will also

enable Māori to identify where, in a generic sense; these areas are and development appropriate management or co-governance mechanisms.

Given this and the key starting points for a regional spatial assessment, the basic application of this criterion is to assume that where there are new areas of proposed development, the likely impact on Māori heritage and areas of cultural significance increases. See Attachment 1, Section 4.2.

	<b>Scenario A</b>	<b>Scenario B</b>	<b>Scenario C</b>	<b>Scenario D</b>
<b>Protection of Māori heritage and areas of cultural significance</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>XX</b>

### 9.3 Enabling economic opportunities for Māori

This criterion focuses on using space in a way that encourages economic opportunities for Māori. Again there are a number of policy matters that can contribute to achieving this and is not limited to the availability of industrial or business areas. It can include but not limited to:

- provision of infrastructure to rural areas such as broadband;
- re-designation of reserves set aside for Māori purposes to multi-purpose.
- reviewing the rates remission policy on Māori Freehold Land to release economic potential
- targeted funding to support community driven projects that promote training and education
- creation of appropriate decision making frameworks concerning areas of Māori interests

When considering Māori economic opportunities it is important to understand the drivers behind why Māori choose to live in particular areas. The skill set that Māori have can often dictate where Māori will settle, traditionally this has been industrial and manual labour industries. However with the changing skill set of Māori and the opportunity to enter into other areas of labour, more industrial/business zones does not necessarily achieve the enabling of economic opportunities for Māori.

An important issue that will significantly shift Māori economic development will be the outcomes from Treaty settlements and the increasing ability for iwi to realise their commercial aspirations. Some of these Treaty settlement negotiations have clearly identified areas of commercial redress. Planning strategies that restrict residential development in tribal areas, due to their pristine and rural character, can often limit the opportunity for Māori economic development.

Given this and the key starting points for a regional spatial assessment, this criterion is applied by identifying the nature of development in areas of high Māori population and enabling greater economic opportunity in areas ring fenced for commercial redress. In assessing the nature of development in areas of high Māori population, it assumes that with increased development comes an increased opportunity for employment and business. See Attachment 1, Section 4.2.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Enabling economic opportunities for Māori</b>	X	✓	✓	✓✓

## 9.4 Promoting Māori culture

This criterion focuses on how the scenarios encourage and enhance access for Māori to resources to maintain their cultural practices.

For Mataawaka (Māori who are not Mana Whenua) in Auckland, this can include access to places such as marae, Māori services and resources used for traditional practices such as rongoa (medicine) or weaving. This can be supported through appropriate policies and is not solely reliant upon the way in which Auckland is configured. It is however important to consider the way in which new or existing town centres are developed to provide for those communities.

For Mana Whenua this criterion explores the way in which greater access to coastal areas or areas of traditional practice eg marae, rivers and Māori land is encouraged. In terms of the scenarios, the assumption is that with more development, there is greater infrastructure support and amenity value thus providing greater and easier access to these areas. For example, better transport networks to rural marae or better access to coastal areas where Māori would collect kaimoana.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Promoting Māori culture</b>	0	X	XXX	X

## 9.5 Preserving the Mauri

This criterion focuses on how each scenario impacts on the environment. This encompasses many of the resource management aspects including impacts on air, land and water from a Māori perspective. Mauri can be described as the essence or the natural state generated from the “life-force”. Mauri also denotes preservation of a state and that to maintain it, only certain activities may occur. Discharging waste into a clean water source will destroy its “mauri”, so there should be actions to ensure that the natural state of the water is preserved.

The assumption here is that encouragement of access to less developed areas and intensifying existing town centres places pressure on the resources of that area and consequently has negative impacts on the Mauri of those resources. See Attachment 1, Section 4.2.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Preserving the Mauri</b>	✓	X	XXX	XX

## 9.6 Provision of open space

Open space plays an important role in the Auckland region. It provides a place to exercise; a place for formal and informal interaction; serves important natural and cultural heritage functions; and is an important catalyst for economic development, raising property values and bringing life and activity into neighbourhoods<sup>45</sup>.

Open space can be divided into three categories:

*Green Spaces* – The land areas that are largely covered in vegetation, including parks, conservation land, cemeteries and margins of water bodies. These areas are predominantly for recreation, visual amenity, protection of biodiversity and cultural heritage.

*Blue Spaces* – Are surface water bodies or waterways occurring on the surface of the land, such as lakes, rivers and streams. Public land adjoining or providing access to beaches is also included. These areas are predominantly for providing recreation, visual amenity, and protection for biodiversity and cultural heritage.

*Grey Spaces* – Primarily refers to the street network. In addition to its primary transportation function, it also provides for passive recreation, amenity, potential connectivity between parks and other civic features, as well as area for exercise<sup>46</sup>.

### *Evaluation*

The scenarios were assessed against the criterion in a workshop involving relevant open space experts. The scenarios were assessed against how they would protect, secure and extend open space networks in the Auckland region.

Scenario A focuses large amounts of growth within major centres. Intensive centres allows for redevelopment opportunities incorporating open space and the concentration of open space investment allowing detailed and targeted planning. In a more intensive urban environment, open space needs to be considered more creatively and accessibility to open space needs to improve. A number of elements need to be considered in a compact and intensive urban form:

- More intensive use of open space, ie we need to make better use of our existing open space (shared use) ;
- More partnerships (eg schools using public parks rather than designated open space of their own, or between council and developers);
- Connecting existing open space networks through strategic acquisitions/easements/covenants to improve functionality as ecological and recreational/commuting corridors;
- Urban squares;
- Roof top provision;

However, a number of difficulties reside in a compact urban form, which includes difficulties in reclaiming, or 'retro fitting' open space, and pressure to develop existing open space. A compact urban form presents the greatest opportunity to protect existing rural and natural (eg Regional Parks) from urban development and ensuring their open space qualities are retained.

Scenario B also provides for significant growth within major centres, which presents similar benefits to those described above. In addition, growth in satellite centres (assuming these are also compact

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<sup>45</sup> Auckland City Open Space Framework 'Our Collective Taonga: Places for People, Places for Nature', 2008. (2008) Auckland City Council.

<sup>46</sup> Auckland Regional Council 2005. *Auckland Regional Open space Strategy*. Page 4

centres) will take pressure off the CBD and other high density areas. Rural towns currently have good rural amenity; growth in them would allow and require provision of more parks within these towns. Development in high amenity coastal areas provides the potential for comprehensive redevelopment, which if done well can provide good open space amenity and help to build on the coastal identity of Auckland. However, there is the danger of altering the character of these areas where comprehensive development plans will be essential.

Scenario C allows no growth outside the existing MUL, the same as Scenario A, however, the key distinction is the focus on many smaller centres (rather than fewer larger centres) and the dispersed infill pattern to accommodate growth. From an open space perspective, this scenario was seen as the least likely to get a comprehensive redevelopment and would likely encourage piecemeal development and dispersed investment not conducive to creating good open space.

The most expansive scenario, D, would present the best opportunity to create new urban open space areas in greenfield areas. However, this is likely to come at a loss to intrinsic values of the landscape through urbanisation. There will be significant detrimental impacts on the Hauraki Gulf and existing open space areas outside of the MUL, including Regional Parks. This scenario is seen as the least likely to protect, secure and extend open space networks in the Auckland region.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Provision of Open Space</b>	✓✓	✓	XX	XXX

### *Conclusion*

Large centres and a compact urban form allow greater opportunities for open space provision from an investment and comprehensive planning perspective, this is due to the ability to target resources where required. However, dispersed centres and infill growth in Scenario C would not allow the concentration of planning and investment required to achieve the required open space provision. The expansive scenario, D, while allowing greater opportunities for new open space areas (in greenfields) this would come at a cost to existing open space values of Auckland’s rural and natural landscapes.

In order to meet this challenge and the many other challenges involved in protecting, securing and extending our open space network over the coming decades, it is essential that we have a well co-ordinated and planned open space network that expands with our growing population.

## 9.7 Protection of historic heritage

Historic heritage is important as a foundation for the region’s identity and character. Preserving and protecting it enables appreciation and enjoyment by future generations.

Historic heritage is defined by the Resource Management Act 1991 (RMA) as being natural and physical resources that contribute to an understanding and appreciation of New Zealand’s history and cultures, deriving from any of the following qualities: archaeological, architectural, cultural, historic, scientific and technological. This includes places of historic heritage such as historic sites, structures, places, and areas, archaeological sites, sites of significance to Māori, including wāhi tapu; and surroundings associated with these resources.

Auckland has an ongoing decline in historic heritage values coupled with a general lack of information and survey across the region. Development, including redevelopment, can often be

viewed to be in conflict with historic heritage values and, to date, the opportunities for historic heritage to add to developments are often not realised. There is however, increasing community concern over the loss of historic heritage.

### *Evaluation*

The evaluation was undertaken by Auckland Council’s Built and Cultural Heritage Team (see Attachment 1, Section 4.2 for full feedback) by examining the location of proposed areas for growth and impact of development relative to places and areas of significant historic heritage value and significant sites scheduled in Auckland Council plans.

The evaluation shows that different growth responses can affect historic heritage in different ways. In Scenarios A and B intensification of centres may present risks to built heritage. Careful zoning and attention to design would be needed to avoid, remedy or mitigate conflicts between intensification and built heritage and heritage character in some proposed growth centres notably Ponsonby, Grey Lynn, Devonport, Northcote, Onehunga and Helensville.

Scenario C, which also includes growth in centres (although to a lesser extent than in Scenarios A and B) and an allowance for widespread infill and redevelopment, could result in conflicts between intensification and the preservation and protection of heritage in residential heritage suburbs such as those identified above. However, these are already protected for their historic heritage values, therefore, growth will be constrained and, in some places, unachievable without compromising existing historic heritage values.

Scenario B identifies areas of high amenity as market attractive. When the market attractive areas are based on natural amenity, particularly the coast, water/rivers, ridgeline or elevations, there is greater likelihood of affecting areas of historic heritage. Based on archaeological site location modelling, can however be anticipated in some areas, particularly areas within approximately 500m of the coast or navigable waterways with a low level of current development.

For Scenario D, and to a lesser extent Scenario B, expansion into greenfield areas it was highlighted that current historic heritage survey coverage in these areas is inadequate to provide a basis for detailed assessment. The potential presence of significant numbers of archaeological sites in some expansion areas would contribute to compliance costs and avoidance of such sites may limit density

	<b>Scenario A</b>	<b>Scenario B</b>	<b>Scenario C</b>	<b>Scenario D</b>
<b>Protection of historic heritage</b>	<b>X</b>	<b>XX</b>	<b>✓</b>	<b>XXX</b>

### *Conclusion*

All scenarios present risks to the protection of the region’s historic heritage, with the risks for each of the scenarios focusing on different aspects of historic heritage. Scenarios A and B have the potential to affect built heritage as part of the intensification of the urban area, particularly growth centres. In contrast Scenarios B and D pose risks to archaeological sites and wāhi tapu with their expansion into greenfield areas. The evaluation indicates that these risks will have to be managed by best practice, avoidance and mitigation. However, mitigation of adverse effects on heritage has the potential to lower development densities that are able to be achieved.

Due to the lack of heritage survey coverage in rural areas, expansion into greenfield areas is considered a greater risk than that presented by intensification in centres. Scenario C which has no additional greenfield growth and less intensification in centres, therefore, scores positively.

# 10 Implementation Evaluation

The evaluation of economic, environmental, social and cultural wellbeing criteria provides a comprehensive assessment of the costs and benefits associated with the spatial form and transport networks in each scenario. However, in addition to this, it is important to evaluate the feasibility of the scenarios from an implementation perspective.

Feedback was sought from market commentators and infrastructure providers and is summarised in the following sections. It is important to note that the feasibility of implementation for each scenario is based on current experience, current available mechanisms and market demands, therefore, changes may occur in the future that affect how implementable each scenario might be. The minimised infrastructure costs criterion has been broken down into a series of sub-criteria to reflect the diversity of feedback received from different infrastructure providers. Feedback was also obtained from Auckland Council’s Area Spatial Planning Team on the feasibility of the development capacity numbers allotted to various locations in the scenarios, based on current plans. An important assumption underpinning each scenario is that current land use plans will need to change to accommodate growth. It was not possible to score this feedback but a summary is included and the full feedback can be seen in Attachment 1.

## 10.1 Summary

**Table 12 Implementation scoring summary**

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Market Feasibility</b>	XXX	✓✓	XXX	✓✓
<b>Minimised infrastructure costs (Transport)</b>	0	XX	XX	XX
<b>Minimised infrastructure costs (Wastewater)</b>	0	XX	X	XXX
<b>Minimised infrastructure costs (Water Supply)</b>	0	X	XX	XXX
<b>Minimised infrastructure costs (Stormwater)</b>	0	X	XX	XXX
<b>Minimised infrastructure costs (Energy – Electricity Supply)</b>	0	X	X	XX
<b>Minimised infrastructure costs (Broadband)</b>	0	X	XX	XX
<b>Minimised infrastructure costs (Education)</b>	X	✓✓	✓✓	XX

### *Conclusion*

Market commentators expressed a clear preference for future allowance of significant amounts of greenfield land as it was seen to provide the closest to a business as usual approach and is most familiar to both developers and the market, it was therefore seen as the most profitable and



feasible solution. However there was also support for growth in satellite towns and intensification options in appropriate market attractive areas. Retaining all future growth within the existing urban footprint was not supported nor seen as feasible.

Capital and operational expenditure for transport projects in each of the scenarios were calculated to provide a relative comparison of the scenarios. When comparing scenarios, Scenario A (\$36.8b) has the lowest estimated cost. Scenarios B (\$45b), C (\$43.7b) and D (\$44.7b) have similar total costs, and while Scenarios B and C perform similarly to Scenario A in terms of accessibility outcomes, Scenario A's total cost of is \$6.9b lower than the next lowest scenario. This significantly lower cost is attributable to Scenario A not including an additional Waitemata Harbour crossing (road or rail) within its transport network. In developing the preferred transport scenario, policy initiatives such as parking management and road pricing/congestion charge require further testing.

Efficient and well-timed provision of physical and social infrastructure is essential in achieving the objectives of the Auckland Plan. Each infrastructure class, including transport, has particular preferences and challenges, however, in general terms, it was highlighted that servicing a compact spatial form is more cost effective than servicing an expansive form, while consideration should be given to previous infrastructure investments in order to gain full return on the financial costs of these previous projects.

## 10.2 Market feasibility

This criterion considers the feasibility of the scenarios from a market point of view. How well the market is likely to respond to the challenge presented by each of the scenarios is an important test of how realistic any future implementation aspirations might be. Expert qualitative information was gained from a workshop of property developers convened to discuss the four scenarios (see Attachment 1, Section 5.1, for the full workshop notes).

### *Evaluation*

Market commentators support intensification in appropriate market attractive areas, but note that this must be complemented with an appropriate provision of greenfield land. However, retaining all future growth within the existing urban area was not supported nor seen as feasible in accommodating future growth. Greenfield land was seen to provide the closest to a business as usual approach and is most familiar to both developers and the market, and is seen as the most profitable and feasible solution for accommodating growth.

The preferred scenario from a developers' perspective would be a mixture of Scenario B (for choice) and Scenario D (for additional greenfields). They noted that whenever there were difficulties in achieving the densities or outcomes desired in more intensive areas such as centres, corridors, amenity areas or satellite towns then the natural response would be to consider greenfield expansion. Scenario A and C were seen as entirely undesirable as the absence of any greenfield land over and above that already planned could make the city unliveable and drive people and businesses elsewhere; Scenario C particularly so, due to the likely widespread community opposition to wholesale suburban infill and redevelopment.

There was support for growth in satellite towns, provided that sufficient employment options are made available. There was also support for intensification options in appropriate market attractive areas, but this must be complemented with sensible provision for greenfield land. It was felt that there is currently insufficient demand in Auckland for the housing typologies required to meet intensification aspirations; there is a large market for the standalone suburban option. Additionally there is a poor perception of intensification amongst the public at large; Auckland Council therefore needs to be a champion for good exemplars. However, it is important to note that this assessment is based on the market today, rather than the future, and it may change over time, for example, terrace housing and apartment development in now a much larger portion of the market now than it was 15 years ago.

Auckland has a geographically unbalanced development market, different communities require different solutions. Intensification in non-market attractive areas would require intervention from local or central government. Strong leadership and a significant investment of time and money are required to implement place based redevelopment projects. New Lynn, for example, has been many years (20 plus) in the making.

The Auckland Plan was seen as a golden opportunity for Auckland Council to signal its intent for the future of Auckland and provide clarity for developers, and for Auckland Council to align all of its regulatory and non-regulatory tools in order to encourage developers to provide the outcomes that Council wishes to see. It was also noted that the capacity of the construction industry is currently insufficient to cope with the projected growth in Auckland (exacerbated by the economic climate and Christchurch earthquakes).

	<b>Scenario A</b>	<b>Scenario B</b>	<b>Scenario C</b>	<b>Scenario D</b>
<b>Market Feasibility</b>	<b>XXX</b>	<b>✓✓</b>	<b>XXX</b>	<b>✓✓</b>

*Conclusion*

Market commentators expressed a clear preference for greenfield expansion because this provides the closest to a business as usual approach and is most familiar to both developers and the market, and therefore the most profitable and feasible solution. However there was also support for growth in satellite towns and intensification options in appropriate market attractive areas. Most importantly, certainty should be provided to the market by Auckland Council being definitive about the future location of the MUL and strictly controlling the release of developable land.

It is important to recognise that market feasibility is only one element of feasibility of the scenarios. Considerable infrastructure investment is required from the public and private sectors. New models of service delivery, changes in consumer preferences, changes in planning and delivery tools and approaches are all required.

## 10.3 Minimised infrastructure costs

This criterion is concerned with the relative estimated cost of the regionally significant infrastructure that would be required to support each scenario. The transport networks contained within the scenarios have been costed by Auckland Council's Transport Strategy Team. In addition, Auckland Council's Infrastructure Strategy Team undertook a consultative exercise with a range of public and private infrastructure providers and received feedback covering a number of infrastructure classes including wastewater, water supply, stormwater, energy (electricity supply), broadband and education (see Attachment 1 for the full report on this feedback).

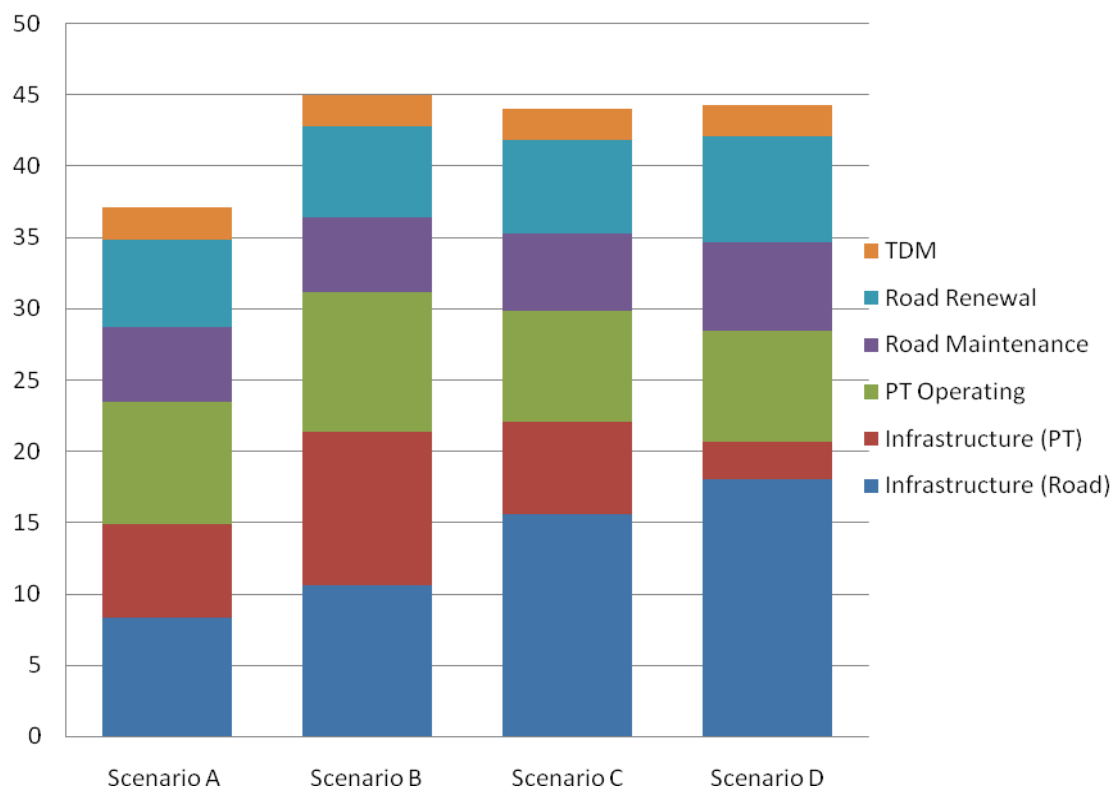
The significance of key economic infrastructure such as the airport and ports is maintained across all four scenarios therefore there is no specific discussion on these. The lack of any feedback on the scenarios from the health sector is an acknowledged gap in this report, however some general health sector feedback received as part of the Futures Project (2010) is included for completeness. No overall score is provided for this criterion, rather there separate score for each of the infrastructure classes, the following sections discuss them in turn.

### 10.3.1 Transport

The transport network components of the scenarios were developed through a series of workshops involving officers from Auckland Council, Auckland Transport, NZTA and MOT. The underlying principles in developing the networks were that they would reflect the land use in each scenario, thereby creating four integrated land use and transport scenarios, and that they would be developed within similar funding envelopes. It was also decided that as the land use in Scenario A was reflective of the region's legacy policy (RPS PC6), the transport network should reflect the RLTS. Equally the Roads of National Significance (RoNS) were included in all other scenarios. The RLTS and RoNS were used as a base for the development of the networks in Scenarios B, C and D, with further projects added to reflect the land use patterns in each of the scenarios. For this reason Scenario A has lower total costs than the other three, which are relatively similar.

Figure 43 below shows a very high level comparison of the transport network costs for both Capital and operating costs, of the four scenarios. TDM, Renewal and Maintenance costs are based on the fundability assessment carried out on the RLTS 2010 Preferred Option (and factored accordingly to reflect the amount of roading in each scenario). PT operating, PT infrastructure and road infrastructure costs have been extracted from the model and are based on a per kilometre costing of the transport networks. This assessment is considered relatively coarse in nature, with many assumptions; however this data is sufficient to show the relativity between the costs of the transport networks.

**Figure 43 Transport Infrastructure and PT Operating Costs (\$Billions)**



When comparing the scenarios solely from the point of view of cost it is clear that Scenario A (\$36.8b) is the least expensive. The other three scenarios have similar total costs (\$45b, \$43.7b and \$44.7b respectively), although they have differing emphasis on roading and PT infrastructure. Scenario B has greater PT infrastructure and hence greater PT operating cost, while Scenario D has greater roading (infrastructure and operating) costs. Scenario C also has large expenditure on road, but not to the same extent as Scenario D. A key reasoning behind the significantly less costs in Scenario A can be attributed to no additional harbour crossing being included within the transport network, whereas, all other scenarios either have a road or rail crossing. Given that the RLTS is the legacy transport policy for the region, Scenario A was scored neutrally with the other three more expensive scenarios scoring negatively.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Transport</b>	<b>0</b>	<b>XX</b>	<b>XX</b>	<b>XX</b>

### 10.3.2 Wastewater

Watercare Services Limited is responsible for the reticulated water and wastewater networks across the region and as such, feedback has only been sought from Watercare. The upgrading and

expansion of wastewater networks can be a lengthy and expensive process. The public has high expectations regarding the quality of wastewater treatment and expects to pay a minimal cost for the service. It is also fraught with consenting issues, given the sensitivity of discharges to the environment and the decrease in land values of properties in close location to new or upgraded wastewater facilities. The cost associated with expanded networks can also be a significant factor rendering a development uneconomic.

Given these factors, Watercare’s preference is for Scenario A, which follows the existing Regional Growth Strategy (which itself has influenced Watercare’s planning to date). However, Watercare does highlight that at least seven to 10 years would be needed to add new areas to their networks (which are not already in their asset management plan).

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Wastewater</b>	<b>0</b>	<b>XX</b>	<b>X</b>	<b>XXX</b>

### 10.3.3 Water Supply

Again, Watercare advise that Scenario A is the preferred option. This scenario follows Watercare’s current asset management plan. The other scenarios face increasing costs, especially the expansive network which would require significant funding to service the coastal and ribbon developments. Watercare has also advised that the intensification associated with Scenario C would be difficult to service. This may be due in part to the engineering difficulties associated with supplying water to the North Shore and Isthmus.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Water supply</b>	<b>0</b>	<b>X</b>	<b>XX</b>	<b>XXX</b>

### 10.3.4 Stormwater

The ownership of stormwater infrastructure is more complicated, with various components owned by private individuals, Auckland Council and Auckland Transport. However, feedback regarding stormwater has only been sought from Auckland Council’s Stormwater Development and Technical Services unit. The stormwater unit provided a number of comments relating to key stormwater management themes for all four scenarios, these being:

- *“Many existing flooding problems and impacts on waterways and coastal receiving environments exist as a result of previous development methods. Comprehensive redevelopment offers sometimes the only opportunity to address these. Cost of addressing these effects after they have occurred is expensive.*
- *Several coastal, low-lying developed areas are at risk of future coastal inundation. Further development in these areas will increase exposure to risk.*

- *Low energy, depositional receiving environments adjacent to the oldest and most urbanised areas of the city are showing the greatest signs of being affected by stormwater contaminants.*
- *Loss of headwaters and channelizing / piping of streams has had a significant impact on biological and physical stream values."*

The stormwater unit also highlighted that it is better for growth to occur in specified intensification areas, rather than general infill or by expansive development, while it is the increase in impervious surfaces rather than population increase which affects stormwater flows and assets. Given these factors, the stormwater unit scored Scenario A neutrally, while Scenario D was scored the most negatively.

	<b>Scenario A</b>	<b>Scenario B</b>	<b>Scenario C</b>	<b>Scenario D</b>
<b>Stormwater</b>	<b>0</b>	<b>X</b>	<b>XX</b>	<b>XXX</b>

### 10.3.5 Energy (electricity supply)

Feedback was received from a number of energy companies. This included electricity distribution and electricity generators, as well as the operators of the Wiri Oil Terminal. A full summary of the feedback can be seen in Attachment 1. With regard to electricity supply, the scoring is based on the feedback from Vector, Transpower, and Counties Power. Greater weighting was placed on Vector's scoring given the large number of customers it serves and the geographic area that it is responsible for.

Vector provided high level costs regarding the nature of their business and costs. They identified that Scenario A would be the cheapest, with Scenarios B and C costing similar amounts (but more than A), while Scenario D would be the most expensive.

Vector also highlighted the difficulty with servicing expansive growth. Electricity distribution in urban Auckland is based on a modular network which must connect back to one of Transpower's Grid Exit Points (GXPs). While this is easier to do within existing urban areas given the shorter distances to existing GXPs, new greenfield areas are more difficult and expensive to connect. Vector identified this as a particular issue for the coastal development in Whitford identified in Scenario D.

	<b>Scenario A</b>	<b>Scenario B</b>	<b>Scenario C</b>	<b>Scenario D</b>
<b>Energy (electricity supply)</b>	<b>0</b>	<b>X</b>	<b>X</b>	<b>XX</b>

### 10.3.6 Broadband

Auckland Council's Broadband Team highlighted a number of high level issues associated with the scenarios. A significant issue was the provision of broadband services to greenfield areas, as properties in areas previously identified as rural may not have adequate access to fibre (thus

resulting in residents being dependent on wireless broadband access). They also highlighted the difficulty in supplying broadband to general infill development (given the need to provide more complex fibre networks), while the use of satellite communities could place additional strain on the provision of fibre networks. Overall, Scenario A was the preferred option for the Broadband Team.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Broadband</b>	<b>0</b>	<b>X</b>	<b>XX</b>	<b>XX</b>

### 10.3.7 Education

Feedback was also received from the Ministry of Education. The Ministry stated that it preferred Scenarios B and C. Both scenarios gave the greatest flexibility to upgrade existing schools and construct new facilities, whereas Scenario A was too dependent on existing facilities (which are often constrained) or the purchase of land within the existing urban area (which would be costly to the Ministry), while Scenario D was too reliant on the provision of new costly facilities.

	Scenario A	Scenario B	Scenario C	Scenario D
<b>Education</b>	<b>X</b>	<b>✓✓</b>	<b>✓✓</b>	<b>XX</b>

### 10.3.8 Health

As previously discussed the lack of any specific feedback and scoring from health sector providers is an acknowledged gap in this report. Feedback obtained as part of the Futures Project (2010) from the Waitemata District Health Board however reinforces the preference for a compact spatial form, as it is more efficient and accessible because of greater physical alignment between health services and concentrated populations (though there are concerns about the cost of purchasing sites). The converse was also stated in that an expansive spatial form presented less efficiency.

### 10.3.9 Conclusion

Transport infrastructure costs are significantly higher than other infrastructure costs and play a predominant role in shaping urban form, therefore the integration of transport projections with planned land use is fundamental to achieving desired spatial outcomes.

Efficient and well-timed provision of physical and social infrastructure will be essential in achieving the objectives of the Auckland Plan. Each infrastructure class, including transport, has particular preferences and challenges, however, in general terms, it was highlighted that servicing a compact spatial form is more cost effective than servicing an expansive form, while consideration should be given to previous infrastructure investments in order to gain full return on the financial costs of these previous projects.

The key message received from infrastructure providers was that land use planning priorities and the sequencing of infrastructure projects should be aligned to form the basis of a comprehensive spatial planning approach.

## 10.4 Feasibility of development capacities

Auckland Council's Area Spatial Planning Team provided feedback on the feasibility of the development capacity numbers allotted to various locations, particularly centres, in the scenarios, based on their knowledge of local plans, both current and pipeline. The feedback did not cover all areas as it was based on the knowledge existent within the team which had been gained during team members' experience in various legacy councils. The feedback also covered a variety of centres within the hierarchy ranging from the CBD to small rural and coastal settlements. The team was asked three questions:

- What is the feasibility of realising the capacity numbers from your perspective and knowledge of the specific areas?
- Are there any changes to the regulatory (and other) frameworks that could make the scenario capacity more feasible in this location?
- What kind of interventions might be necessary to make the capacity numbers achievable in this location?

The feedback received was detailed and reflected the unique character of each location. A number of factors that can affect development capacities were highlighted, such as current zoning, existing infrastructure and environmental constraints and community feeling. The feedback on the regulatory framework and intervention mechanisms has been incorporated into the implementation section of this report (Section 11.4).

The feedback was converted into a feasibility ranking for the residential and employment capacities in each location (high, medium and low) with the intention of determining an overall ranking for each scenario. This ranking would then be translated into a score based on the three ticks three crosses system. However, this approach did not help to distinguish between the scenarios because an overall medium feasibility ranking was attributed to each scenario thereby generalising to such an extent that the subtleties of locations, or location types, in each scenario was lost. For this reason, this feedback has not been used in the scoring of any criteria.

The ranking exercise was useful in that it highlighted potential areas where capacities were likely to be unfeasible. For the most part, the capacities received either high or medium feasibility rankings. There were four notable exceptions however, where low feasibility rankings were given. The employment capacities for future urban areas (for example Hobsonville, Long Bay and Takanini) in both Scenarios B and C, and the rural towns of Kumeu and Warkworth in Scenario D, were all deemed to be unfeasible under current conditions. This perhaps highlights the challenges of providing sufficient employment opportunities in the urban periphery and in satellite towns. Rural towns (not including those satellites identified for significant growth) in Scenario B were given a low feasibility ranking for their dwellings capacity. This is a reflection of the considerable infrastructure



and environmental constraints in these settlements and potential strong community opposition to the significant development that would likely occur.

# 11 Evaluation Summary

This evaluation process is an assessment of how well the four land use and transport scenarios deliver on the long term outcomes sought for Auckland. In the face of considerable future growth, it can be expected that scenarios may show deterioration in some of the criteria measures compared with the baseline year of 2006. Not only does this reflect the scale of population growth anticipated for Auckland by 2041, it also suggests that determining a spatial form for the region cannot deliver, in itself, all of the region’s desired outcomes. Indeed new policy interventions will also have an important role in achieving these desired outcomes. However, it is important to note that in many cases spatial form will be a necessary precondition in reinforcing other policy initiatives.

## 11.1 Evaluation scores

Table 13 below, summarises the scores afforded to each of the scenarios through the evaluation process. During the evaluation some ‘sub-criteria’ were added at the request of subject matter experts, for example 2.5 Avoidance of Natural Hazards, was subdivided into three sub-criteria.

**Table 13 Evaluation criteria scores**

Ref	Subject / Criterion	Scenario A	Scenario B	Scenario C	Scenario D
<b>1</b>	<b>Economic wellbeing</b>				
1.1.1	Improved travel reliability (road)	XX	X	X	XXX
1.1.2	Improved travel reliability (PT)	✓✓	✓✓	✓✓	✓✓
1.2	Improved accessibility to economic activity	XX	XX	XX	XXX
1.3.1	Improved access to labour pool (road)	✓	✓	✓	XX
1.3.2	Improved access to labour pool (PT)	✓✓	✓✓	✓✓	0
1.4	Increased productivity	✓✓	✓✓	✓✓	✓
1.5	Land extensive business sectors	X	✓	X	✓
1.6	Energy resilience	0	0	0	X
1.7	Improved accessibility to productive rural areas	XX	X	X	XX
1.8	Protection of productive rural land	0	X	0	XX
<b>2</b>	<b>Environmental wellbeing</b>				
2.1	Reduced greenhouse gas emissions	0	0	0	X
2.2	Protection of or enhancement of marine values	X	XX	XX	XXX
2.3	Protection of or enhancement of stream corridors	X	XXX	XX	XXX
2.4	Identify, protect and enhance terrestrial ecosystems	✓	XX	✓	XXX
2.5.1	Avoidance of existing hazards	X	XX	X	XX
2.5.2	Avoidance of new hazards	0	X	0	XX
2.5.3	Exposure to existing hazards	XX	X	XX	X
<b>3</b>	<b>Social wellbeing</b>				
3.1.1	Greater housing affordability	0	0	0	X
3.1.2	Greater housing affordability for deprived households	✓	✓	✓	X

Ref	Subject / Criterion	Scenario A	Scenario B	Scenario C	Scenario D
3.2	Greater housing choice	0	✓✓	✓	X
3.3	Improved accessibility	✓	✓	✓	0
3.4	Improved accessibility for deprived households	0	0	0	X
3.5	Improved accessibility to social infrastructure	X	0	X	XX
3.6	Improved access to local employment opportunities	0	0	0	XX
3.7	Improved levels of physical activity	✓✓	✓	✓	0
3.8	Improved air quality (impact on public health)	X	X	X	X
3.9	Improved water quality (impact on public health)	X	XXX	XX	XXX
<b>4</b>	<b>Cultural wellbeing</b>				
4.1	Protection of Māori heritage and areas of cultural significance	0	0	0	XX
4.2	Enabling economic opportunities for Māori	X	✓	✓	✓✓
4.3	Promoting Māori culture	0	X	XXX	X
4.4	Preserving the Mauri	✓	X	XXX	XX
4.5	Provision of open space	✓✓	✓	XX	XXX
4.6	Protection of historic heritage	X	XX	✓	XXX
<b>5</b>	<b>Implementation</b>				
5.1	Market feasibility	XXX	✓✓	XXX	✓✓
5.2.1	Minimised infrastructure costs (transport)	0	XX	XX	XX
5.2.2	Minimised infrastructure costs (wastewater)	0	XX	X	XXX
5.2.3	Minimised infrastructure costs (water supply)	0	X	XX	XXX
5.2.4	Minimised infrastructure costs (stormwater)	0	X	XX	XXX
5.2.5	Minimised infrastructure costs (energy – electricity supply)	0	X	X	XX
5.2.6	Minimised infrastructure costs (broadband)	0	X	XX	XX
5.2.7	Minimised infrastructure costs (education)	X	✓✓	✓✓	XX

It is important reiterate that there is no weighting (including equal weighting) attached to the criteria. The findings of the scenario evaluation are presented in the following sections.

## 11.2 Key themes

While each criterion can be considered individually in terms of scenario performance, the findings for each criterion cannot be considered in isolation because there are many interrelationships between them and across the wellbeings. This section summarises the key themes that emerged through the evaluation process.

### 11.2.1 Economic development

A compact scenario could lead to a higher value economy with increased agglomeration of business services in centres, particularly the CBD and larger centres. In all scenarios, accessibility (including to ports and the airport) shows an initial improvement in line with transport infrastructure investment,

but then begins to decline over time. This is likely due to transport infrastructure investment not keeping pace with continued population and employment growth in the longer term.

The lack of provision for new greenfield land for Group 1 industrial activities could result in the loss of lower value activities to elsewhere in New Zealand or even overseas. Provision of greenfield land beyond the current MUL for industrial activities is required and can provide locations for lower value activities as they are displaced from their current locations by higher value activities.

### 11.2.2 Transport

In terms of accessibility related model outputs, the more compact scenarios (A, B and C) generally perform similarly, and better than the most expansive scenario, D. This includes measures such as congestion, vehicle kilometres travelled, the cost of travel and the number, distance and speed of trips. However, generally speaking, accessibility decreases in all scenarios to 2041, therefore, additional tools and investment in the transport network will be required. The level of accessibility provided in the scenarios was an important consideration in the evaluation because improvements in accessibility provide benefits across all four wellbeings.

Capital and operational expenditure for transport projects in each of the scenarios were estimated to provide a relative comparison of the scenarios. When comparing scenarios, Scenario A (\$36.8b) has the lowest estimated cost. Scenarios B (\$45b), C (\$43.7b) and D (\$44.7b) have similar total costs, and while Scenarios B and C perform similarly to Scenario A in terms of accessibility outcomes, Scenario A's total cost is \$6.9b lower than the next lowest scenario. This significantly lower cost is attributable to Scenario A not including an additional Waitemata Harbour crossing (road or rail) within its transport network. In developing the preferred transport scenario, policy initiatives such as parking management and road pricing or a congestion charge require further testing.

### 11.2.3 Infrastructure

Efficient and well-timed provision of physical and social infrastructure will be essential to achieving the objectives of the Auckland Plan. Each infrastructure class has particular preferences, however, generally, infrastructure providers favoured Scenario A, as it was seen that a compact urban form with concentrated growth in a limited number of large centres is much more efficient (and less costly) for provision of infrastructure than an expansive, low density urban form. An important matter expressed by a number of providers was that when planning for growth, due consideration to previous infrastructure investments should be given in order to gain full return on the financial costs of these previous projects.

The key message conveyed from infrastructure providers was that land use planning priorities and the sequencing of infrastructure projects should be aligned to form the basis of a comprehensive spatial planning approach.

### 11.2.4 Market feasibility

Market commentators support intensification in appropriate market attractive areas, but note that this must be complemented with an appropriate provision of greenfield land. The preferred market

scenario would be a combination of Scenario B (for choice) and Scenario D (for additional greenfields).

Auckland has a geographically unbalanced development market and different communities require different solutions. Intensification in non-market attractive areas would require interventions from local or central government. Importantly, certainty should be provided to the market by Auckland Council being definitive about the future location of the MUL and strictly controlling the release of developable land.

#### 11.2.5 Housing affordability and choice

The model outputs indicate that the most expansive scenario (Scenario D) has the least affordable housing of all the scenarios; this is emphasised further when transport costs are considered. Scenario D is also more unaffordable for lower income households than for the region as a whole reaffirming that these households are more vulnerable to increases in housing and transport costs.

While increased transport costs in a more expansive scenario may be expected, an increase in housing costs is perhaps counterintuitive. This suggests that the market demand for houses in an expansive scenario would not deliver affordable housing, particularly in desirable greenfield locations. This is reinforced by the more compact and intensive scenarios, A, B and C, having housing costs that are considerably lower than Scenario D, and also lower than at 2006, in the lower income zones.

It is important to note that the discussion on housing affordability in this report is based on model outputs only, refer to the separate Auckland Plan housing workstream technical paper<sup>47</sup> for a more detailed discussion of housing issues.

Recent research papers indicate that there will continue to be strong demand for detached housing into the future. Studies also indicate that in order to meet the demand for housing there will need to be a greater reliance on more multi-unit housing. Scenarios B and C provide the greatest range of housing typology choice, while Scenario D provides the greatest locational choice.

#### 11.2.6 Climate change

None of the scenarios achieve the Mayor's target of a 40 per cent reduction in net Greenhouse Gas (GHG) emissions by 2031 on 1990 levels. Model outputs show that total CO<sub>2</sub> emissions from vehicles are similar in the more compact scenarios of A, B and C, all three being significantly less than the expansive Scenario D. However, all scenarios show a decline in CO<sub>2</sub> emissions per capita, as a result of assumed technological advancements in the vehicle fleet.

This shows that land use policy alone will not deliver required reductions in GHG emissions. Travel demand by private vehicle will continue to increase with a growing population; the consequences of this growth will depend on the development of effective transport policy at a national, regional and local level.

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<sup>47</sup> Auckland Council. (2011) Technical Workstream Draft Auckland Plan: Housing.

### 11.2.7 Natural hazards

Concentration of development within the current urban area will increase population and infrastructure vulnerability, particularly for low frequency hazard events (eg volcanic eruption or earthquake). The scenarios which expand the urban footprint (B and D) will disperse risk from both low frequency hazard events and localised frequent events (eg flooding). However Scenarios B and D will also expose development to new hazards, such as flooding in the south and land instability and coastal hazards in the north.

Different growth patterns create different risks to hazards, extensive research on hazards and their risks should be undertaken and a long term management approach for hazards and their consequences needs to be implemented for new growth areas.

### 11.2.8 Environmental quality

All scenarios perform negatively because the scale of projected growth will inevitably put increased pressure on the natural environment, particularly if current policy and practice continue. A compact urban form is more desirable as it focuses growth in town centres and reduces environmental risk to new areas (as would occur through greenfield growth). It is best to avoid development in catchments and areas that are not currently developed because intensive development of an already degraded catchment is preferable to developing in an otherwise undamaged or highly valued area. Scenario D, inevitably, performs the worst against the environmental criteria due to its expansive form.

### 11.2.9 Heritage and cultural values

All scenarios present risks and opportunities in the protection of heritage and cultural values. Intensification and infill in Scenarios A, B and C increase risks for built heritage through redevelopment within the existing urban area, this is of particular concern for Scenario B where intensification of high amenity areas (which are often areas of cultural and heritage significance) may result in pressure or even loss of these values due to urban development. Greenfield expansion in Scenarios B and D can affect landscape amenity values and areas currently unknown for their inherent values. Additionally, the tendency for major arts, cultural, recreational, and to a lesser extent religious facilities, to locate in central areas could lead to capacity constraints and competition in an intensive urban environment, while in a dispersed urban form, accessibility issues may arise.

Urban form can have major impacts on heritage and cultural values, whether it is expansive or contained growth, policy which protects these areas from urban growth pressures will be essential into the future.

### 11.2.10 Māori

The impacts of the different scenarios on specifically tangata whenua values are difficult to quantify. It will be important for Auckland Council and Māori to have an on-going dialogue at all levels of planning from strategic to local, to ensure that the effects of different growth scenarios on the aspirations of Māori are understood and protected.

### 11.2.11 Rural

Rural productivity was assessed in two ways: Loss of productive rural soils and general accessibility. Greenfield expansion in Scenario D inevitably leads to large areas of productive rural soils lost to urban expansion, this is also true for Scenario B, albeit to a lesser degree than in Scenario D. The most compact scenarios (A and C) result in no loss beyond that of already planned areas of greenfield growth.

In general terms, accessibility from important productive areas to the airport and port decreases in all scenarios, however, in a few cases current levels of accessibility are maintained. The largest decrease in accessibility is seen from the north in Scenarios A and D: the former so far as to display a doubling of travel time, which is a likely consequence of the transport network not including the Puhoi to Wellsford motorway; while the latter is likely due to significant amounts of greenfield growth to the north of Auckland.

## 11.3 Locations for growth

The scenarios contain different land use components which represent different ways of catering for growth. The themes that have emerged from the evaluation process have been applied to some of these spatial responses and this discussion is presented below<sup>48</sup>.

### 11.3.1 Urban centres

Urban centres play a major role in accommodating growth in both Scenarios A and B. Focusing residential and employment growth within a hierarchy of centres presents opportunities for increased accessibility to employment, social infrastructure and local services, while reducing dependency on mechanised travel modes. It also provides opportunities for agglomeration benefits for certain business sectors (particularly in larger centres) and for the most efficient provision of physical and social infrastructure.

The environmental challenges of centres-based growth include further degradation of existing receiving environments and remnant ecological values (unless mitigation measures are put in place), however, centres focused growth avoids environmental impacts to new areas (such as that in greenfield growth). Increasing density can also present challenges around the retention and promotion of local character and heritage values, including the provision of public open space. Embedding good urban design principles in the realisation of centres-based intensification will support both the retention, and enhancement, of these values.

The market feasibility of delivering intensive development throughout the metropolitan area is a significant challenge, as is the provision of appropriate housing choice, particularly at high and medium densities. Auckland's unbalanced development market means that a suite of tools, including policy interventions and possibly subsidy from local or central government, would be required to meet intensification objectives in non-market attractive centres. Multi-unit

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<sup>48</sup> It should be noted that there is no discussion of mixed use corridors in this report. This is a result of the technical difficulties in defining the spatial extent of corridors in the model's zoning system. Refer to the Auckland Regional Growth Corridors Report (Auckland Regional Council, 2010) for further information on corridors.

developments do not necessarily supply the housing typologies that match current market preferences; therefore there is a need to identify new typologies which can meet market demand.

### 11.3.2 Satellite centres

Satellite centres are distinct settlements located outside the metropolitan area and are a particular feature of Scenario B. These towns provide residential and employment growth opportunities which can contribute to relieving growth pressure within the metropolitan area. All scenarios contain growth in rural towns; however those identified specifically as satellite centres in Scenario B are Pukekohe, Warkworth, Kumeu/Huapai, Helensville and Wellsford, in addition to two new towns at Dairy Flat and Wesley.

Satellite centres were evaluated as being a generally positive concept and a preferable option to traditional suburban expansion. Growing existing towns builds on existing social infrastructure and community values, provides a greater range of housing choice and can be a catalyst for additional investment in physical infrastructure. Concentrating development in settlements rather than dispersing it within rural areas also better protects productive rural land and environmental and heritage values.

However, most of the satellite centres have environmental constraints (eg flooding, land instability, ecological constraints), which would need to be appropriately managed and is likely to affect the sequencing of growth.

While satellite centres would by definition interact closely with metropolitan Auckland in terms of employment and recreational choices, and the provision of certain higher-level social and cultural facilities, it is not intended that they become dormitory commuter towns nor lose their important role as service towns to their rural hinterland. Comprehensive master planning would need to occur to provide a balance of residential and employment opportunities, accompanied by appropriate social and physical infrastructure.

Scenario B identifies two new towns (Dairy Flat and Wesley), project timeframes did not allow for a specific analysis of the costs, benefits and practicality of the new town concept in the Auckland context. New towns can be used to preserve the integrity of and separation between existing towns as well as contributing to a regional balance in residential and employment choices. They would be expected to develop according to the principles of transit orientated design, which is why they have been located on the RTN where growth can be supported by appropriate passenger transport: Dairy Flat on the northern busway extension to Silverdale and Wesley on the rail line to Pukekohe.

### 11.3.3 Amenity areas

Urban areas of high amenity, such as those along ridgelines or in coastal areas, are often attractive to the market because they are desirable residential locations and therefore allow developers to undertake profitable projects. Scenario B identifies broad areas of high amenity in close proximity to eastern and northern urban coastlines. In Scenario D growth in these same areas is focused in centres that are market-attractive.

These amenity areas provide residential, and to a lesser extent, employment growth opportunities within the metropolitan area. This additional development capacity can be considered



supplementary to that provided in centres, particularly where centre capacity is insufficient to accommodate projected growth.

Appropriate redevelopment and intensification in amenity areas is likely to result in more efficient use of land resulting in smaller housing units which would contribute to greater diversity of choice. However, given land values in these areas, this will only likely produce housing for the upper and middle end of the market, and therefore not cater for the affordable housing market.

It is important that the type and scale of development in amenity areas is carefully controlled in order to protect the range of values that have made the areas desirable in the first place. These areas tend to be perceived as being explicitly “natural” in character including good views and valued natural and historical heritage; they are also more likely to be rich in areas of cultural significance to Māori. Additionally, intensification directly adjacent coastal areas will significantly increase exposure to natural hazards such as tsunami, cliff instability, sea level rise and coastal inundation.

It is also important to note that there are forms of amenity other than ridgelines and coastlines which can provide further opportunities for redevelopment and intensification. Built amenity based on heritage or good urban design (such as in Ponsonby, Grey Lynn or Mount Eden), amenity based around open space (parks or playing fields) and amenity based around accessibility to infrastructure such as community services or transport options, can all provide pockets of development opportunity.

#### 11.3.4 Suburban intensification

Widespread intensification of suburban areas at (on average) medium densities through infill and redevelopment opportunities, and the distribution of development capacity amongst the region’s many local and neighbourhood centres, is the major growth response contained in Scenario C.

While, in theory, this approach could encourage cohesive neighbourhoods with good access to employment and social facilities, the scale of infill and redevelopment required in Scenario C is not deemed to be feasible or desirable for a number of reasons.

This piecemeal approach is not deliverable from a market point of view and is inefficient from the point of view of targeted infrastructure provision making it likely to provide development capacity too slowly to accommodate projected growth. Additionally, business agglomeration opportunities would be lost with the dispersal of employment locations, and local environmental, heritage and character values would be compromised.

This said, there are some elements of Scenario C that received a positive response. The concept of investing in local and neighbourhood centres is supported for a range of reasons including community cohesion, provision of local services and the potential for aging in place. Smaller centres therefore have an important role to play as part of a wider hierarchy of centres (see Section 11.3.1 Urban Centres). There is also scope for some targeted (as opposed to large scale) intensification in traditionally suburban areas of high amenity, as discussed in Section 11.3.3 Amenity Areas.

### 11.3.5 Expansion areas

Expansion areas, also known as greenfields, can be defined as large areas of previously undeveloped land that have been identified for urbanisation, primarily located at the periphery of the existing metropolitan area. All scenarios contain a degree of greenfield expansion because they incorporate the future urban areas identified in the region's legacy policy documents.

Scenarios B and D provide expansion areas beyond those which are already planned, to accommodate both residential and employment growth, including land for Group 1 business activities. While both scenarios provide the same amount of land for Group 1 business activities, Scenario D provides significantly more residential land than Scenario B.

#### 11.3.5.1 Expansion areas - residential

This form of expansive development is often seen as the traditional and most achievable option for accommodating urban growth. Accommodating the scale of growth projected for Auckland within the existing planned urban footprint is often perceived as not feasible given current market and community preferences, and the intervention tools available to both local and central government.

Expansion areas provide a number of benefits as an option for accommodating growth in that they relieve growth pressure within existing urban areas which may have development constraints of one kind or another. They conform to the tried and tested business model of Auckland's major property developers making them an easier and more profitable option for the private sector. Greenfield development also provides opportunities for master planning to ensure integration with infrastructure provision, strict subdivision controls, good quality urban design, and best practice environmental mitigation.

However, provision of infrastructure for an expansive spatial form is more costly than for a compact form because it requires major additional investment in new network components. Peripheral greenfield development also raises issues of accessibility including increased travel costs for residents accessing employment and social services, this would be particularly acute for lower socio-economic groups. Additionally, the modelling indicated that an expansive urban form did not result in an increase in housing affordability, suggesting that market demand may not deliver affordable housing in desirable greenfield locations. Furthermore, an expansive form was found to also generate more travel trips resulting in greater travel related carbon emissions than in a compact spatial form.

While expansion areas provide significant capacity for housing (especially detached housing) this occurs at the periphery of the existing urban area and therefore not necessarily where housing demand exists. Furthermore, urban expansion into previously undeveloped areas leads to new natural hazard risks such as flooding and land instability, and major degradation of environmental values such as natural heritage or landscape amenity.

#### 11.3.5.2 Expansion areas - Group 1 business activities

There is an identified need for additional land for Group 1 business activities in Auckland, and Scenarios B and D meet this demand by providing capacity at Silverdale, Whenuapai, Auckland

International Airport, Drury and Paerata. These locations satisfy specific locational requirements which depend on access to supplies, consumers, ports and airports.

The environmental risks for providing additional Group 1 business land are similar to those identified for residential land however Group 1 activities carry additional risks. Industrial activities are more likely to involve polluting substances; this along with large impervious surface areas and increasing stormwater runoff heightens the risk of contaminated stormwater entering receiving environments.

### 11.3.6 Business Areas

Auckland's business areas are a major location of employment and productivity, however, productive activities can be outcompeted for space in these areas by 'higher value' land use activities such as retail, cafes, restaurants and bars, office and residential. While a degree of ancillary activities are required, this can have the dual effect of undermining the performance of the core productive activities located in the business areas and also undermining nearby town centres.

There is a recognised need to maintain and protect business areas from inappropriate activities due to their importance in contributing to future productivity. For this reason, the location and capacity of business areas have generally been kept constant in the scenarios.

The activities in some of these areas are likely to transition over time into higher value productive activities. This will result in the displacement of lower value productive activities; therefore it is crucial that these generally industrial activities are catered for also. The provision of additional greenfield land for Group 1 business activities (as previously discussed) will play an important role in providing location options for these displaced activities.

## 11.4 Implementation

Subject matter experts provided feedback on the implementation tools that could be required to achieve the spatial form outcomes contained in the scenarios. The feedback received does not constitute a comprehensive analysis of the range of tools available, rather it presents some ideas that are worthy of further, more detailed, consideration. A full discussion of the implementation and funding options available to Auckland Council in implementing the first Auckland Plan, is contained in the separate Approach to Implementation and Funding<sup>49</sup> technical paper.

The feedback received contains a mixture of regulatory and non-regulatory tools and focuses on themes such as achieving intensification goals in non-market attractive areas, managing the rate of urban expansion, and ensuring good urban and environmental outcomes. It has been grouped into three categories according to the level of public sector intervention required - high, medium and low.

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<sup>49</sup> Auckland Council. (2011) Technical Workstream Draft Auckland Plan: The Approach to Implementation and Funding.

#### 11.4.1 High public sector intervention

Establishment of a special purpose vehicle, such as an Urban Development Authority or property development company, would allow Auckland Council to play a leadership role in achieving intensification, urban design and redevelopment objectives. Such an organisation could be statutorily established and have planning powers (such as compulsory acquisition) allowing it to undertake catalytic projects and demonstrate best practice development.

As a large land owner and employer in Auckland, the public sector has the potential to align its own land use decisions to Auckland Council's spatial objectives. For example, large local and central government employers can choose to locate in key centres in order to act as 'seed' employers thereby signalling a commitment to Auckland Council's strategic objectives. In addition, Housing New Zealand owned land can be utilised for urban renewal purposes, while also providing for affordable housing.

#### 11.4.2 Medium public sector intervention

Public Private Partnerships (PPPs) were suggested as an alternative means of procurement that might be appropriate, or may offer better value for money, for certain large scale infrastructure projects. Use of PPPs could allow certain projects to be brought forward increasing the likelihood of spatial objectives being achieved, or being achieved sooner. However, decisions around the merits of using the PPP tool in New Zealand should be subject to rigorous analysis and comparisons with existing public sector procurement methods.

Auckland Council has funding tools currently available which could be used to incentivise development in line with strategic objectives, an example given was Development Contributions policy. This could include identifying the true cost of development, the timing of when contribution payments are required, or other simple discounts to the cost of growth funded by rates, where broader outcomes are achieved.

#### 11.4.3 Low public sector intervention

It was noted by a number of subject matter experts that the existing planning framework could be better coordinated in order to integrate infrastructure provision with development and to realise strategic objectives. This can be achieved through a number of complimentary methods such as:

- Ensuring that Unitary Plan mechanisms, such as development controls, zoning (ie up-zoning) and sequencing the release of land for development, are aligned with the Auckland Plan
- Streamlining planning processes which could include simplifying consents processes, fast-tracking critical projects and creating specific town centre planning teams with delegated authority
- Holistic structure, master and precinct planning to clearly define the role, intent and capacity of an area within the wider regional strategic context
- Design Guides covering good urban design, low impact design etc

- Ensuring best practice environmental planning, including integrated catchment planning, water sensitive urban design etc

## 12 Conclusions

The findings of the evaluation process, summarised in the preceding sections, provide the basis for some conclusions around the spatial form that could best enable Auckland to meet the challenges of the future.

### 12.1 The impacts of growth

The extent of population and employment growth projected for Auckland will inevitably cause some adverse effects. Accommodating a population of 2.3 million people by 2051 will put considerable pressure on the natural environment and require significant additional investment in infrastructure. Ensuring the most appropriate spatial form, which is supported by well-timed investment in infrastructure, will ameliorate some of the worst adverse effects. These will need to be supported by policy interventions in areas where spatial form and infrastructure alone are unable to make sufficient difference.

### 12.2 Spatial form

This evaluation clearly shows that a compact spatial form is preferable for Auckland. Scenarios A, B and C performed quite similarly in many respects, particularly in the modelling; Scenario D, the expansive scenario, however, was often an outlier and scored the most negatively (please see the full body of the report for the complete evaluation results and associated discussion). For most criteria, a compact approach performs the best by allowing for:

- An increased likelihood of fostering a more productive economy, through greater business agglomeration opportunities and protection of productive rural land. A compact form also leads to reduced traffic congestion allowing better access to skilled labour, and ensuring that important sites of economic activity, including the port and airport, are more accessible.
- More efficient and cost effective provision and servicing of physical infrastructure such as the transport network, three waters and energy.
- Fewer negative environmental impacts due to lower greenhouse gas emissions, avoidance of higher quality environmental areas and better protection of ecological, landscape, heritage and marine values.
- A strong network of centres enabling better social cohesion, walkable neighbourhoods, ageing in place opportunities and better access to social infrastructure including local facilities.

However, it is important to note that for some criteria the expansive approach performs better. Therefore, while acknowledging that a compact approach is preferable, the following should also be taken into consideration in making trade-offs about Auckland's future spatial form:

- There are concerns that some of the more intensive theoretical densities implied in some of the scenarios could not be met through existing market demand.

- There is a clearly identified need for additional greenfield land for Group 1 business activities, which can only be provided by expanding the existing urban footprint.
- Concentration of development increases vulnerability to low frequency hazard events (however expansion increases vulnerability to new and localised high frequency hazard events).

The results indicate a compact spatial form that includes some flexibility to take account of the factors discussed above.

### 12.3 Infrastructure provision

The extent of growth anticipated in Auckland dictates the need for significant investment in infrastructure, particularly transport and water infrastructure. This evaluation has shown that a compact approach with focused intensification in specific locations provides the most cost effective and feasible form of development for infrastructure providers, and that expansive growth is often more costly, requiring significant investment in new network components. The challenge will be to ensure that investment is used in a way that is most efficient and effective. The main conclusions from this evaluation around provision of infrastructure are:

- A need for land use and transport integration. On balance, a wide range of outcomes, such as businesses agglomeration, social cohesion, opportunities for physical activity and local and sub-regional accessibility can be supported through a strong network of centres supported by a complementary transport networks, particularly the rapid transport network.
- The model outputs identified that the significant transport investment in the next decade will improve accessibility across the region, but that the level of accessibility will subsequently decline as growth overtakes the investment. Investment in transport infrastructure, particularly passenger transport, in the scenarios is effectively ‘front-loaded’ in the first decade. It is important to recognise that additional policy intervention and or investment would be required in the longer term future to address key issues such as regional accessibility.
- Infrastructure provision is a lengthy and costly exercise that requires significant lead-in times, with infrastructure networks often less responsive to rapid changes in spatial form. Infrastructure providers also need adequate time to reorganise their work programs and desire a consistent approach to growth area prioritisation.
- Collaboration with physical and social infrastructure providers will be fundamental to aligning implementation and funding priorities, in order to achieve desirable land use outcomes.

### 12.4 Land use planning is necessary but not sufficient

Determining and planning Auckland’s future spatial form will not be sufficient, in itself, to deliver the outcomes sought. While agreeing that a compact spatial form provides the most benefits, this will

need to be underpinned and promoted by a complimentary range of other, equally important mechanisms:

- A strong focus on implementation, setting a clear policy direction, supported by Area Spatial Planning, the Long Term Plan and the Unitary Plan. Partnership with central government and iwi will be critical and additional implementation tools (for example an urban development authority or PPPs) will also have to be given serious consideration.
- Comprehensive investment in core infrastructure, such as passenger transport, roading, three waters and power supply. It is important that this investment is signalled in advance and that planning and provision is aligned with land use decisions.
- Future growth will be dependent on the securing of appropriate funding for infrastructure and new construction. Depending on the level of Auckland Council intervention and the requirements of growth areas, a variety of intervention mechanisms (such as funding) may be employed. While these are currently subject to a separate investigation, such mechanisms may include targeted rates, and refinement of development contribution policies.
- Central and local government policy interventions; for example those that can support achievement of national guidelines of standards, such as introducing emission standards for vehicles.

This technical report does not identify one of the four scenarios as the final and preferred spatial form for Auckland; it does, however, outline some of the key elements that should be considered when arriving at the preferred spatial form. This evaluation has shown that in order to achieve the outcomes sought; Auckland requires a compact spatial form which retains some flexibility to cater for future growth pressures. This needs to be reinforced through comprehensive planning, investment and provision of core infrastructure, as well as a range of supporting national and local policy interventions.

## 12.5 Next steps

The Scenario Evaluation Workstream is one of a number of workstreams providing the evidential base for the Auckland Plan. The Draft Auckland Plan will articulate a proposed preferred spatial form which will be based upon the conclusions of these processes. The next stage of the scenario work will involve modelling and evaluation of the preferred land use and transport scenario. This will contribute to the further refinement of the preferred spatial form for Auckland.



# 13 Glossary and Abbreviations

## 13.1 Glossary

**Active mode** - Non-motorised travel modes such as walking and cycling.

**Airshed** - An area bounded by geographical and/or meteorological constraints, within which activities discharge contaminants. The Auckland region comprises 12 airsheds – the Auckland airshed is the area within the MUL, others have been established in rural towns and areas where growth is expected.

**AM peak** – The time period between 7am and 9am.

**Generalised costs** - The sum of time and monetary costs of transportation combined into a common unit (minutes for this report). Car costs include travel time, vehicle operating costs (petrol), parking and any tolls. For PT they include in-vehicle, walk, wait and transfer times and fares.

**Gross regional product (GRP)** - The total market value of all final goods and services produced within a region in a given period of time (usually a calendar year). It is also considered the sum of the value added at every stage of production (the intermediate stages) of all final goods and services produced within a region in a given period of time, and it is given a money value.

**Group 1 business activities** - Land extensive business activities including manufacturing, construction, wholesale trade, transport and storage. Generally have low numbers of employees per hectare.

**Group 2 business activities** - More land intensive business activities including business services and retail. Generally have higher numbers of employees per hectare.

**Hapu** - A sub-tribe, usually containing a number of whanau with a common ancestor.

**Home based work trips (HBW)** - Commuter trips, from home to work and back.

**Interpeak** – A two hour average taken from the time period between 9am and 3pm.

**Iwi** - A Maori tribe, usually containing a number of hapu with a common ancestor.

**Kaitiaki / Kaitiakitanga** - The tangata whenua guardian who exercises ancestral responsibilities of kaitiakitanga.

**Mana whenua** - Territorial rights, power from the land. Power associated with possession and occupation of tribal land.

**Marae** - The complex of buildings and land which make up the meeting house, dining hall, and includes developments such as kaumatua (elders) housing, kohanga reo (language nests), kokiri units (skills training centres) and other supporting facilities, which provides a focal point for Maori cultural, spiritual, social, political and economic activity.

**Mauri** - Life force, life essence.

**Mode share** - Proportion of total number of trips taken by a specific travel mode ie passenger transport (bus rail, ferry) private vehicle, and active forms of transport such as cycling and walking).

**Physical infrastructure** - Includes ports, airports and airport approach services, bulk water supply and drainage reticulation and associated works; energy generation and transmission; transport and communications facilities and networks; solid waste disposal facilities; and defence establishments.

**Quality transit network (QTN)** - Network of high-frequency, high-quality transit services. The majority of these are bus services operating bus priority measures between key centres and over major corridors. The QTN complements the Rapid Transport Network by connecting at key hubs locations.

**Rahui** - A form of tapu restricting the use of land, sea, rivers, forests, gardens and other food resource. It can include prohibitions on people gathering food in an area, for a specified period after a drowning, or the conservation of species through prohibitions on the harvest of kaimoana (seafood).

**Rapid transit network (RTN)** - A Rapid Transit Network has been identified as an extension of the projects in the Regional Passenger Transport Plan. It aims to provide longer-term support for the more intensive growth proposed by the Regional Growth Strategy and to improve the region's transport system.

**Social (and cultural) infrastructure** - The system of services, networks and facilities that support people and communities; includes community development processes.

**Tangata whenua** - Local people, hosts, indigenous people of the land; people born of the whenua.

**Taonga** - Something highly prized or treasured, tangible or intangible, that contributes to maori wellbeing. The term equates roughly to the concept of a resource, but incorporates a range of social, economic and cultural associations. Included, for example, are te reo (the Maori language), wāhi tapu, waterways, fishing grounds, mountains and place names.

**Te ao Maori** - The Maori world or worldview.

**Tikanga** - Correct procedure, custom, habit, lore, method, manner, rule, way, code, meaning, reason, plan, practice, convention.

**Travel demand management (TDM)** - Initiatives aimed at modifying travel behaviour in order to maximise the efficient use of transport systems. Examples of TDM measures include teleworking, ride sharing, more flexible work and educational hours, road pricing, parking constraints, cycling, walking and land use policies that support intensive mixed-use development.

**Urupa** - Burial ground, cemetery, graveyard.

**Wāhi Tapu** - A place sacred to Maori in the traditional, spiritual, religious, ritual or mythological sense.

**Whanau** - An extended Maori family including the nuclear family.

## 13.2 Abbreviations

ARC	Auckland Regional Council
ART3	Auckland Regional Transport model version 3
ASF	Auckland Sustainability Framework
ASP3	Auckland Strategic Planning model version 3
ATM2	Auckland Transport Models version 2
AQNES	National Environment Standards for Air Quality
BLEG	Business Land and Economy Group
CBD	Central Business District
CHRANZ	Centre for Housing Research Aotearoa New Zealand
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
EFM	Economic Futures Model
GHG	Greenhouse Gasses
GXP	Grid Exit Point
HBW	Home based work trips
HMA	Housing Market Areas
LCN	Local Connector Network
LENZ	Land Environments of New Zealand
LTCCP	Long Term Council Community Plan
LUC	Land Use Capability
MfE	Ministry for the Environment
MOT	Ministry of Transport
MSD	Ministry of Social Development
MUL	Metropolitan Urban Limits
NES	National Environmental Standards
NO <sub>2</sub>	Nitrogen Dioxide
NORSGA	Northern Strategic Growth Area
NO <sub>x</sub>	Nitrous Oxide
NPS:FW	National Policy Statement for Freshwater
NSC	North Shore City
NZTA	New Zealand Transport Agency

PPP	Public Private Partnerships
PM <sub>10</sub>	Fine Particulates
PM <sub>2.5</sub>	Fine Particulates
PT	Passenger Transport
QTN	Quality Transit Network
RDC	Rodney District Council
RAP	Rural Advisory Panel
RGS	Auckland Regional Growth Strategy
RMA	Resource Management Act
RLTS	Auckland Regional Land Transport Strategy
RoNS	Roads of National Significance
RPS	Auckland Regional Policy Statement
RPS PC6	Auckland Regional Policy Statement Plan Change 6
RTN	Rapid Transit Network
SH	State Highway
SO <sub>2</sub>	Sulphur Dioxide
TDM	Travel Demand Management
VEPM	Vehicle Emissions Projections Model
VKT	Vehicle Kilometres Travelled
VOC	Volatile Organic Compounds
WDBH	Waitemata District Health Board

## 14 References

- ARUP. (2011). *Potential Policy Options to reduce greenhouse gas emissions: Technical Report (Draft)*. Client Report for Auckland Council. Auckland, New Zealand.
- ASP3.2 Application Report (2008) (model user manual).
- Auckland City Open Space Framework 'Our Collective Taonga: Places for People, Places for Nature', 2008. (2008) Auckland City Council.
- Auckland Council (2011). Technical Workstream Draft Auckland Plan: Business and Employment Growth.
- Auckland Council. (2011) Technical Workstream Draft Auckland Plan: Housing.
- Auckland Council. (2011) Technical Workstream Draft Auckland Plan: Social Infrastructure.
- Auckland Council. (2011) Technical Workstream Draft Auckland Plan: The Approach to Implementation and Funding.
- Auckland Regional Council. (2002) Auckland Regional Economic Development Strategy.
- Auckland Regional Council. (2010) Auckland Regional Growth Corridors Report
- Auckland Regional Council 2005. Auckland Regional Open space Strategy.
- Auckland Regional Council. (2008) Regional Energy Database.
- Auckland Regional Council. (2009) Industry Snapshot for the Auckland Region: The Manufacturing Sector.
- Auckland Regional Council. (2009) Issues and Options: Climate Change.
- Auckland Regional Council. (2010) State of the Environment report for the Auckland region.
- Auckland Regional Council. (2010) Future Land Use and Transport Planning Project
- Auckland Regional Growth Strategy, 1999. (1999) Auckland Regional Council.
- Auckland Regional Policy Statement, 1999. (1999) Auckland Regional Council.
- Beacon Pathway Ltd. (2010) The determinants of tenure and location choices for 20-40 year old households in the Auckland Region. Centre for Housing Research Aotearoa New Zealand
- Business Land and Economy Group. (2007) Auckland Region Greenfield Business Land Report.
- Business Land and Economy Group. (2007) Report on the findings of the Business Land and Economy Group.
- CHRANZ. (2006) Fact Sheet: Affordable Housing in New Zealand, prepared for the National Summit – Affordable Housing. Wellington.
- DTZ New Zealand. (2005) *Housing Tenure Aspirations and Attainment*. A report for the Centre of Housing Research Aotearoa New Zealand, Wellington.
- Ministry of Social Development. (2008) *Social Report*. As reported in Royal Commission on Auckland Governance, Volume 1, Part 3 Vision for Auckland
- Regional Growth Forum: Auckland Regional Council. (2003) *Regional Affordable Housing Strategy*.
- Royal Commission on Social Policy (1988) *The April Report* Royal Commission on Social Policy: Wellington.

Rutherford, R. (2009) Transport Planning Solutions: *Auckland Regional Rural Transport Issues, Regional Land Transport Strategy Working Report No.10*, Auckland Regional Council.

Social Infrastructure Planning Framework for Waitakere City, 2007. (2007) Waitakere City Council.

Te Manatu Taonga Ministry for Culture and Heritage. (no date) *Cultural Wellbeing - What is it?*  
[online] <http://www.culturalwellbeing.govt.nz/what-cultural-well-being>.

# 15 Appendices

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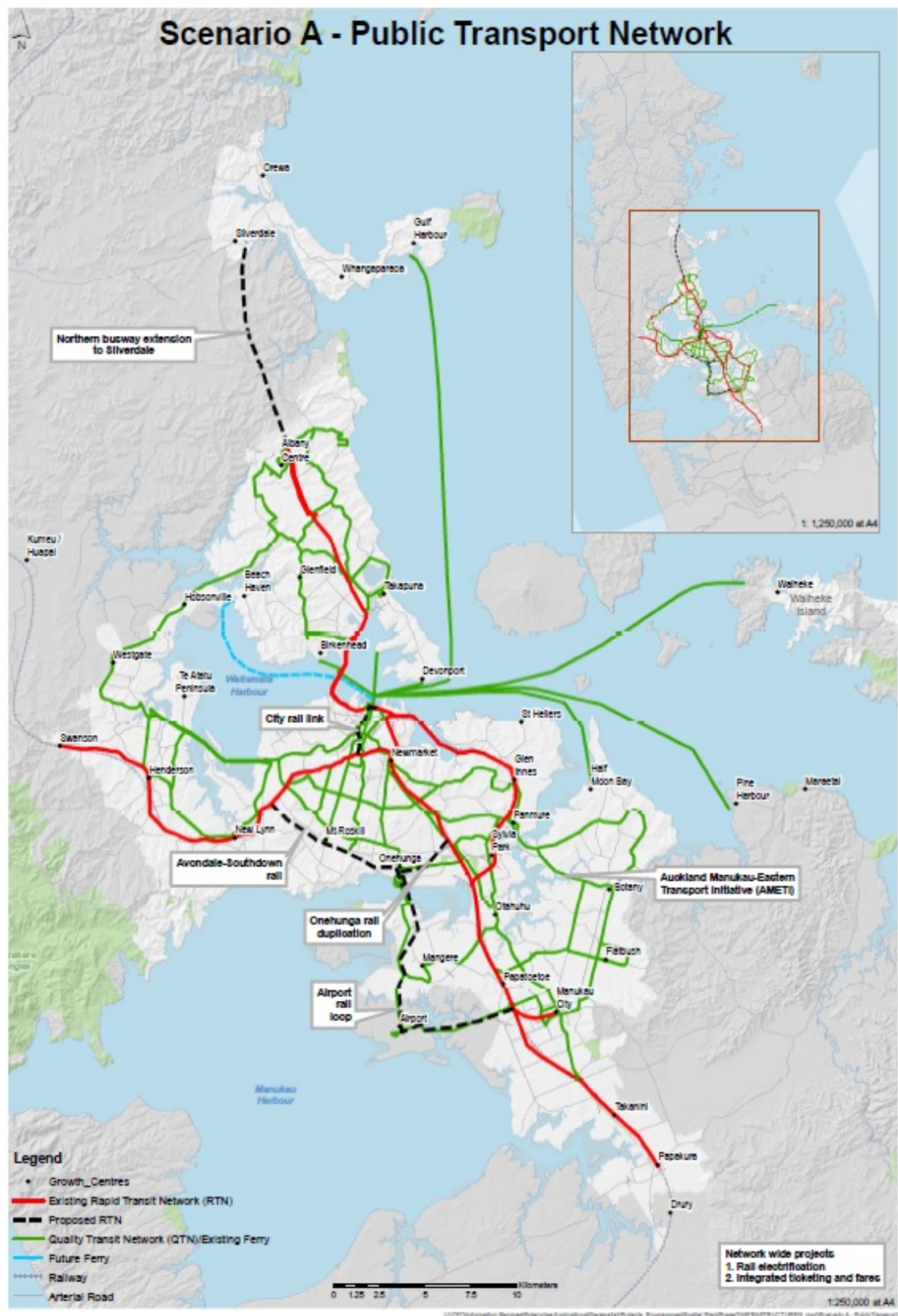
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### *Maps*

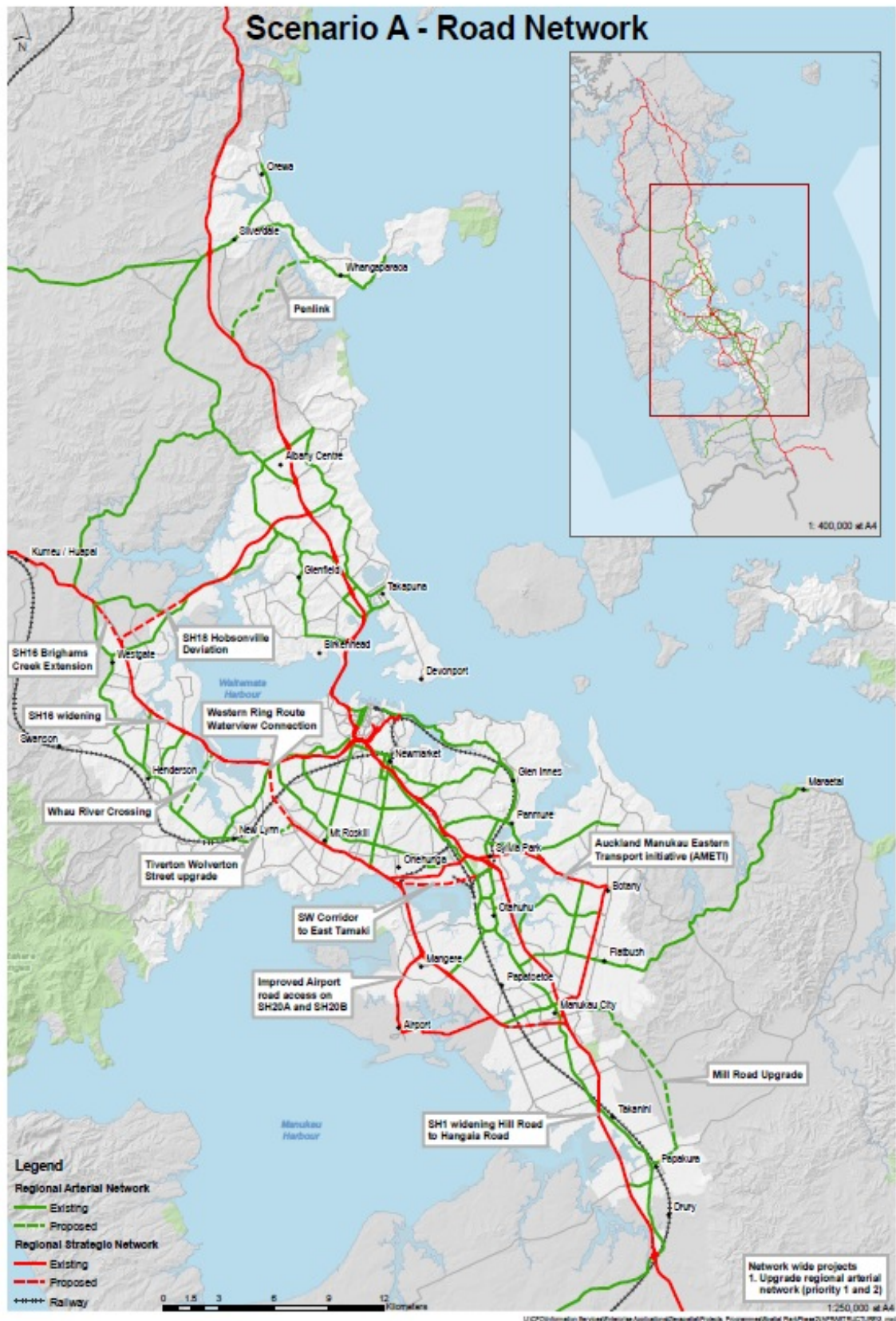
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## 15.2 Appendix 2 – Transport network maps

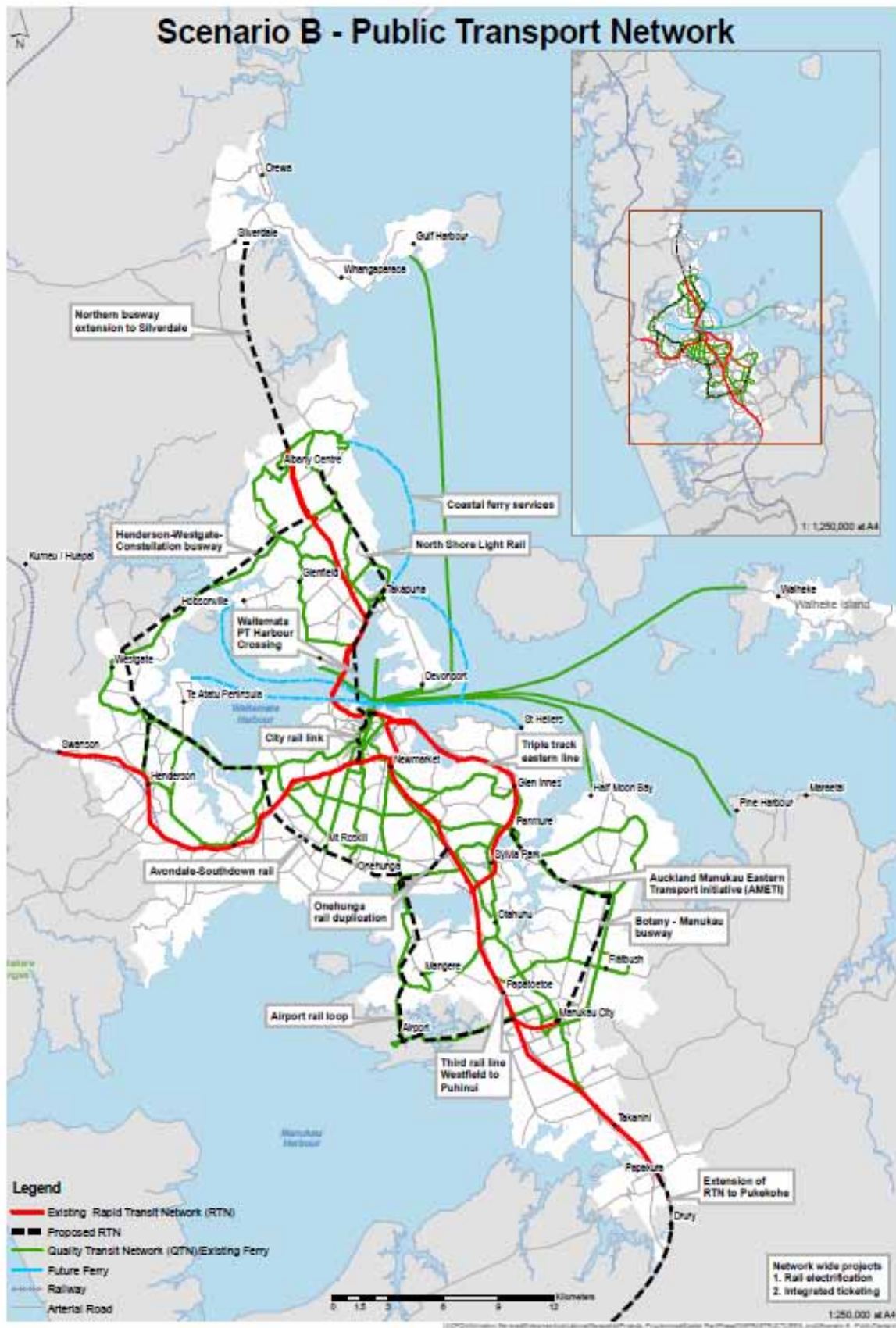
Map 11 - Scenario A - public transport network



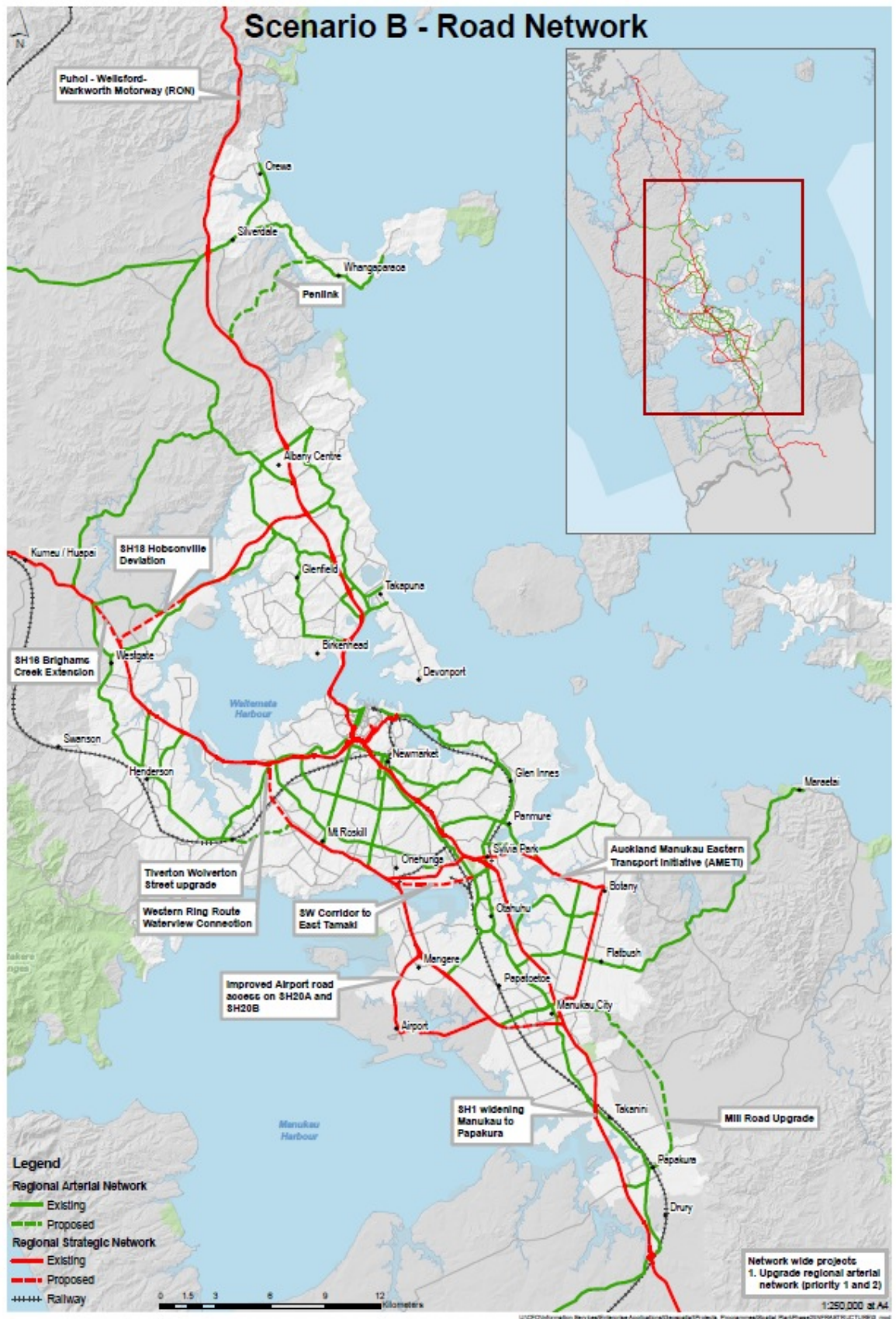
Map 12 - Scenario A - road network



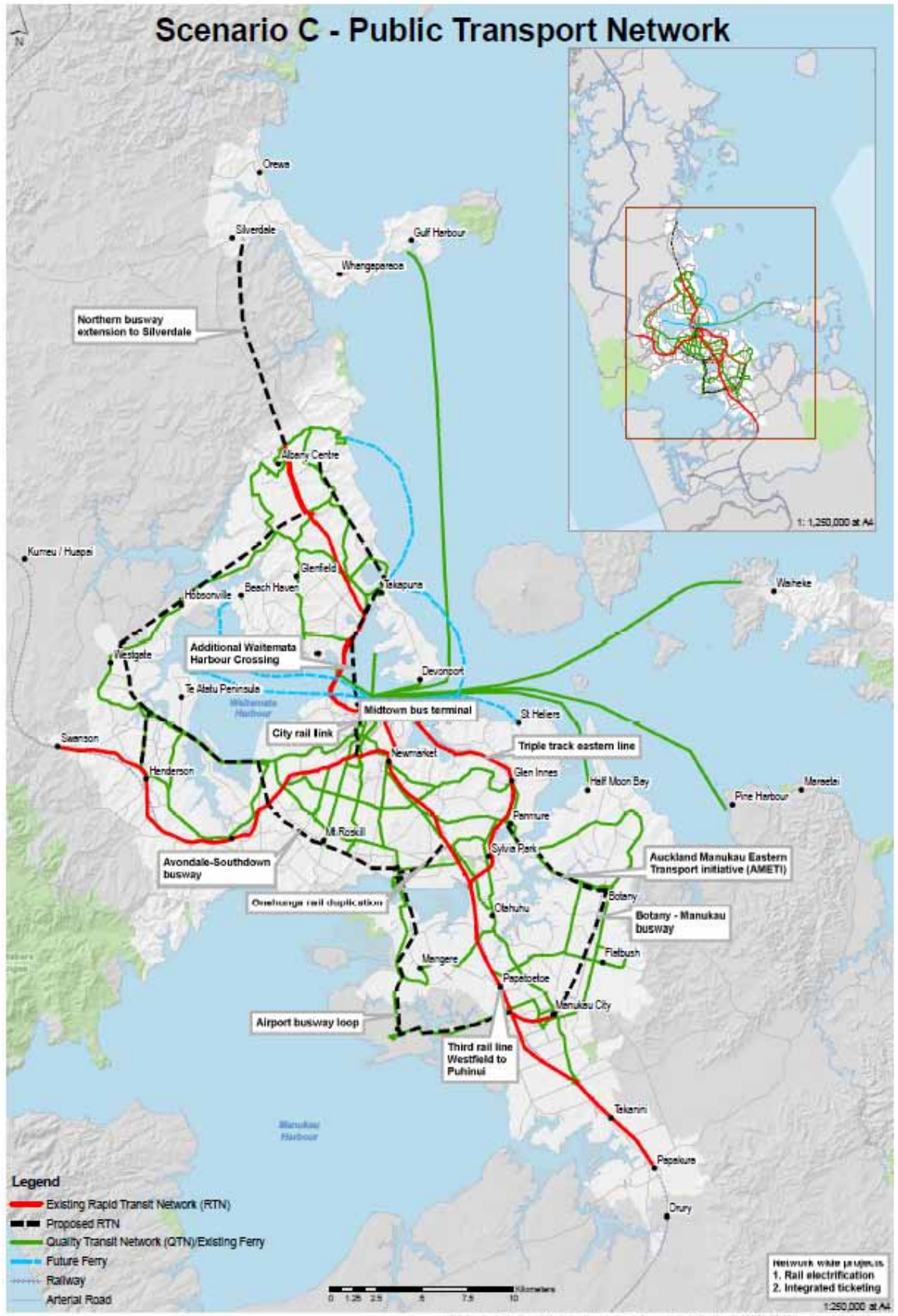
Map 13 - Scenario B - public transport network



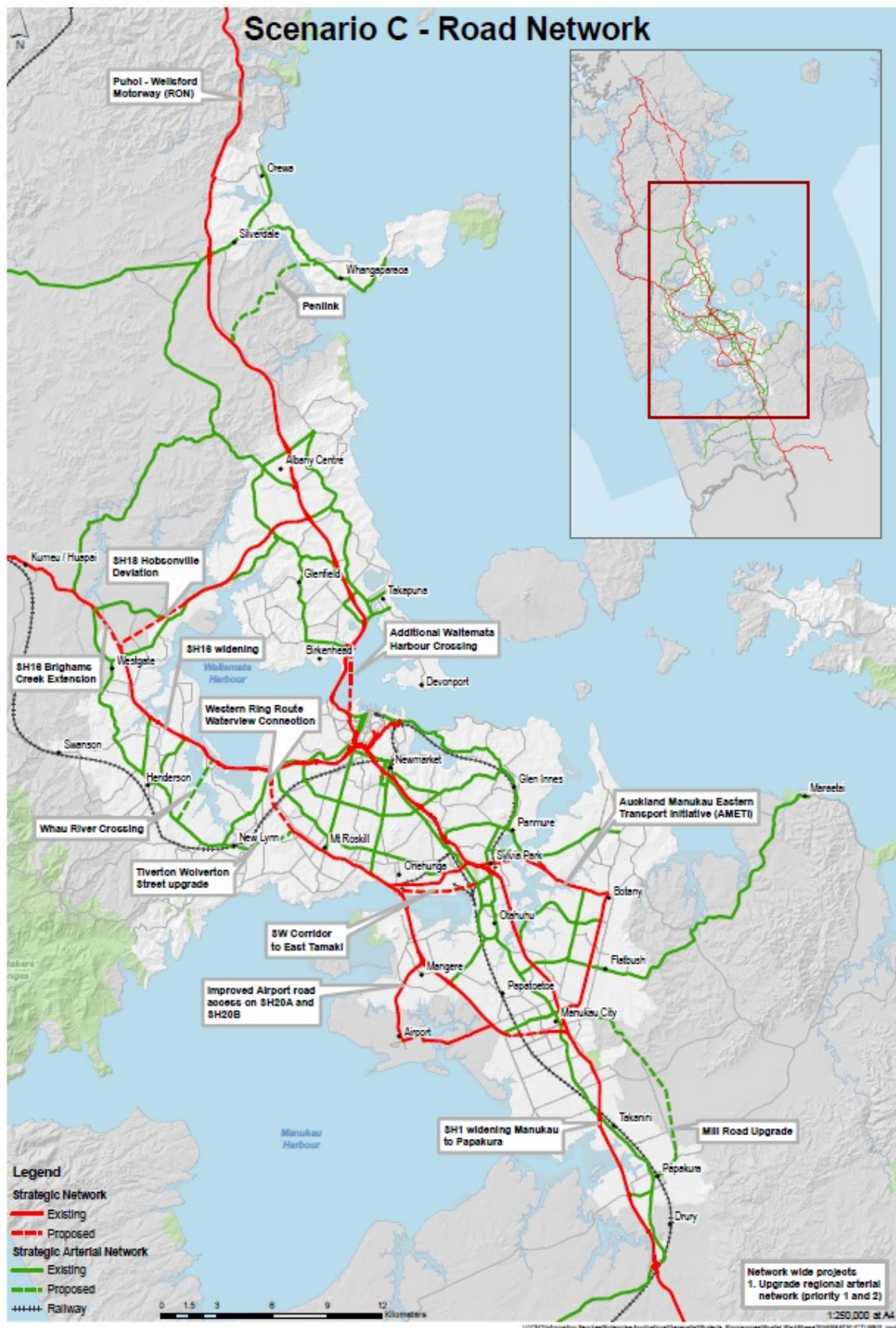
Map 14 - Scenario B - road network



Map 15 - Scenario C - public transport network

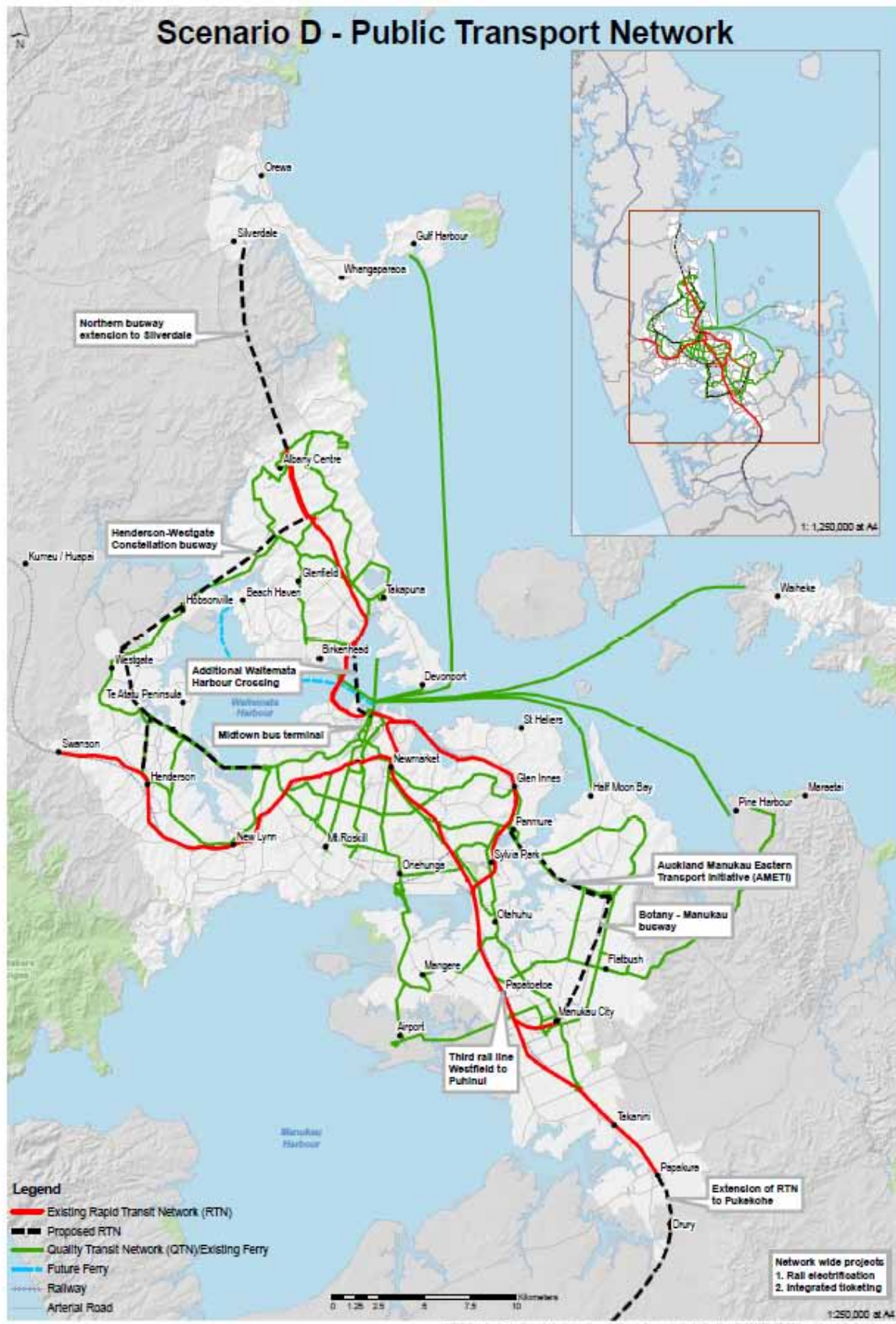


Map 16 - Scenario C - road network

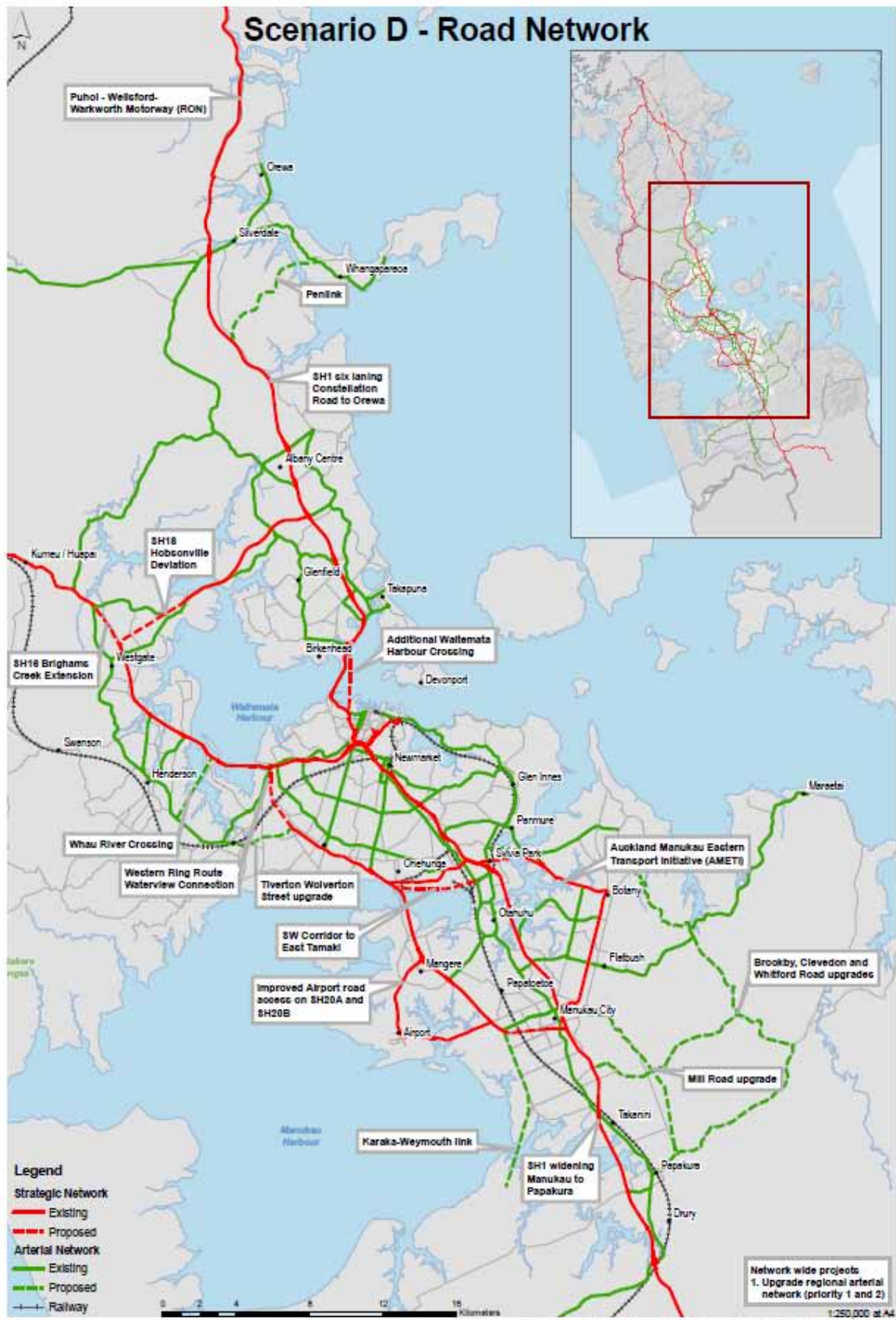




Map 17 - Scenario D - public transport network



Map 18 - Scenario D - road network



### 15.3 Appendix 3 – Comparison of major transport projects

Project	Scenario A	Scenario B	Scenario C	Scenario D
Puhoi Wellsford Motorway Extension	No	Yes	Yes	Yes
Additional peripheral roading for new urban areas (north)	No	No	Yes	Yes
SH1 6 laning Constellation Rd to Orewa	No	No	No	Yes
North Shore Rail	No	Yes	No	No
Additional Waitemata Harbour Crossing	No	Rail crossing only	Road crossing only	Road crossing only
Whau River Crossing	Yes	No	Yes	Yes
Henderson-Westgate-Constellation RTN Busway	No	Yes	No	Yes
City Centre Rail Link	Yes	Yes	Yes	No
City Centre midtown bus tunnel and bus interchange station (for North Shore bus services)	No	No	Yes	Yes
Avondale to Southdown RTN	Yes - Rail Link	Yes - Rail Link	Yes - Busway	No
Onehunga rail duplication	Yes	Yes	Yes	No
Sth Western to East Tamaki Corridor	No	Yes	Yes	Yes
Third rail line on eastern line	No	Yes	Yes	No
Airport RTN	Yes - Rail Link	Yes - Rail Link	Yes - Busway	No
Third Rail Line Westfield to Puhinui	No	Yes	Yes	Yes
Botany to Flat Bush to Manukau RTN busway extension	No	Yes	Yes	Yes
Improvements to SH22 and SH16	No	No	Yes	Yes
Mill Rd Arterial Corridor Upgrade	Yes to Papakura only	Yes to Papakura only	Yes to Papakura only	Yes to Drury
SH1 widening from Manukau to Papakura	No	Yes	Yes	Yes
Bridge to Karaka	No	No	No	Yes
Extension of RTN rail network (electrification) to Pukekohe	No	Yes	No	Yes
Additional peripheral roading for new urban areas (south)	No	No	Yes	Yes

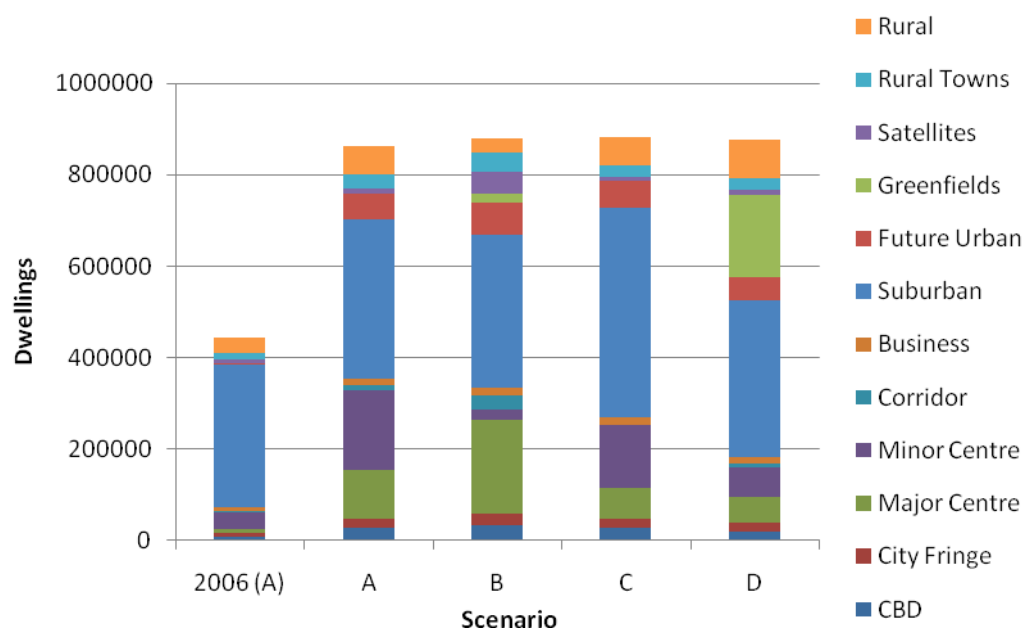
## 15.4 Appendix 4 – Comparison of scenario capacities

### 15.4.1 Total dwellings and employment capacity provided in each scenario

**Table 14 Total number of dwellings by location**

Totals (#)	Dwellings (Scenario A definition used for comparison)				
	2006 (A)	A	B	C	D
CBD	9,363	27,000	35,000	27,000	20,000
City Fringe	7,893	20,000	25,000	20,000	20,000
Major Centre	9,045	108,000	203,783	67,412	56,539
Minor Centre	35,022	173,600	22,639	138,600	64,362
Corridor	4,209	10,000	30,000	0	6,241
Business	8,856	16,097	17,259	17,142	15,647
Suburban	311,169	348,577	335,601	457,400	342,982
Future Urban	3,219	54,535	68,178	58,291	50,035
Greenfields	0	0	21,568	0	180,518
Satellites	6,294	11,813	46,299	10,133	11,499
Rural Towns	15,174	30,345	43,500	23,199	23,126
Rural	33,783	62,714	31,176	62,143	86,017
<b>TOTAL</b>	<b>444,027</b>	<b>862,681</b>	<b>880,003</b>	<b>881,320</b>	<b>876,966</b>

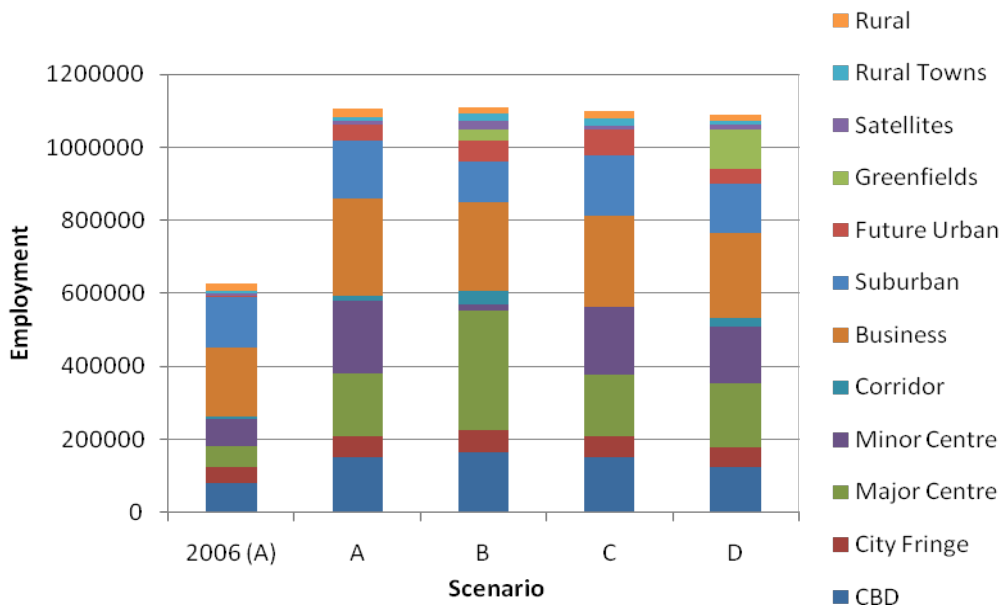
**Figure 44 Total number of dwellings by location**



**Table 15 Total number of employees by location**

Totals (#)	Employment (Scenario A definition used for comparison)				
	2006 (A)	A	B	C	D
CBD	82,097	150,000	165,000	150,000	125,000
City Fringe	41,321	60,000	60,000	60,000	55,000
Major Centre	59,183	171,020	327,208	168,300	172,755
Minor Centre	73,359	197,283	16,713	183,279	156,474
Corridor	8,222	16,500	37,485	0	21,728
Business	186,233	265,597	243,400	250,813	234,584
Suburban	139,402	156,928	111,128	166,200	135,504
Future Urban	3,810	44,189	57,963	68,984	38,590
Greenfields	0	0	29,584	0	109,000
Satellites	5,027	11,052	24,160	11,926	11,605
Rural Towns	8,514	10,770	18,531	17,927	13,217
Rural	21,329	21,939	17,978	21,419	14,338
<b>TOTAL</b>	<b>628,497</b>	<b>1,105,279</b>	<b>1,109,150</b>	<b>1,098,848</b>	<b>1,087,795</b>

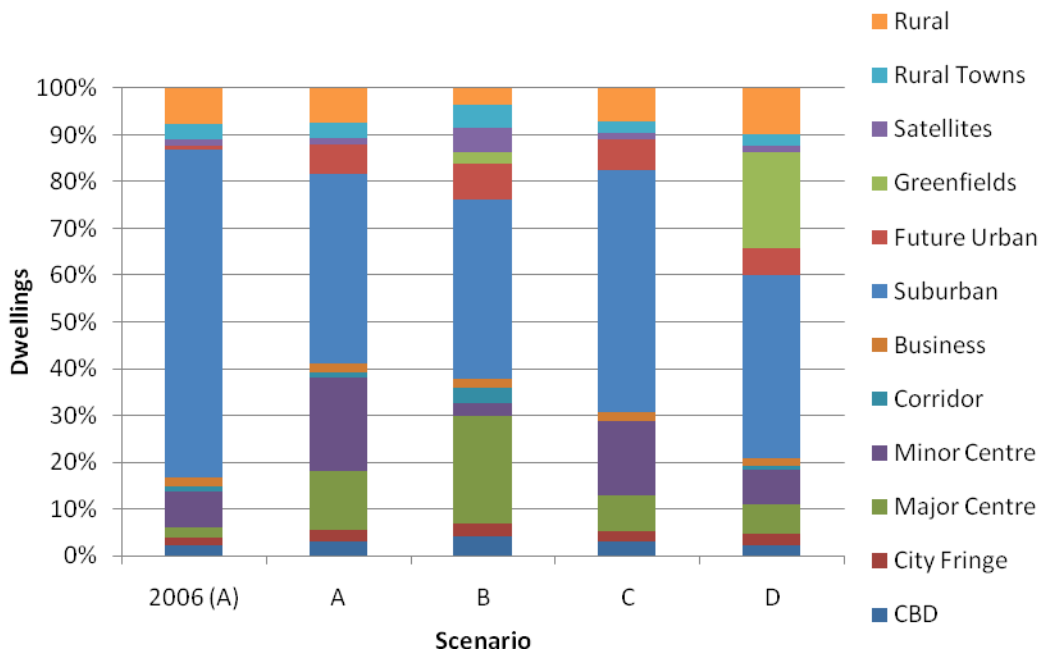
**Figure 45 Total number of employees by location**



**Table 16 Total percentage of dwellings by location**

Totals (%)	Dwellings (Scenario A definition used for comparison)				
	2006 (A)	A	B	C	D
CBD	2.1%	3.1%	4.0%	3.1%	2.3%
City Fringe	1.8%	2.3%	2.8%	2.3%	2.3%
Major Centre	2.0%	12.5%	23.2%	7.6%	6.4%
Minor Centre	7.9%	20.1%	2.6%	15.7%	7.3%
Corridor	0.9%	1.2%	3.4%	0.0%	0.7%
Business	2.0%	1.9%	2.0%	1.9%	1.8%
Suburban	70.1%	40.4%	38.1%	51.9%	39.1%
Future Urban	0.7%	6.3%	7.7%	6.6%	5.7%
Greenfields	0.0%	0.0%	2.5%	0.0%	20.6%
Satellites	1.4%	1.4%	5.3%	1.1%	1.3%
Rural Towns	3.4%	3.5%	4.9%	2.6%	2.6%
Rural	7.6%	7.3%	3.5%	7.1%	9.8%
<b>TOTAL</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

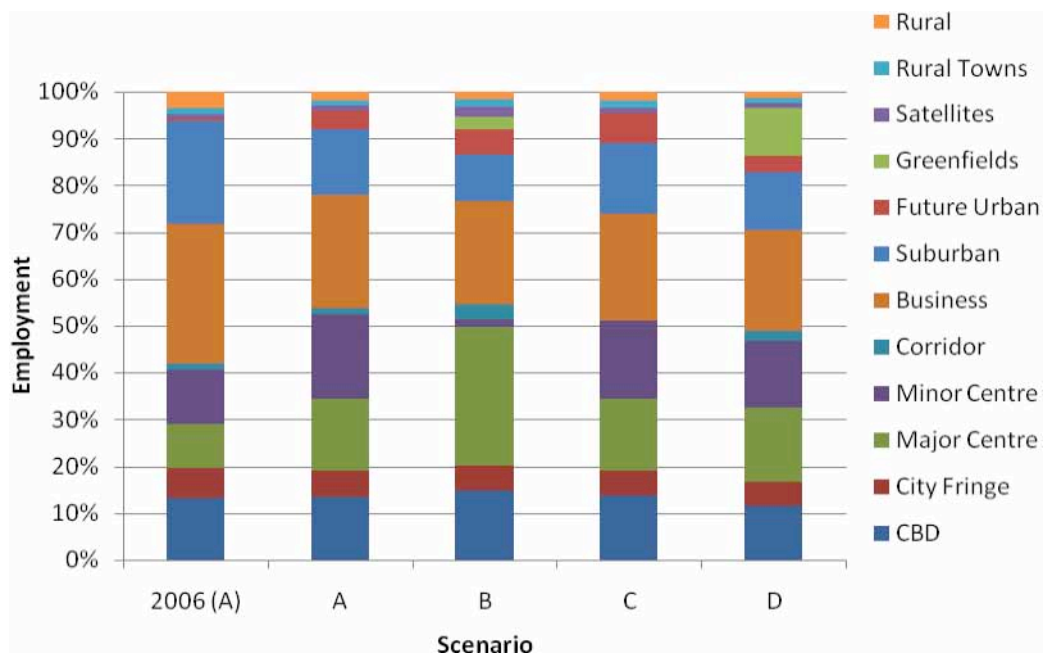
**Figure 46 Total percentage of dwellings by location**



**Table 17 Total percentage of employees by location**

Totals (%)	Employment (Scenario A definition used for comparison)				
	2006 (A)	A	B	C	D
CBD	13.1%	13.6%	14.9%	13.7%	11.5%
City Fringe	6.6%	5.4%	5.4%	5.5%	5.1%
Major Centre	9.4%	15.5%	29.5%	15.3%	15.9%
Minor Centre	11.7%	17.8%	1.5%	16.7%	14.4%
Corridor	1.3%	1.5%	3.4%	0.0%	2.0%
Business	29.6%	24.0%	21.9%	22.8%	21.6%
Suburban	22.2%	14.2%	10.0%	15.1%	12.5%
Future Urban	0.6%	4.0%	5.2%	6.3%	3.5%
Greenfields	0.0%	0.0%	2.7%	0.0%	10.0%
Satellites	0.8%	1.0%	2.2%	1.1%	1.1%
Rural Towns	1.4%	1.0%	1.7%	1.6%	1.2%
Rural	3.4%	2.0%	1.6%	1.9%	1.3%
<b>TOTAL</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

**Figure 47 Total percentage of employees by location**

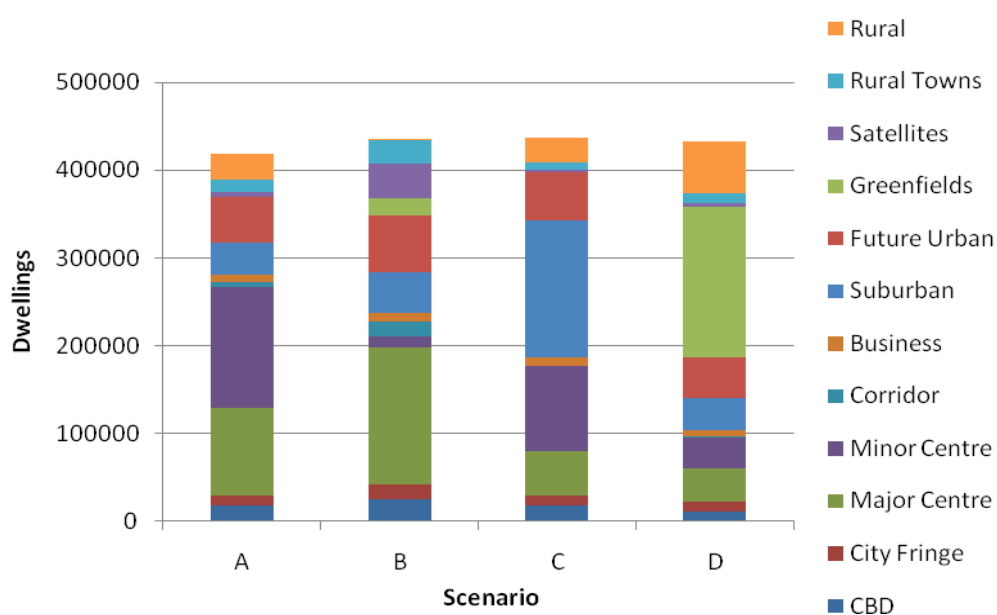


## 15.4.2 Total change in dwellings and employment capacity provided in each scenario

**Table 18 Change in number of dwellings by location**

Change (#)	Dwellings (Change relative to Scenario Definition)			
	A	B	C	D
CBD	17,637	25,637	17,637	10,637
City Fringe	12,107	17,107	12,107	12,107
Major Centre	98,955	154,688	50,327	37,672
Minor Centre	138,578	13,333	97,284	35,523
Corridor	5,791	17,187	0	739
Business	7,241	8,904	8,781	7,067
Suburban	37,408	47,061	155,861	36,448
Future Urban	51,316	64,653	55,072	47,212
Greenfields	0	19,699	0	170,519
Satellites	5,519	38,367	3,338	4,704
Rural Towns	15,171	29,286	8,355	10,409
Rural	28,931	54	28,531	59,902
<b>TOTAL</b>	<b>418,654</b>	<b>435,976</b>	<b>437,293</b>	<b>432,939</b>

**Figure 48 Change in number of dwellings by location**

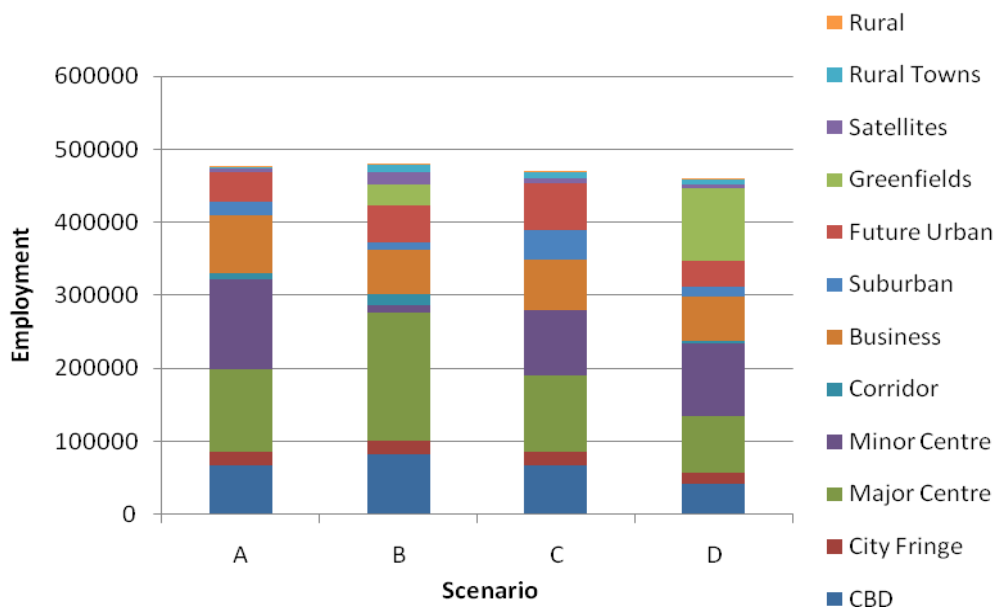




**Table 19 Change in number of employees by location**

Change (#)	Employment (Change Relative to Scenario Definition)			
	A	B	C	D
CBD	67,903	82,903	67,903	42,903
City Fringe	18,679	18,679	18,679	13,679
Major Centre	111,837	175,269	103,418	78,998
Minor Centre	123,924	9,652	89,161	98,365
Corridor	8,278	15,680	0	3,498
Business	79,364	60,737	70,295	61,056
Suburban	17,526	9,012	39,319	13,234
Future Urban	40,379	51,856	65,174	35,203
Greenfields	0	28,195	0	99,831
Satellites	6,025	16,994	6,017	5,696
Rural Towns	2,256	11,616	10,064	6,676
Rural	610	60	321	159
<b>TOTAL</b>	<b>476,782</b>	<b>480,653</b>	<b>470,351</b>	<b>459,298</b>

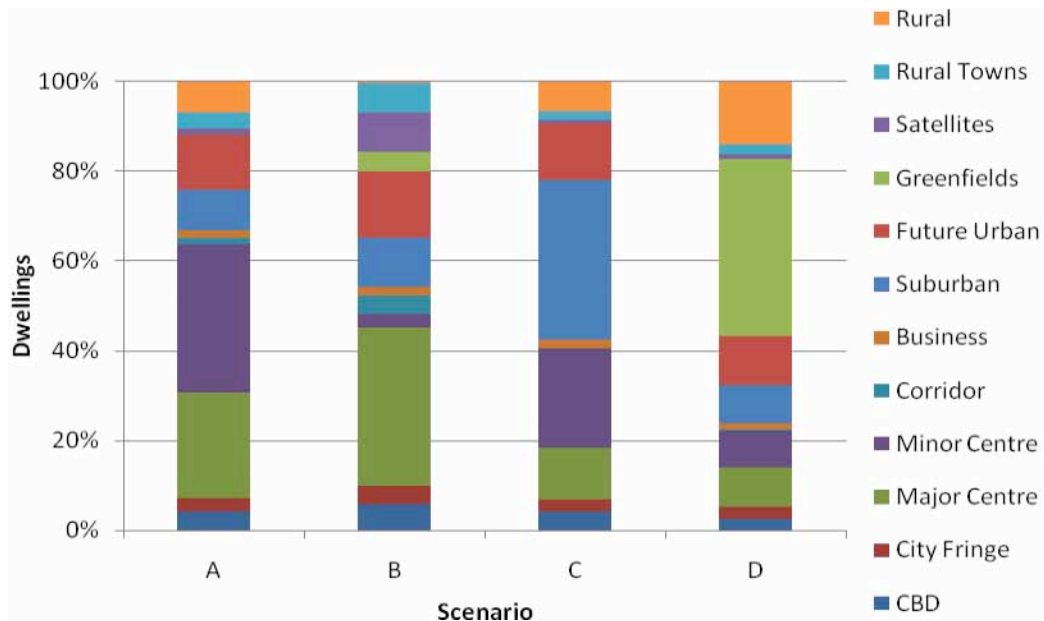
**Figure 49 Change in number of employees by location**



**Table 20 Percentage change in dwellings by location**

Change (%)	Dwellings (Change relative to Scenario Definition)			
	A	B	C	D
CBD	4.2%	5.9%	4.0%	2.5%
City Fringe	2.9%	3.9%	2.8%	2.8%
Major Centre	23.6%	35.5%	11.5%	8.7%
Minor Centre	33.1%	3.1%	22.2%	8.2%
Corridor	1.4%	3.9%	0.0%	0.2%
Business	1.7%	2.0%	2.0%	1.6%
Suburban	8.9%	10.8%	35.6%	8.4%
Future Urban	12.3%	14.8%	12.6%	10.9%
Greenfields	0.0%	4.5%	0.0%	39.4%
Satellites	1.3%	8.8%	0.8%	1.1%
Rural Towns	3.6%	6.7%	1.9%	2.4%
Rural	6.9%	0.0%	6.5%	13.8%
<b>TOTAL</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

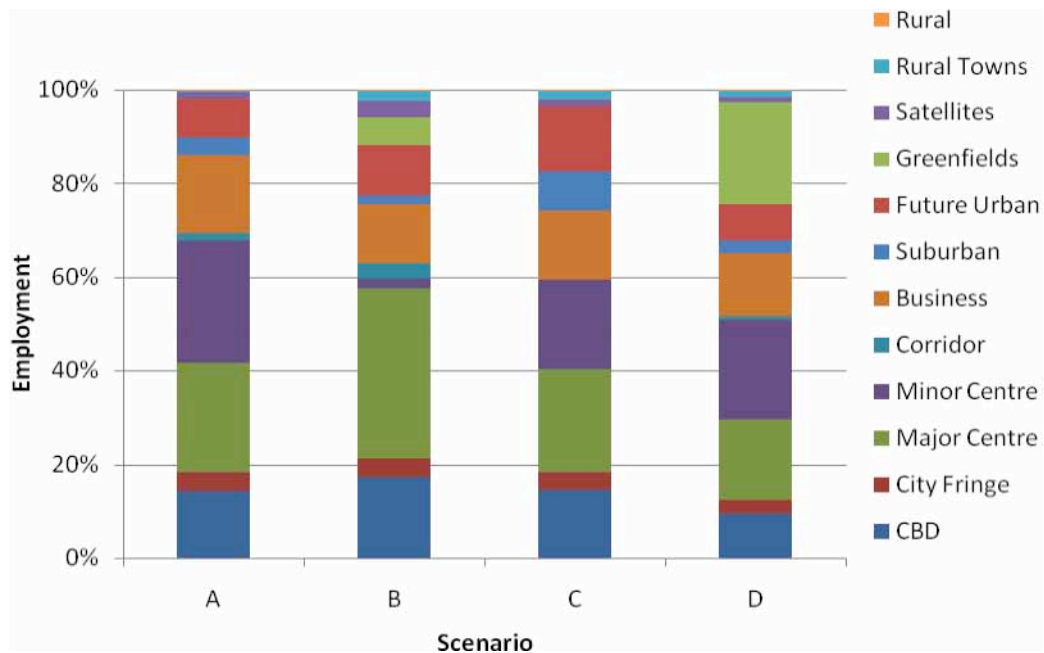
**Figure 50 Percentage change in dwellings by location**



**Table 21 Percentage change in employees by location**

Change (%)	Employment (Change relative to Scenario Definition)			
	A	B	C	D
CBD	14.2%	17.2%	14.4%	9.3%
City Fringe	3.9%	3.9%	4.0%	3.0%
Major Centre	23.5%	36.5%	22.0%	17.2%
Minor Centre	26.0%	2.0%	19.0%	21.4%
Corridor	1.7%	3.3%	0.0%	0.8%
Business	16.6%	12.6%	14.9%	13.3%
Suburban	3.7%	1.9%	8.4%	2.9%
Future Urban	8.5%	10.8%	13.9%	7.7%
Greenfields	0.0%	5.9%	0.0%	21.7%
Satellites	1.3%	3.5%	1.3%	1.2%
Rural Towns	0.5%	2.4%	2.1%	1.5%
Rural	0.1%	0.0%	0.1%	0.0%
<b>TOTAL</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

**Figure 51 Percentage change in employees by location**



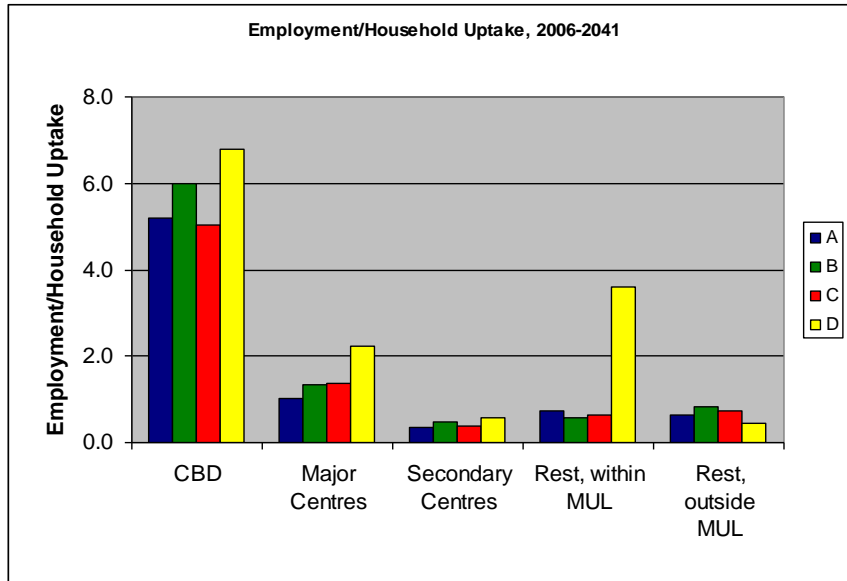
## 15.5 Appendix 5 – Additional graphs

The following graphs were all considered through the evaluation of the criteria but were not the focus of scoring and are therefore provided for reference.

### 15.5.1 Model outputs summary

#### *Land use outputs*

**Figure 52 Employment/household growth by area category 2006-2041**



**Figure 53 Employment growth 2006-2041 for retail, office, industrial, warehouse**

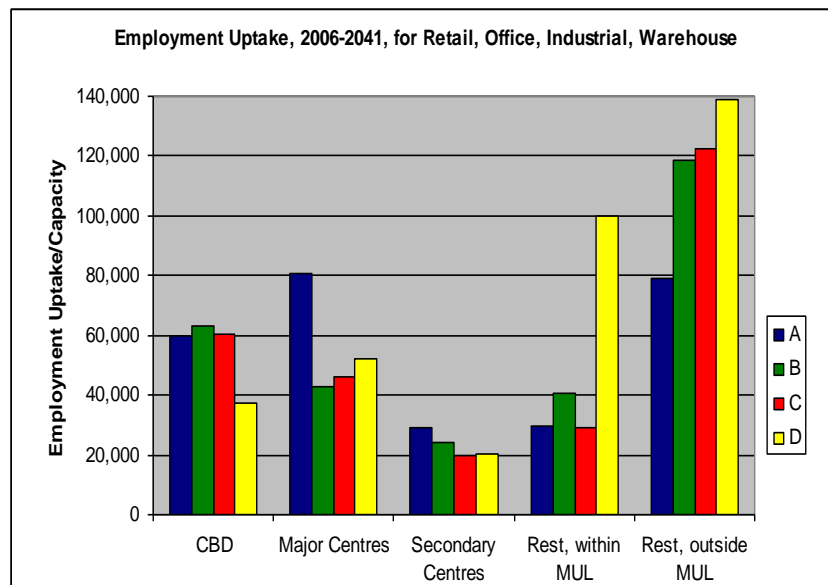


Figure 54 Household growth in major centres 2006-2041

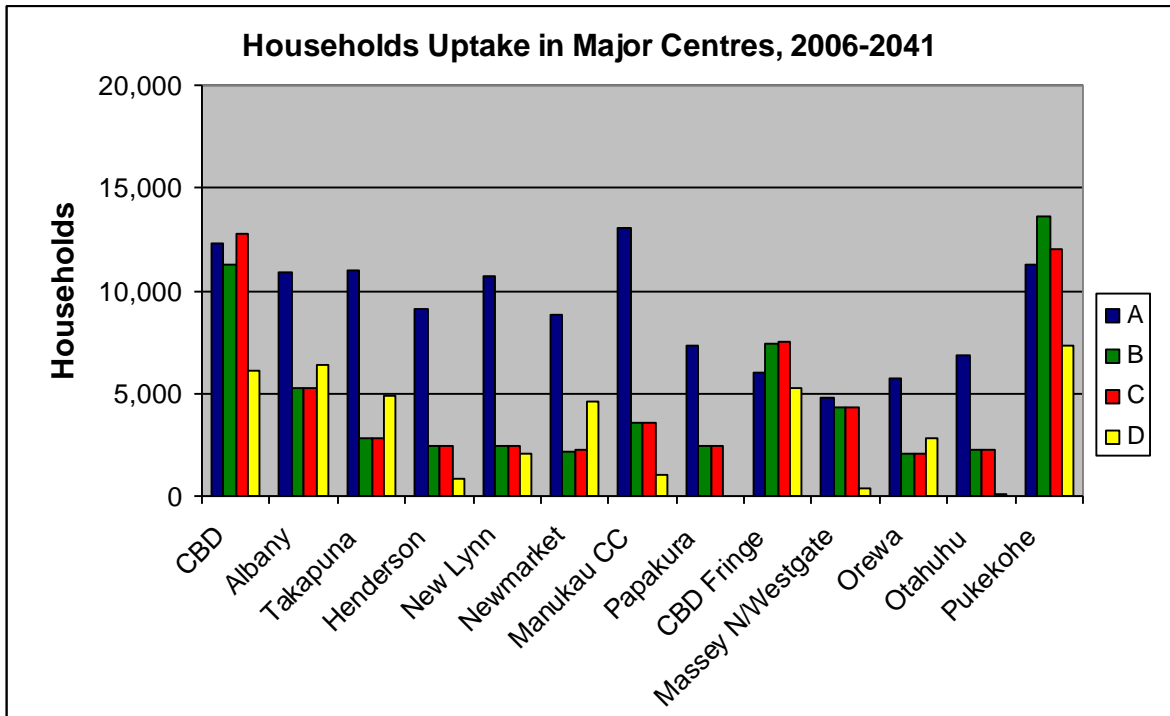


Figure 55 Employment growth in major centres 2006-2041

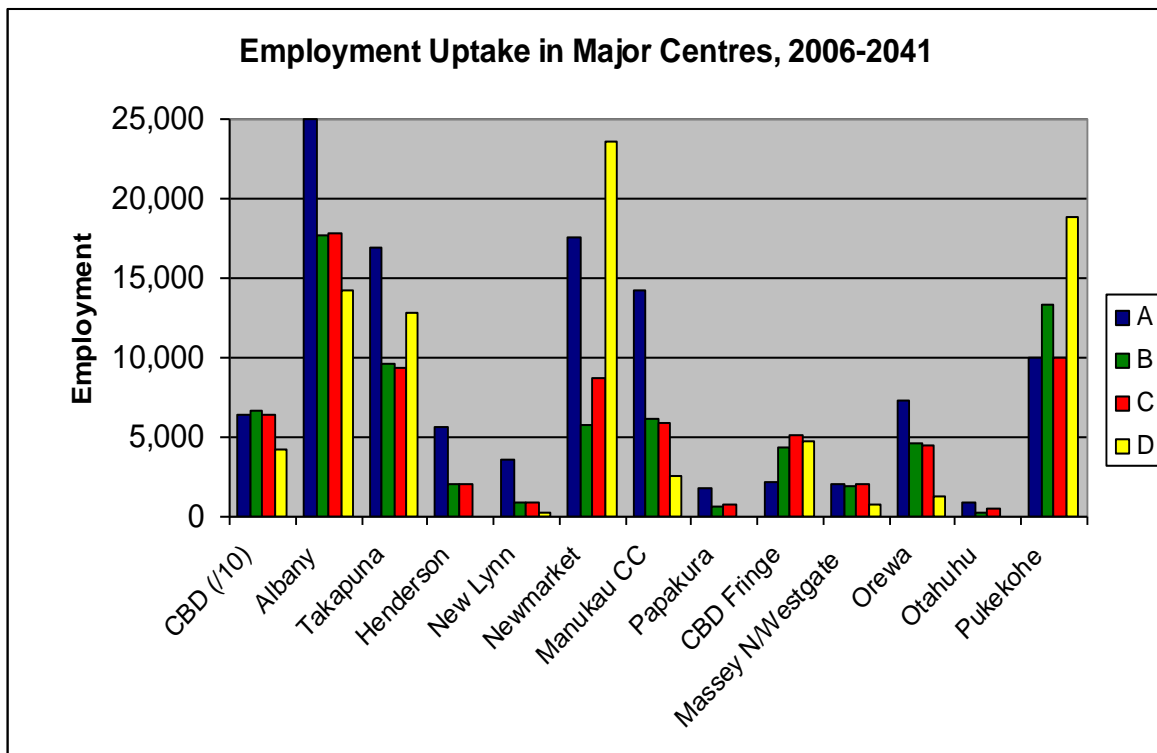


Figure 56 Employment vs household growth in major centres 2006-2041

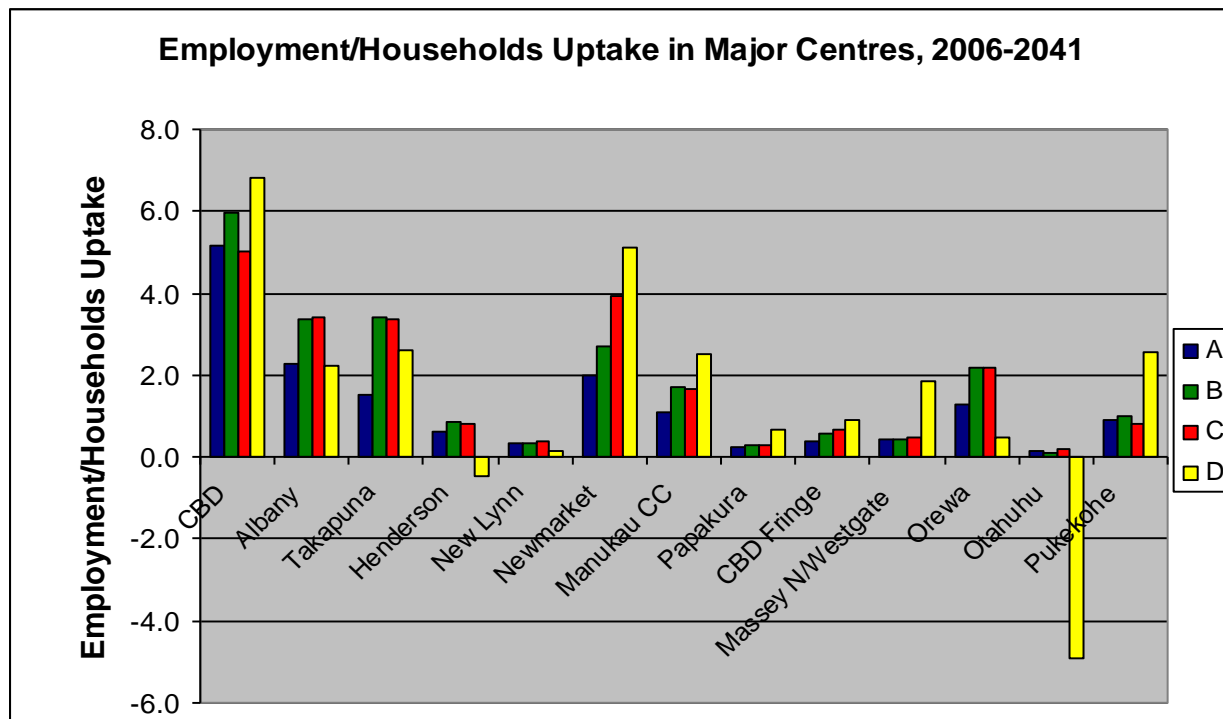


Figure 57 Household growth in secondary centres 2006-2041

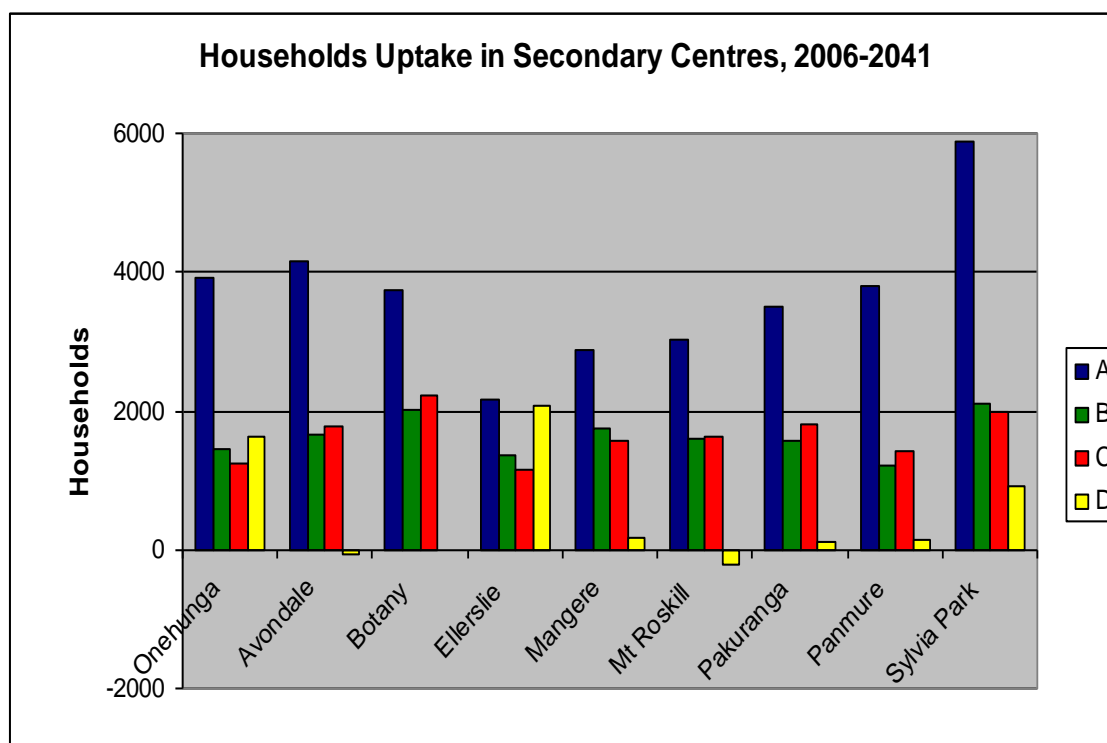


Figure 58 Employment growth in secondary centres 2006-2041

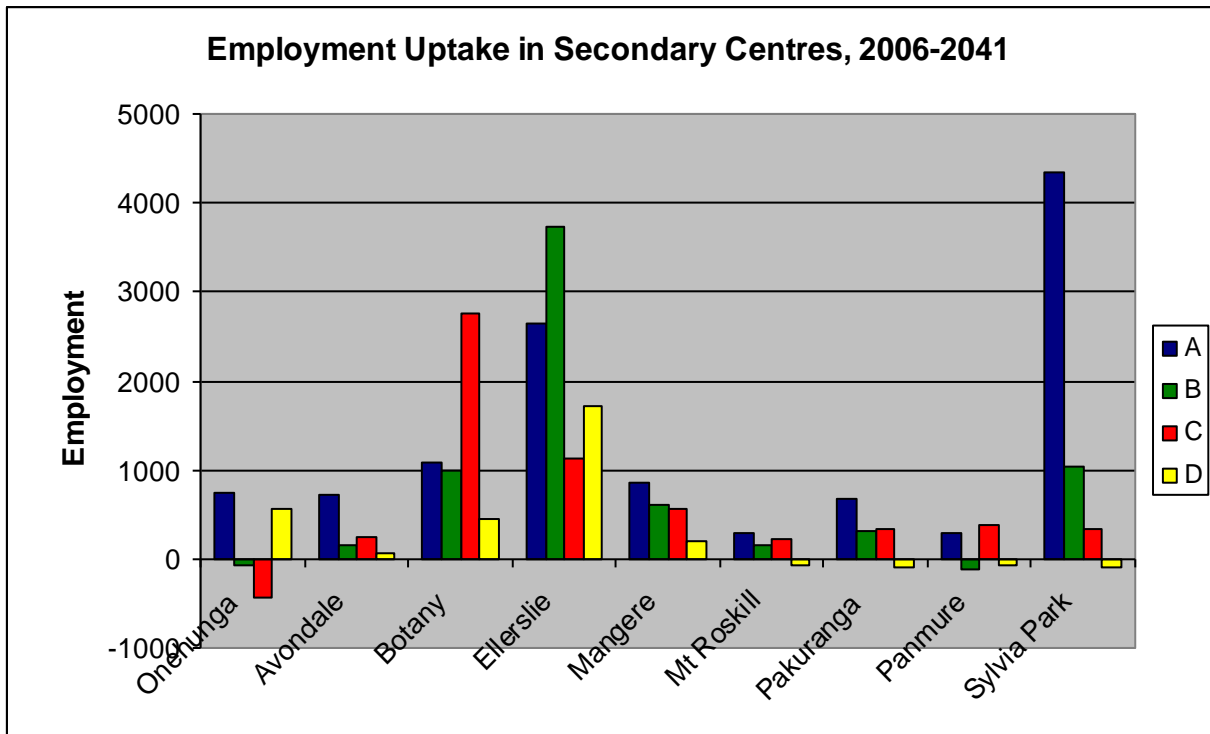
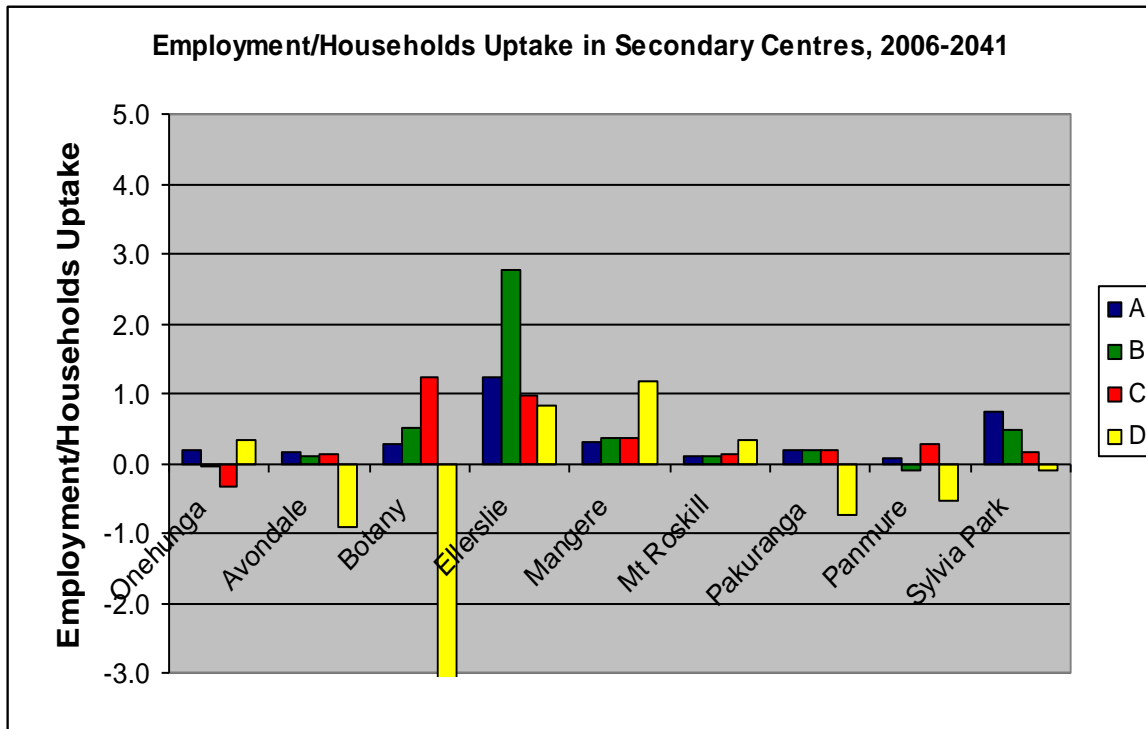


Figure 59 Household uptake in secondary centres 2006-2041



Transport outputs

Figure 60 PT demand vs supply

AM PT Sc	2006	Scenario A			Scenario B			Scenario C			Scenario D			
		2021	2031	2041	2021	2031	2041	2021	2031	2041	2021	2031	2041	
Hibiscus-North Shore	North	0.0	0.2	0.2	0.1	0.2	0.3	0.2	0.2	0.3	0.2	0.1	0.1	0.1
	South	0.3	0.9	0.8	0.5	0.8	0.7	0.4	0.8	0.8	0.4	1.0	1.4	0.8
North Shore	North	0.1	0.4	0.4	0.3	0.3	0.3	0.2	0.3	0.4	0.4	0.2	0.2	0.2
	South	0.4	0.6	0.5	0.3	0.6	0.5	0.3	0.6	0.6	0.4	0.6	0.7	0.4
Waitemata Harbour	North	0.1	0.2	0.3	0.2	0.2	0.2	0.1	0.2	0.3	0.3	0.2	0.2	0.2
	South	0.4	0.6	0.5	0.4	0.5	0.5	0.3	0.6	0.6	0.4	0.6	0.8	0.5
West of Northern Motorway	East	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.3	0.4	0.3
	West	0.1	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2
Waitakere North	East	0.4	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.3	0.2	0.2
	West	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
Waitakere Central	East	0.5	0.5	0.3	0.2	0.5	0.3	0.2	0.5	0.3	0.3	0.4	0.4	0.3
	West	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
West Isthmus	East	0.5	0.5	0.3	0.2	0.5	0.4	0.3	0.5	0.3	0.3	0.4	0.4	0.3
	West	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Central Isthmus	North	0.5	0.5	0.4	0.4	0.5	0.4	0.4	0.5	0.4	0.4	0.5	0.5	0.5
	South	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
CBD	in	0.4	0.5	0.4	0.3	0.5	0.4	0.4	0.5	0.4	0.4	0.5	0.5	0.4
	out	0.1	0.2	0.2	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
East Tamaki	North	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	South	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
South Isthmus	North	0.6	0.4	0.2	0.2	0.3	0.2	0.2	0.4	0.3	0.3	0.4	0.5	0.5
	South	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Manukau	North	0.4	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.4	0.6	0.7
	South	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Manurewa-Takanini	North	0.3	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.3	0.4	0.5
	South	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West of Southern Motorway	East	0.3	0.2	0.2	0.3	0.2	0.2	0.3	0.2	0.3	0.3	0.3	0.3	0.3
	West	0.3	0.2	0.2	0.3	0.2	0.2	0.3	0.2	0.3	0.3	0.3	0.3	0.3

15.5.2 Economic wellbeing graphs

Improved travel reliability

Figure 61 Percentage of congested VKT (arterial roads)

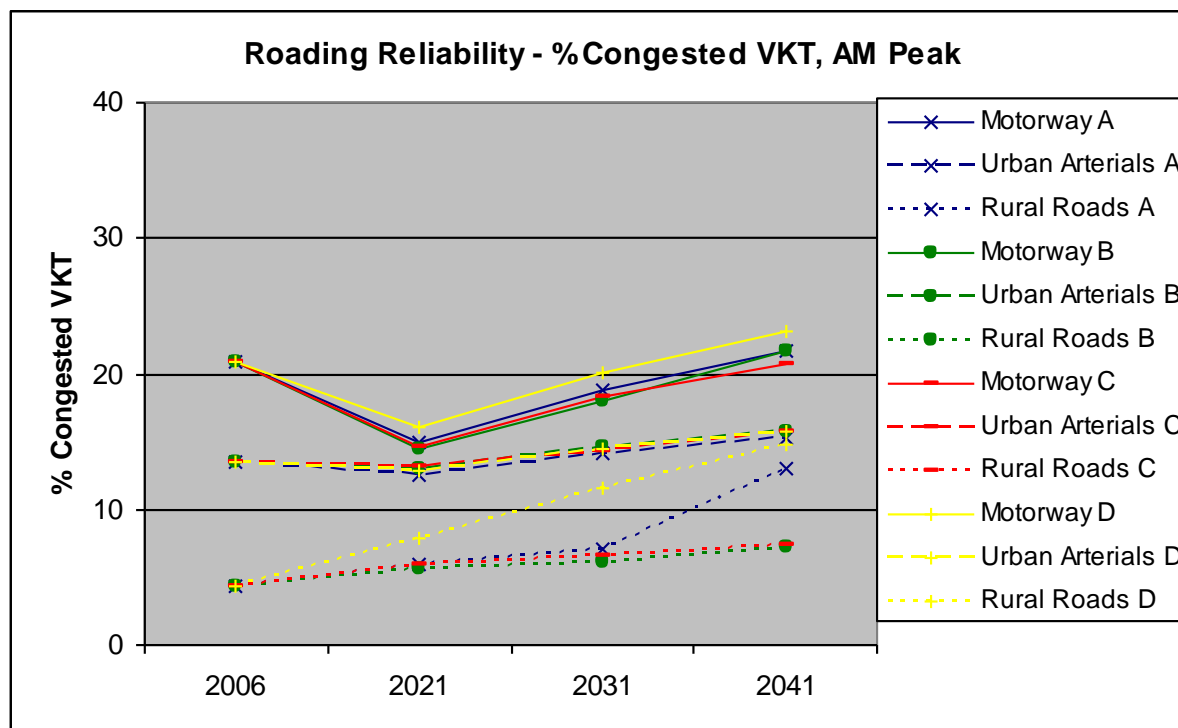




Figure 62 Percentage of congested VKT (north and central)

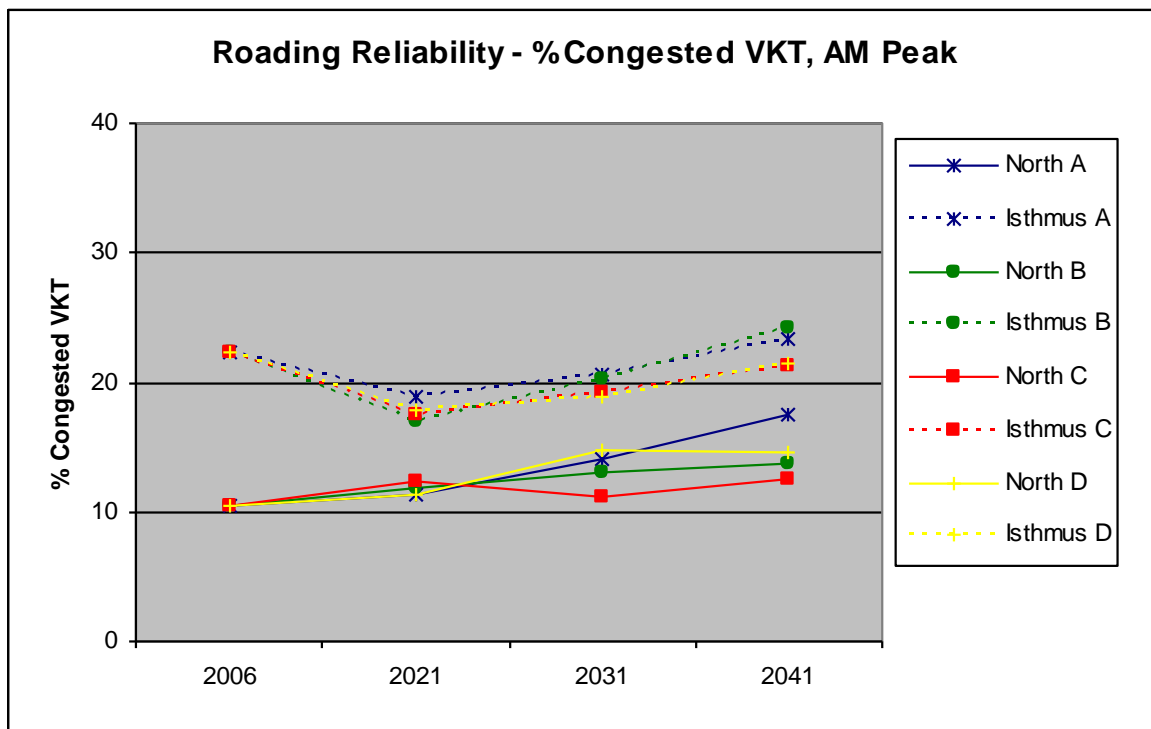


Figure 63 Percentage of congested VKT (west)

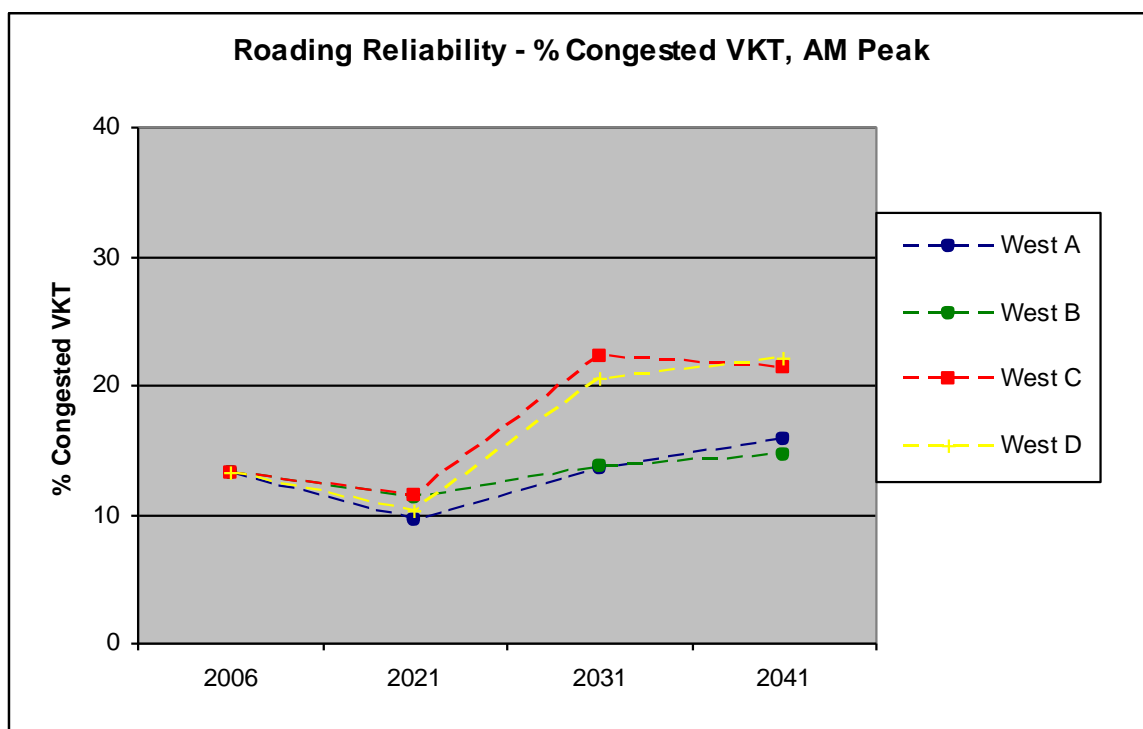


Figure 64 Percentage of congested VKT (south)

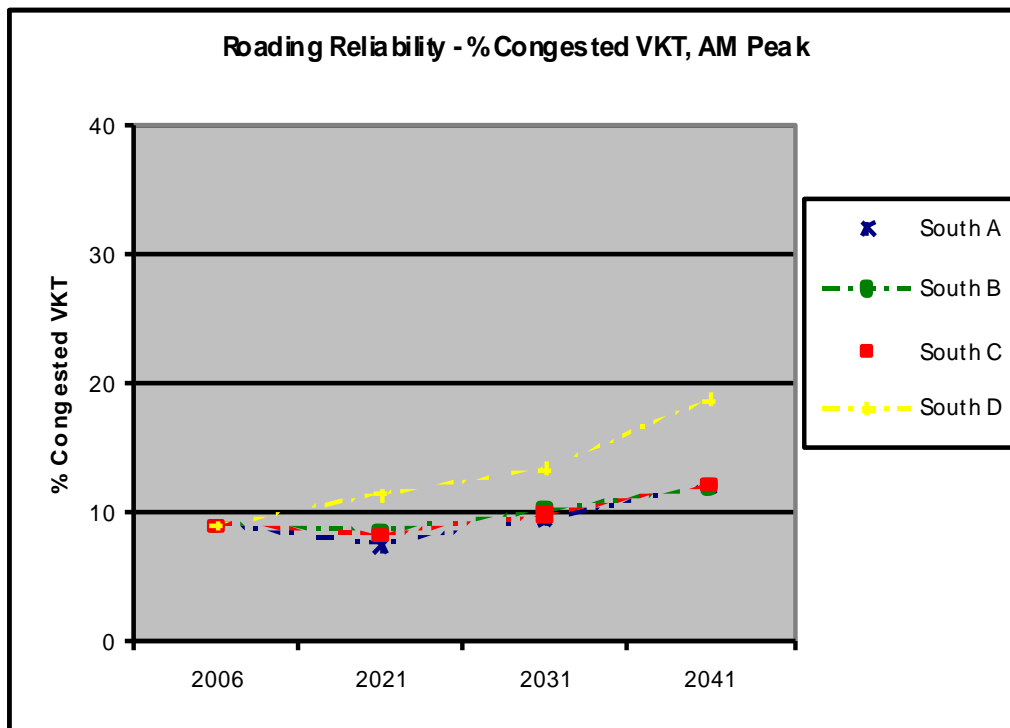


Figure 65 Percentage of congested VKT, Interpeak

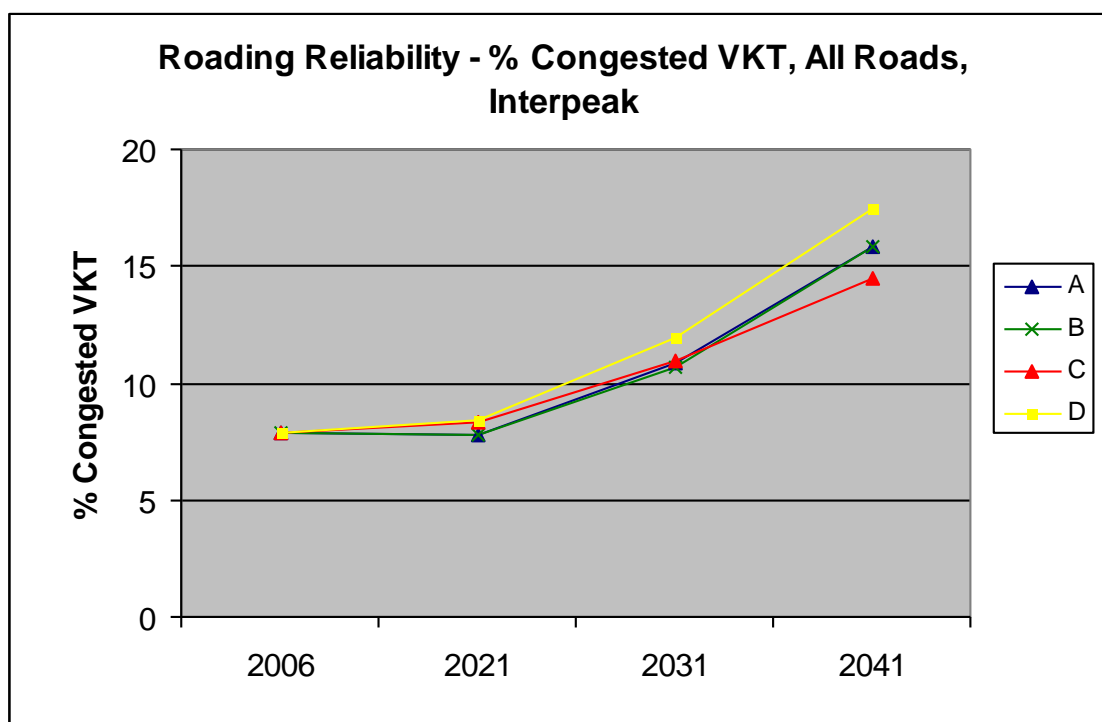


Figure 66 Percentage of congested car VKT on QTN in north and central (no bus lanes)

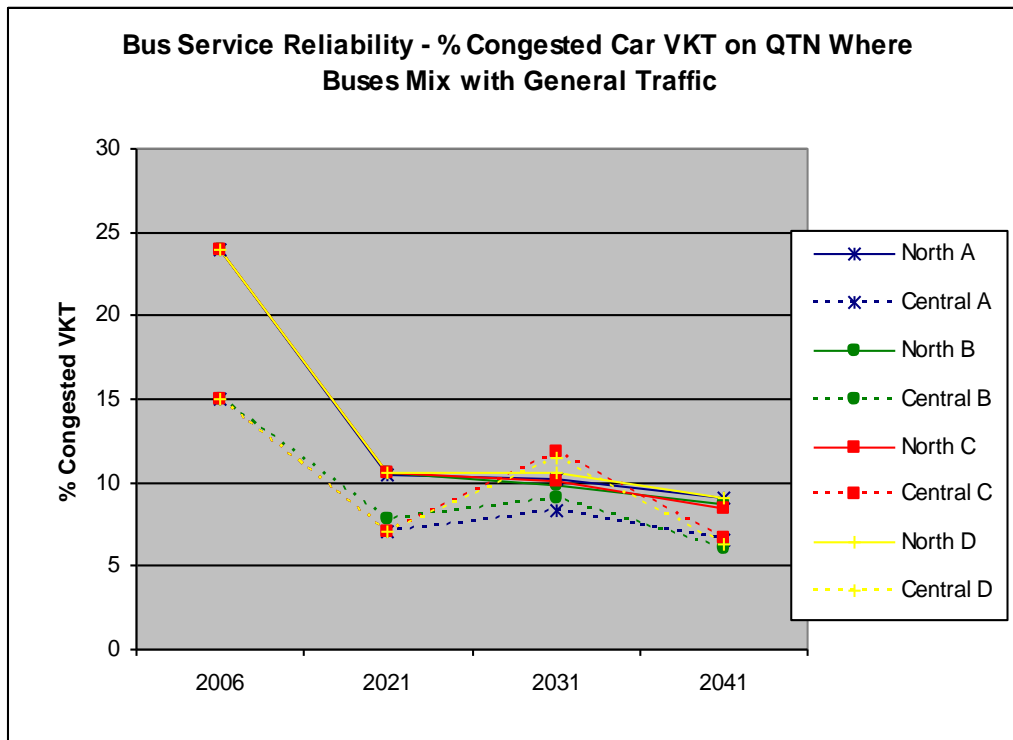


Figure 67 Percentage of congested car VKT on QTN in west (no bus lanes)

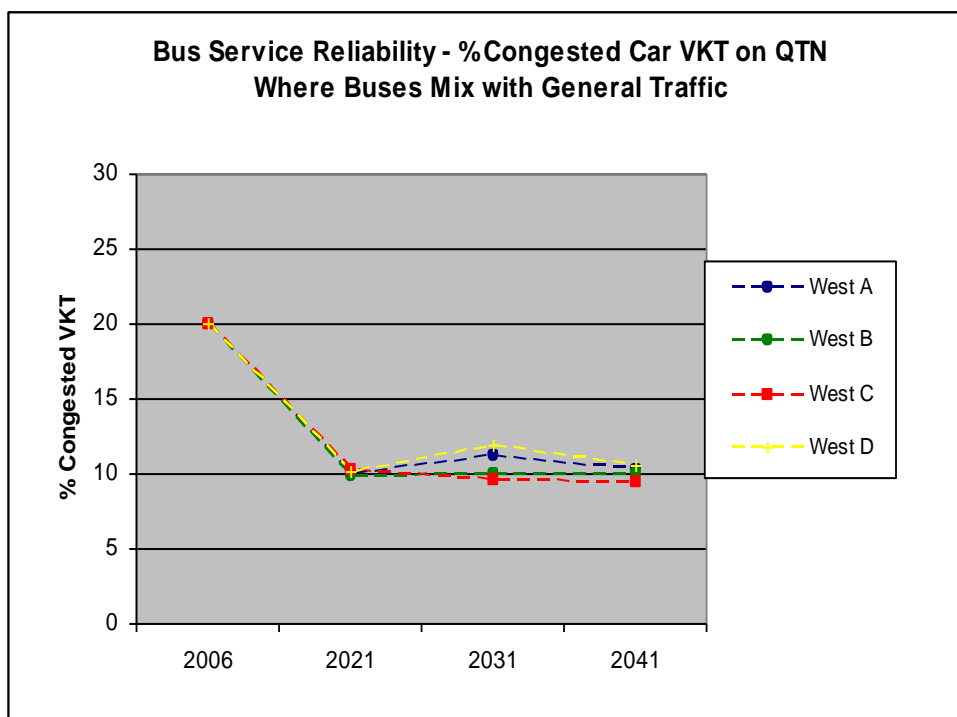
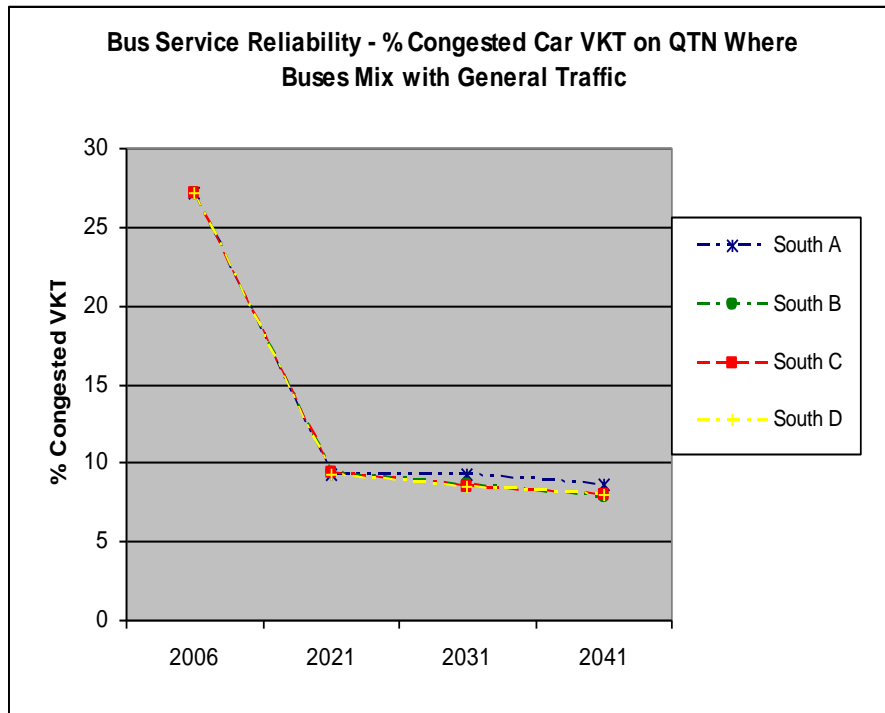


Figure 68 Percentage of congested car VKT on QTN in south (no bus lanes)



Improved accessibility to economic activity

Figure 69 Access to strategic economic sites

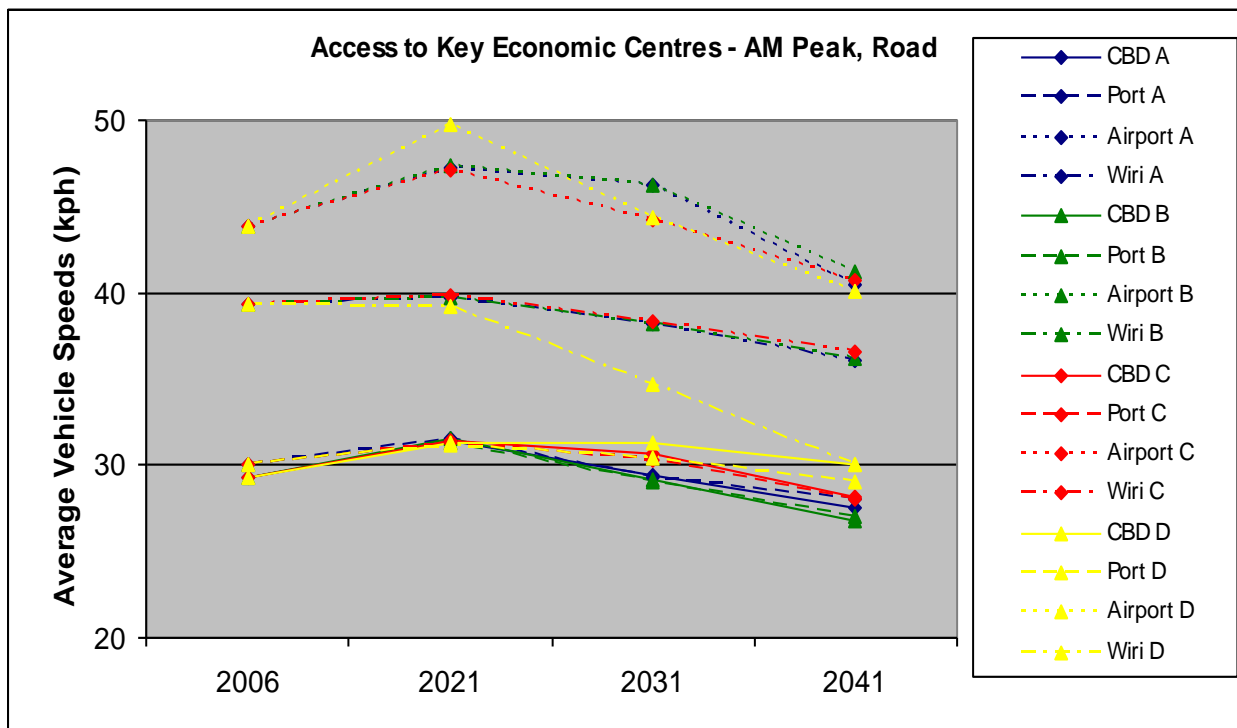


Figure 70 Access to key economic centres

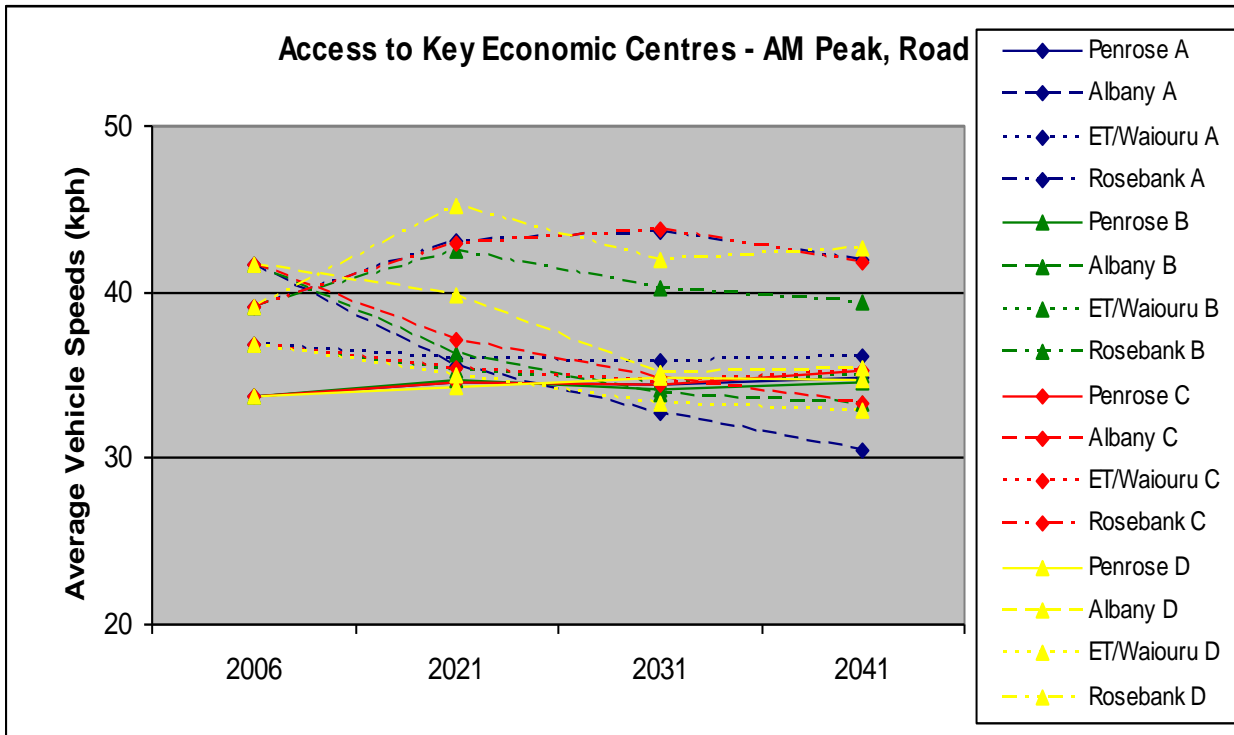


Figure 71 Access to strategic economic sites

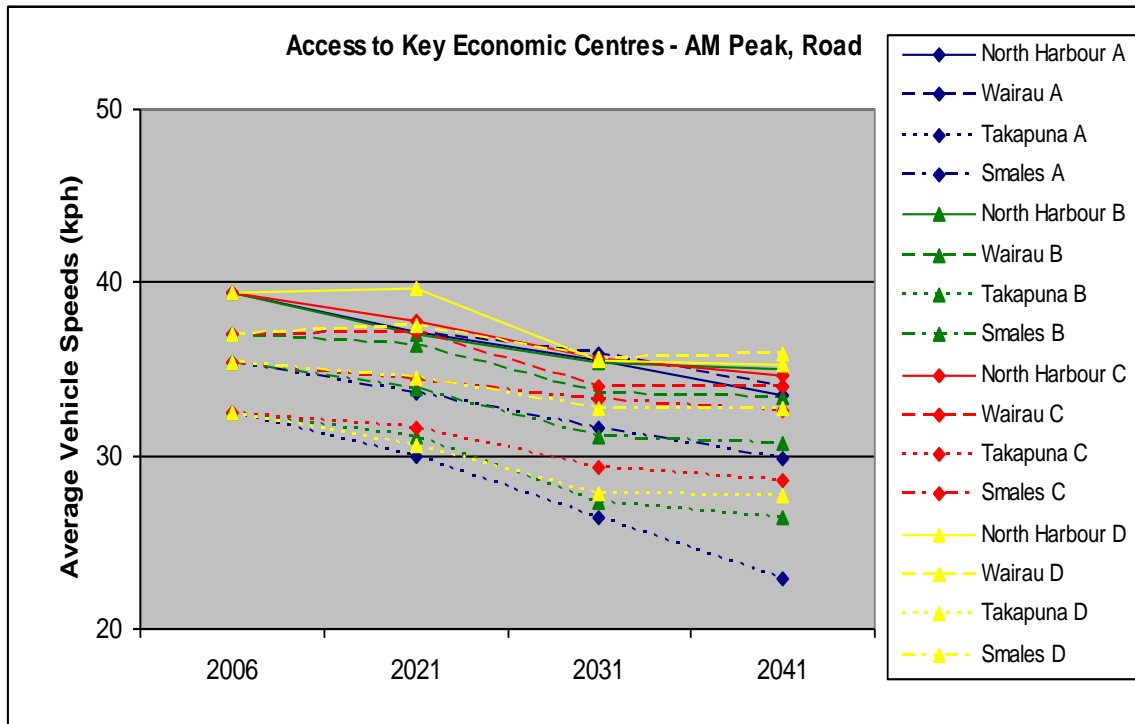


Figure 72 Access to key economic centres

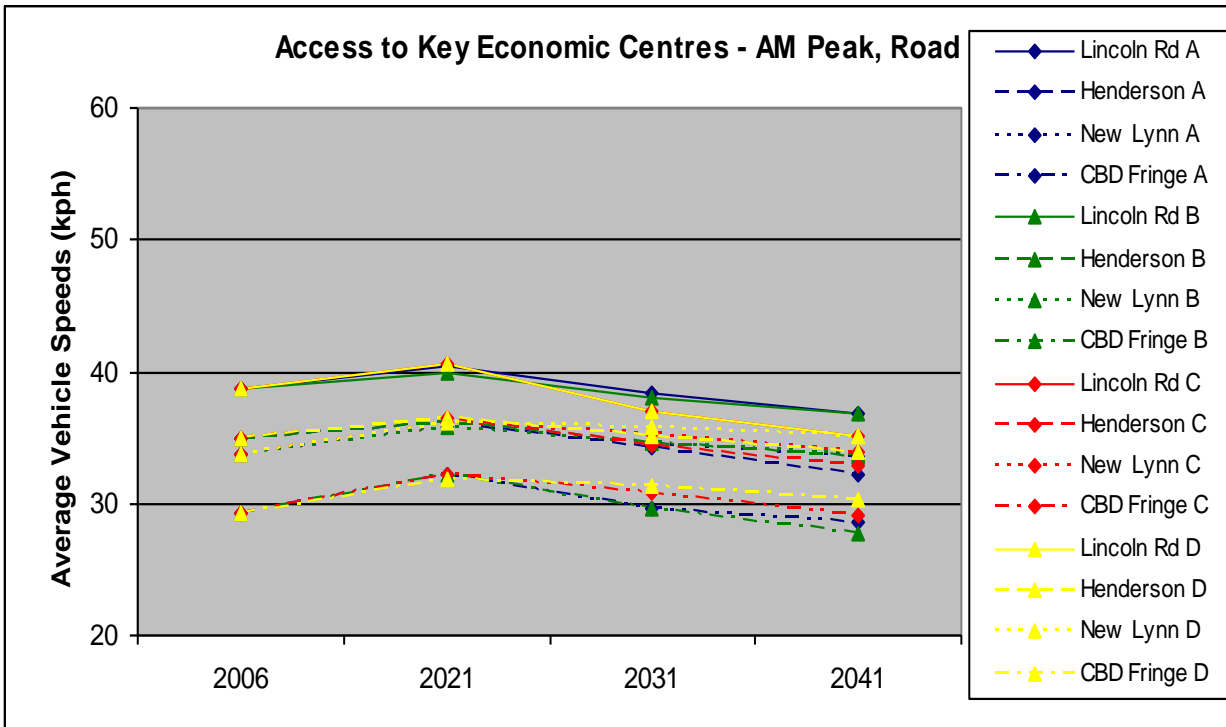


Figure 73 Access to strategic economic sites

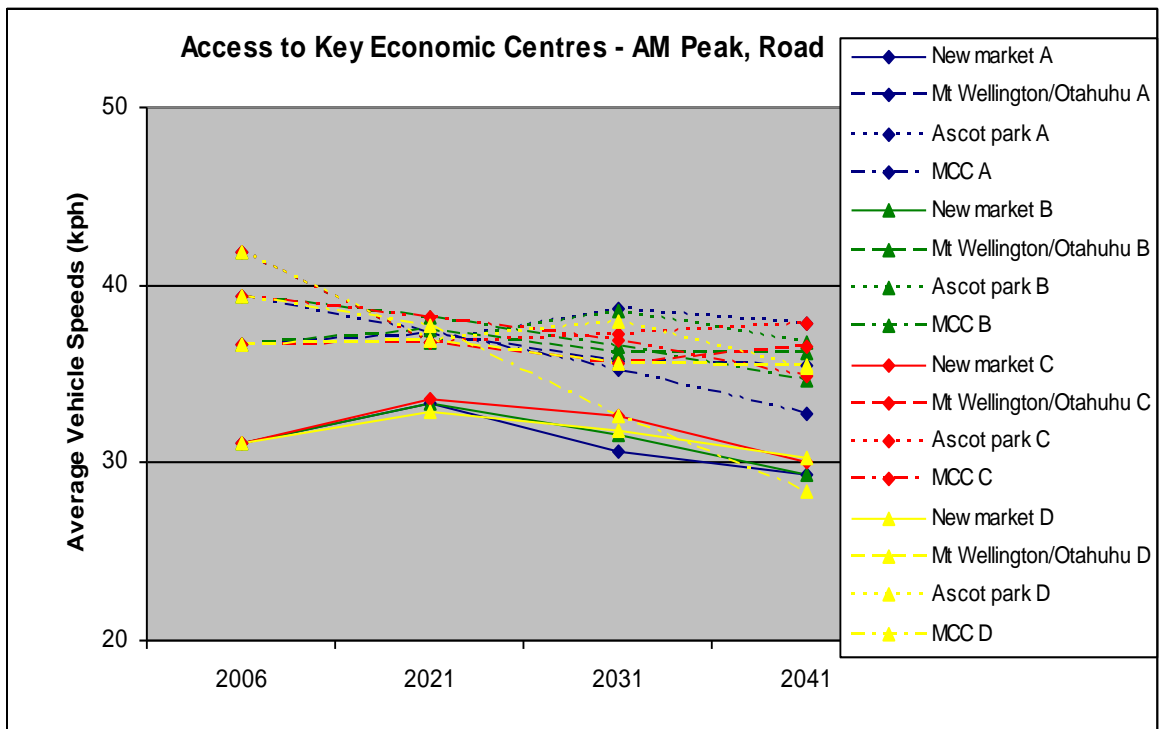


Figure 74 Access to key economic centres

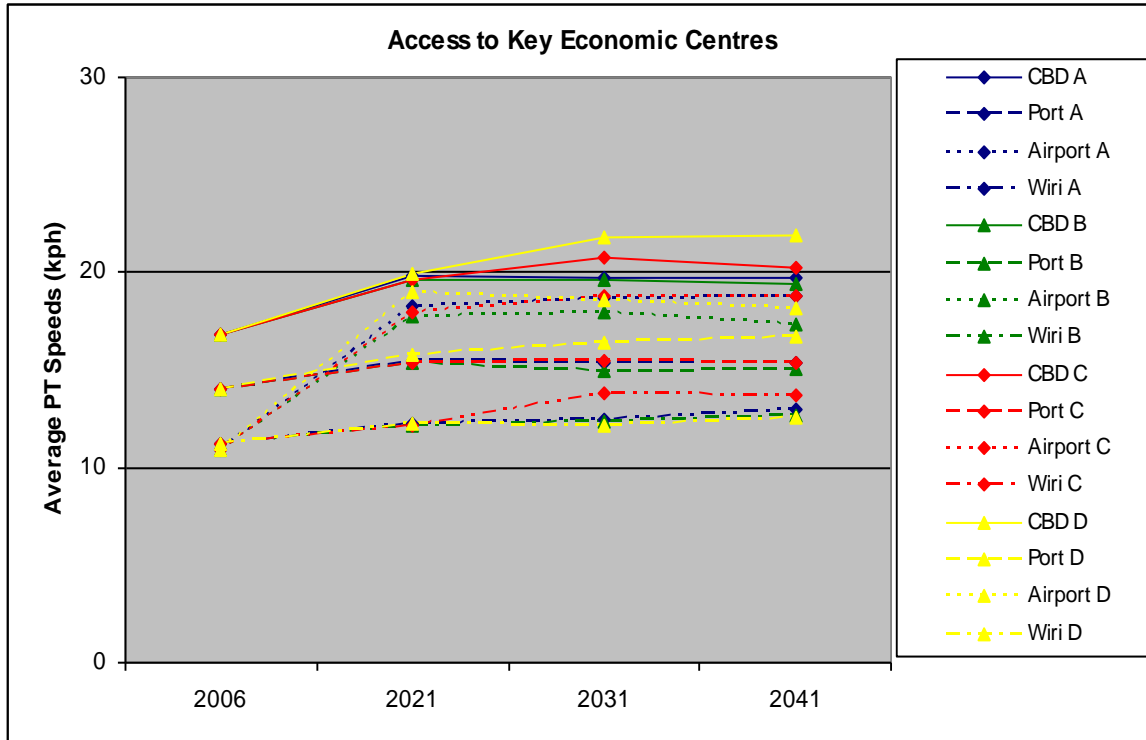


Figure 75 Access to strategic economic sites

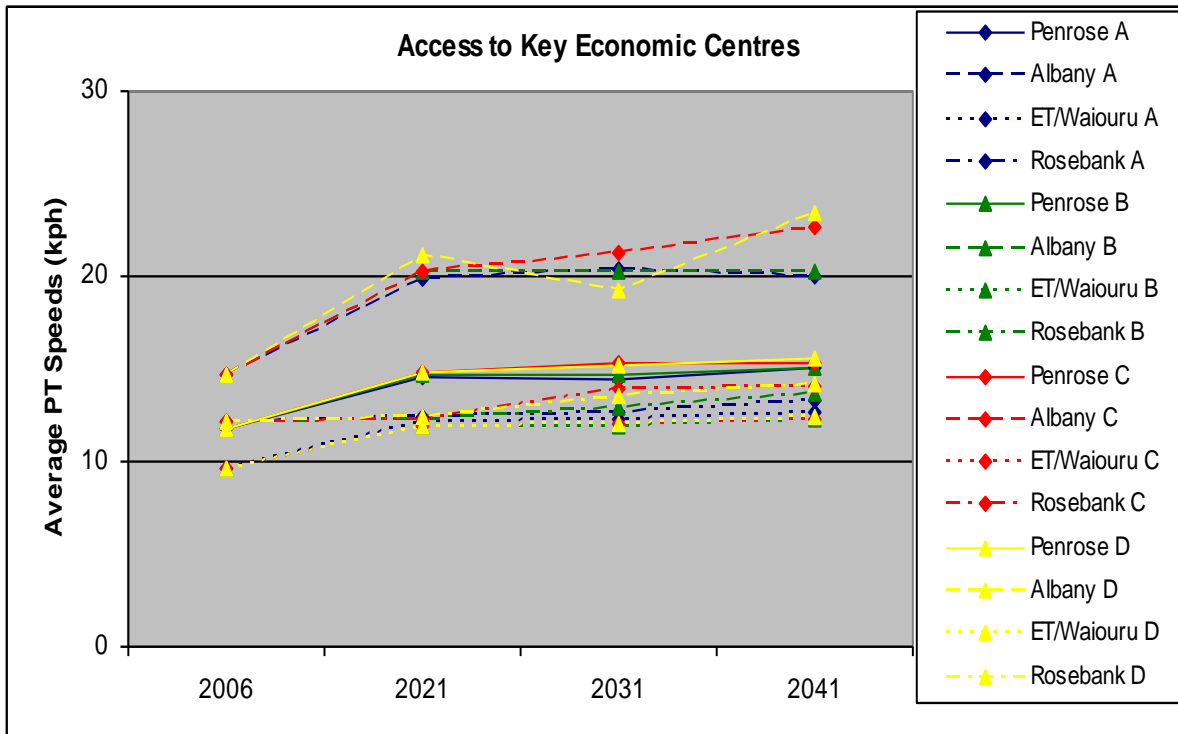


Figure 76 Access to key economic centres

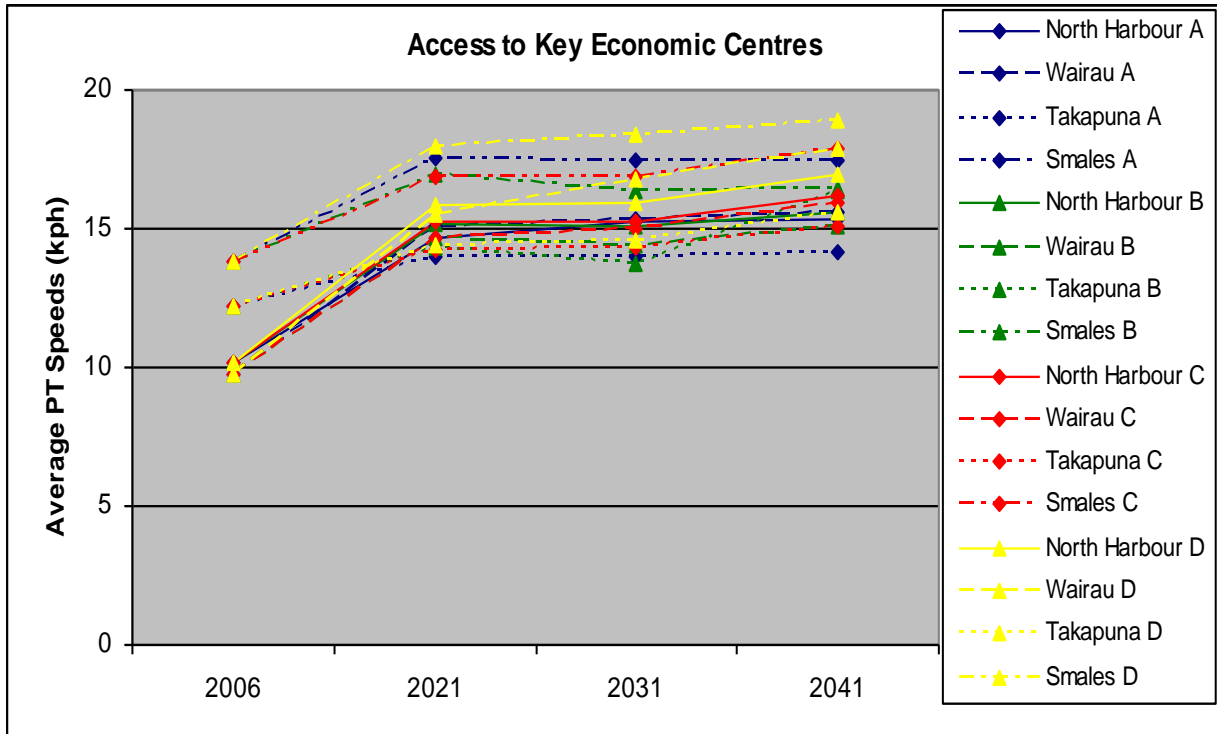


Figure 77 Access to strategic economic sites

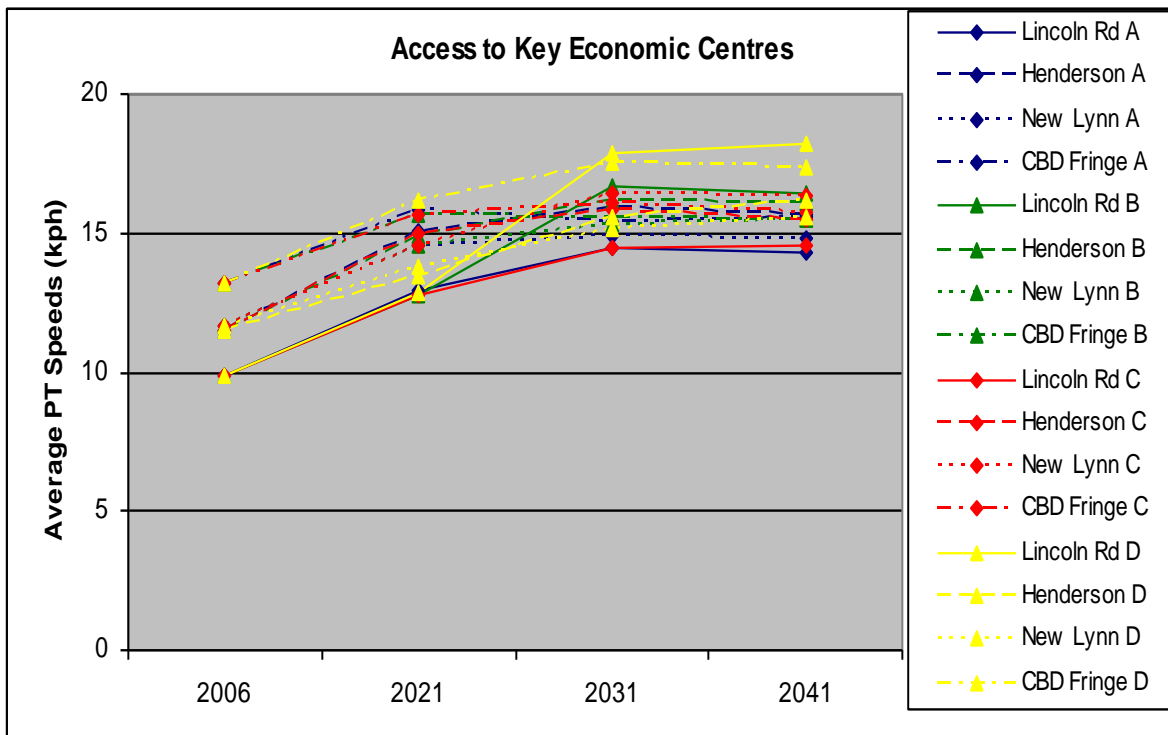




Figure 78 Access to key economic centres

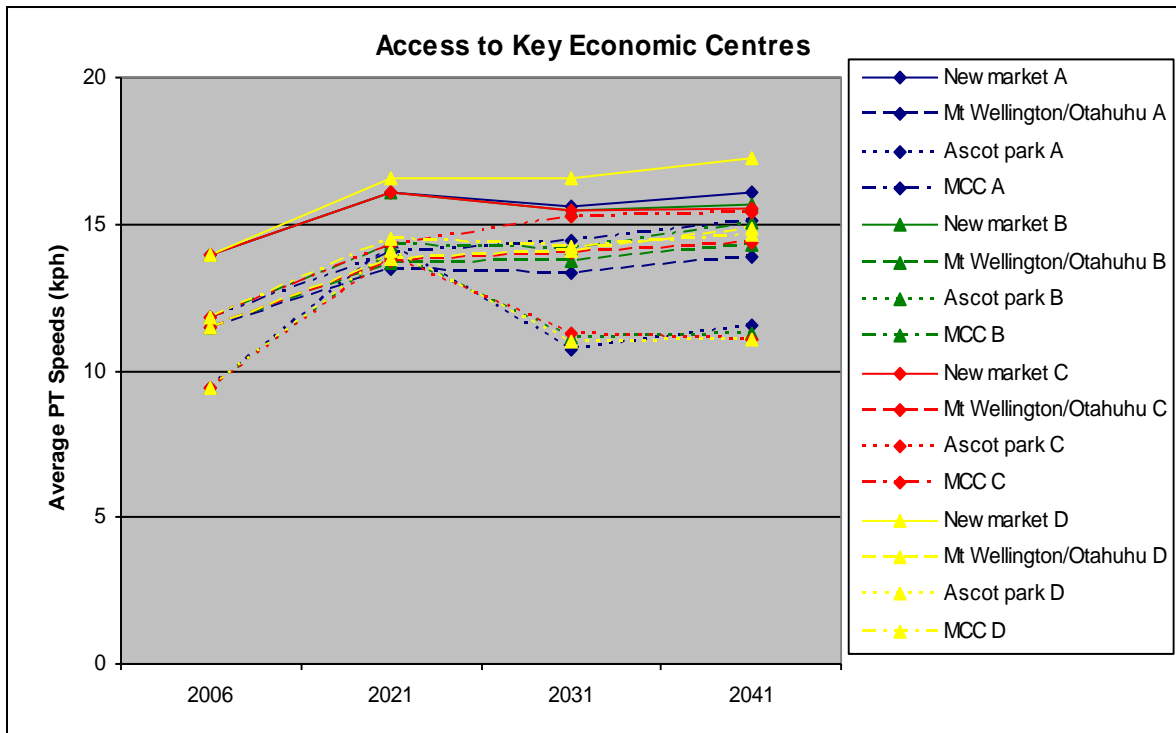


Figure 79 Access to strategic economic sites

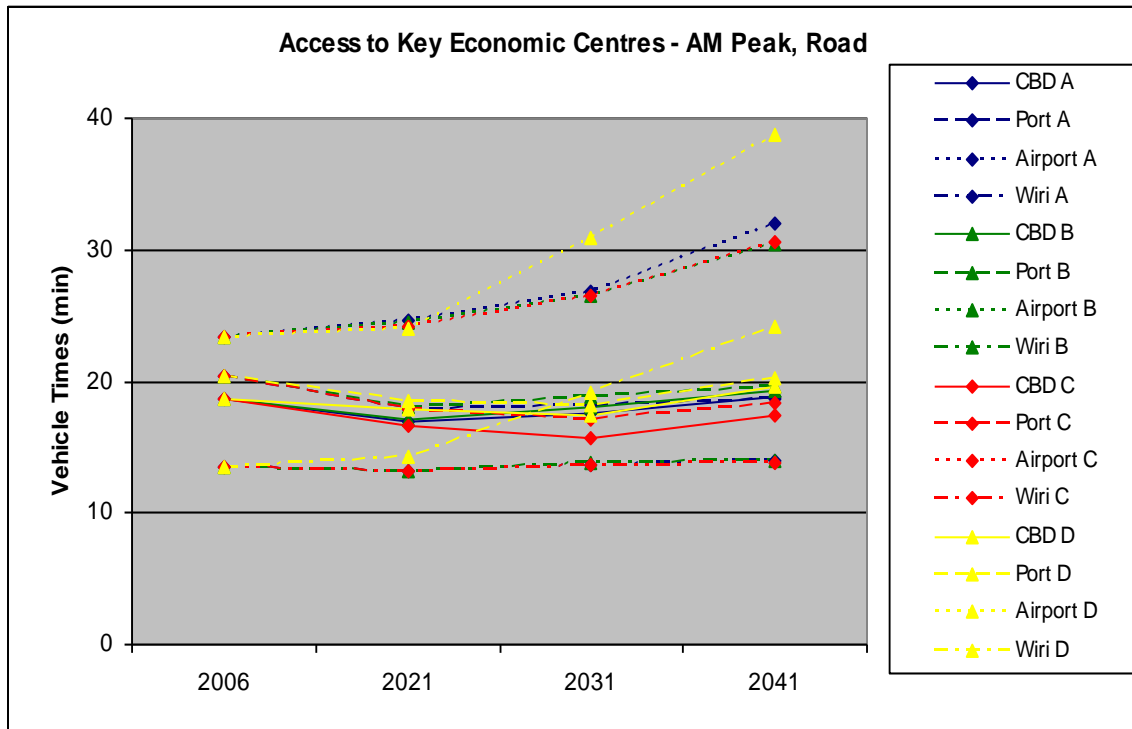


Figure 80 Access to key economic centres

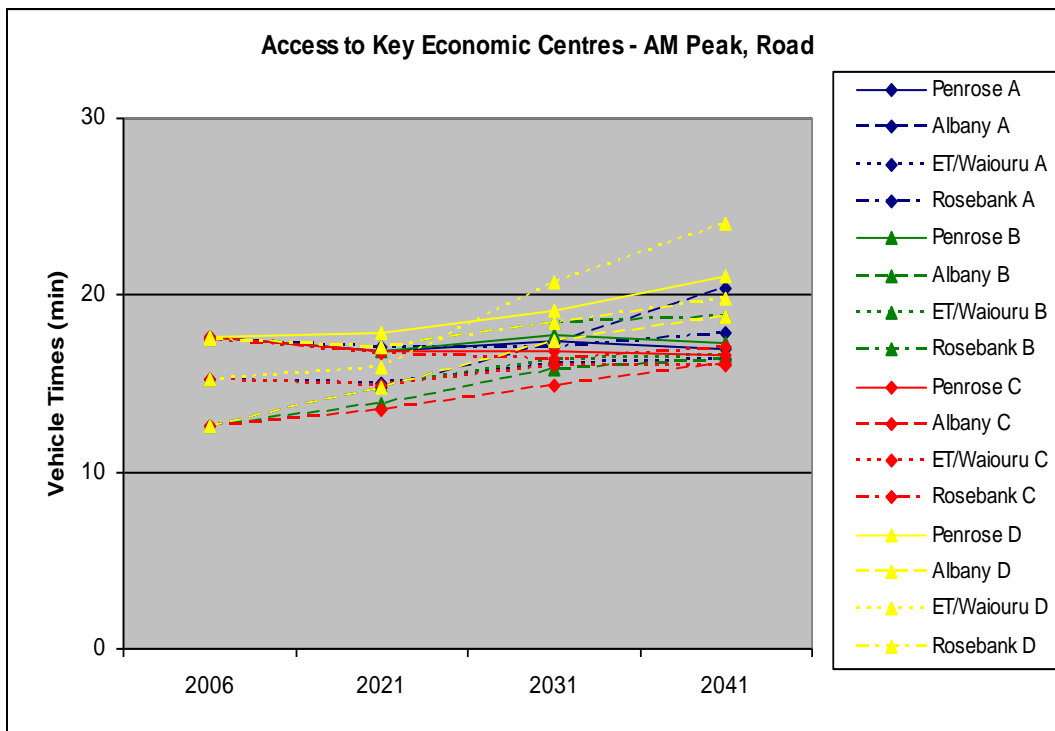


Figure 81 Access to strategic economic sites

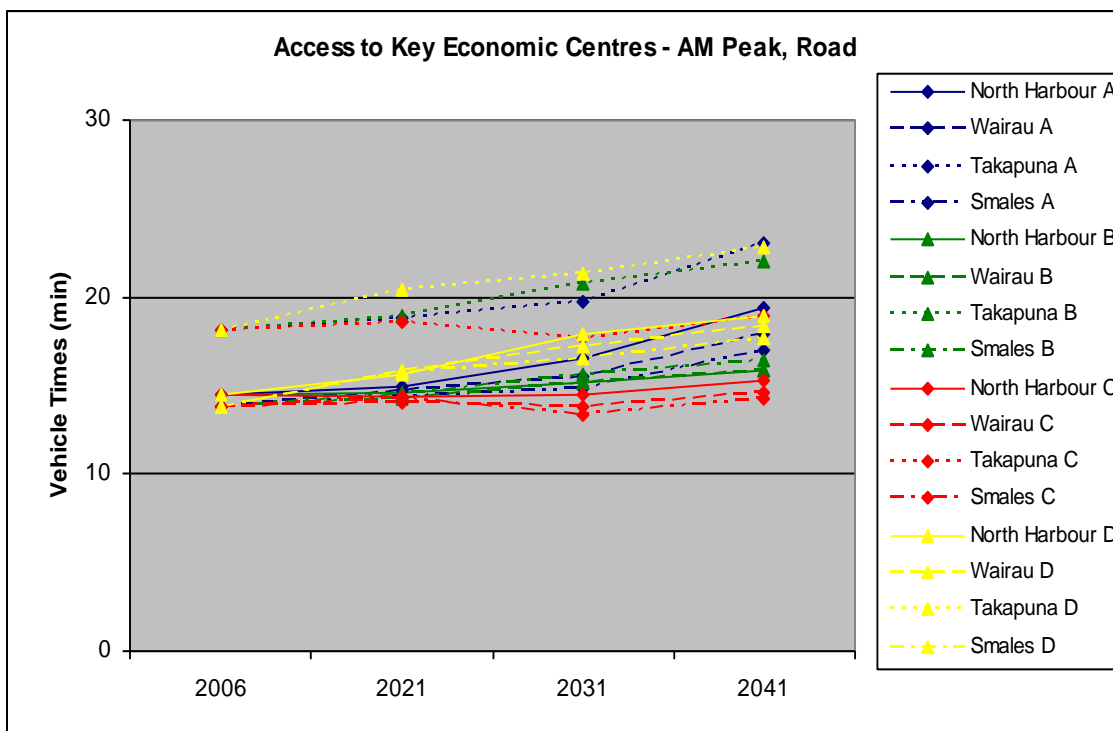


Figure 82 Access to key economic centres

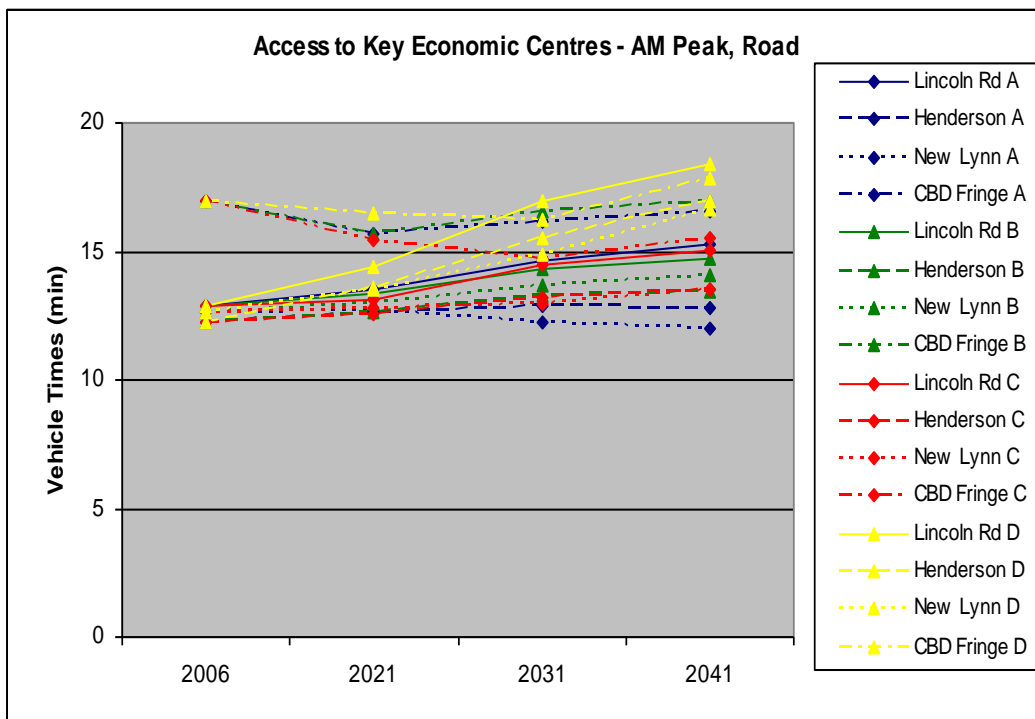


Figure 83 Access to strategic economic sites

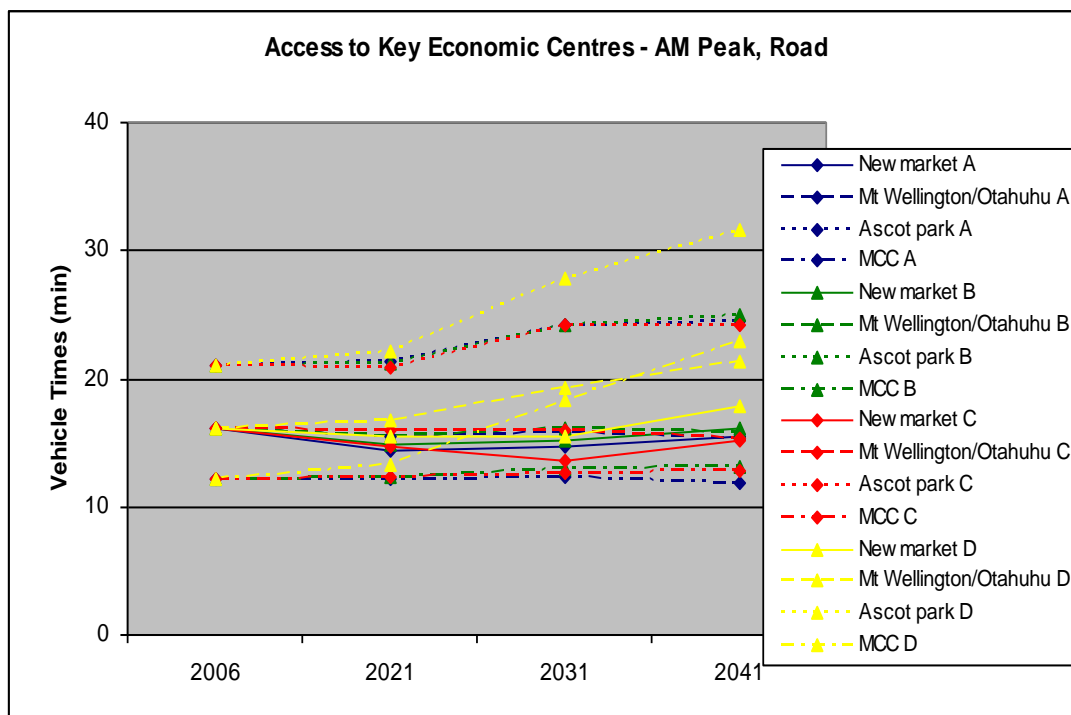


Figure 84 Access to key economic centres

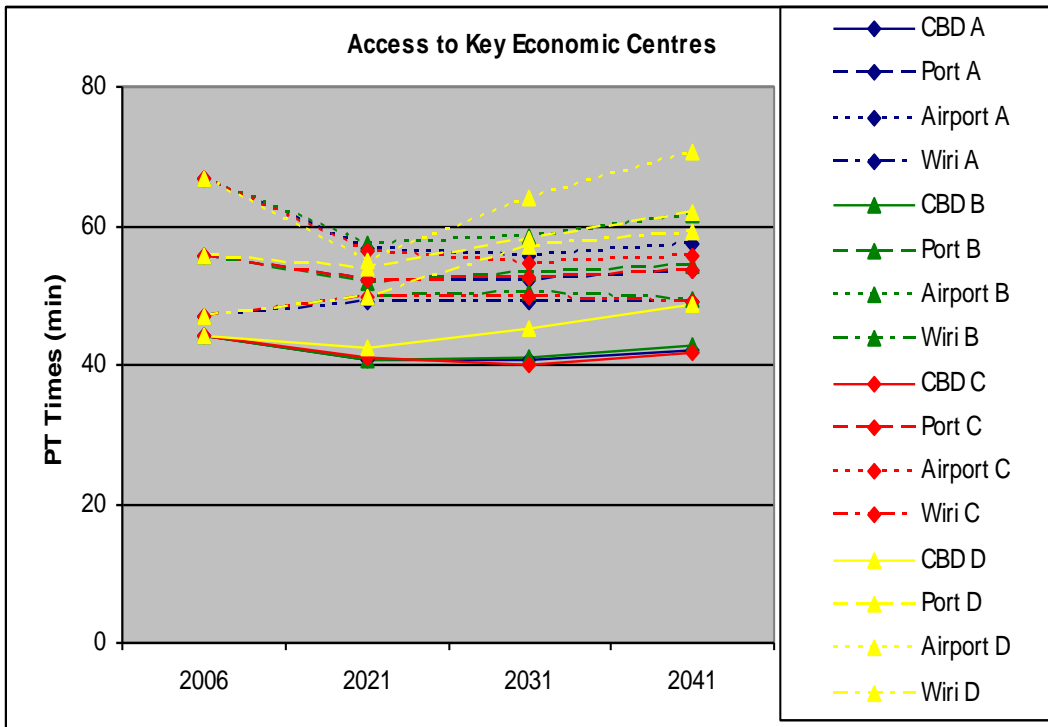


Figure 85 Access to strategic economic sites

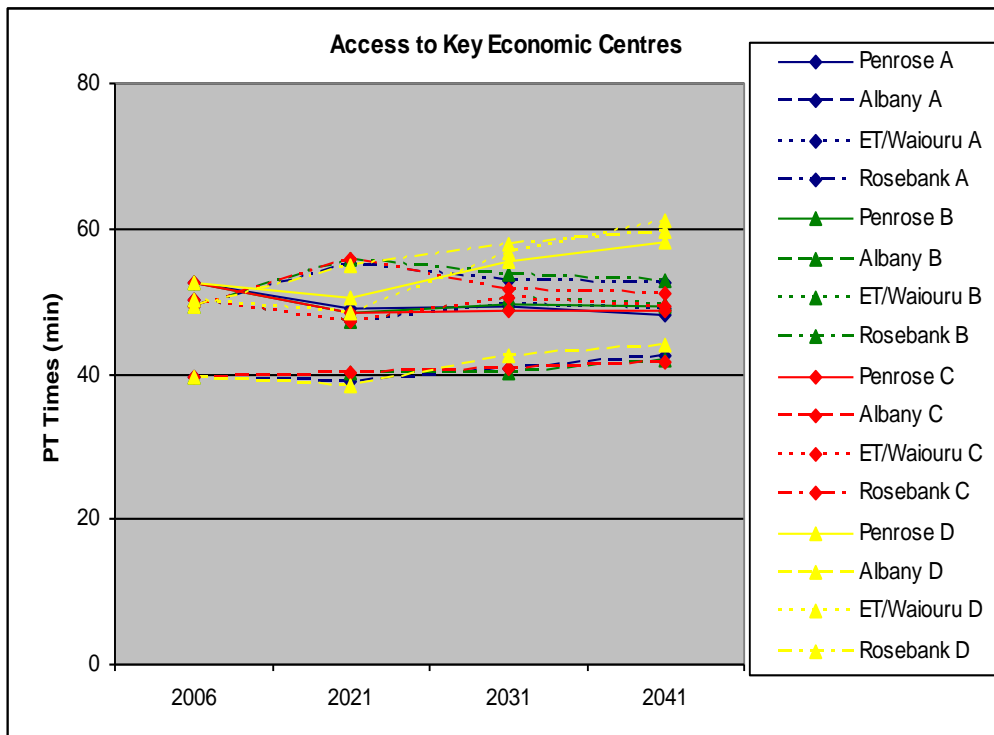


Figure 86 Access to key economic centres

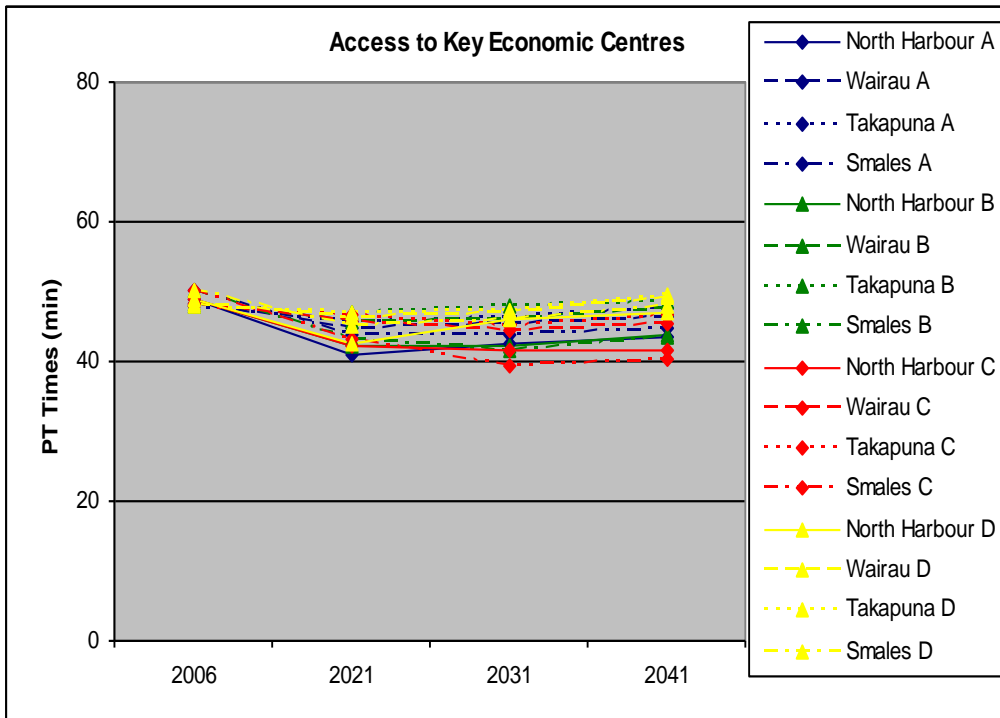


Figure 87 Access to strategic economic sites

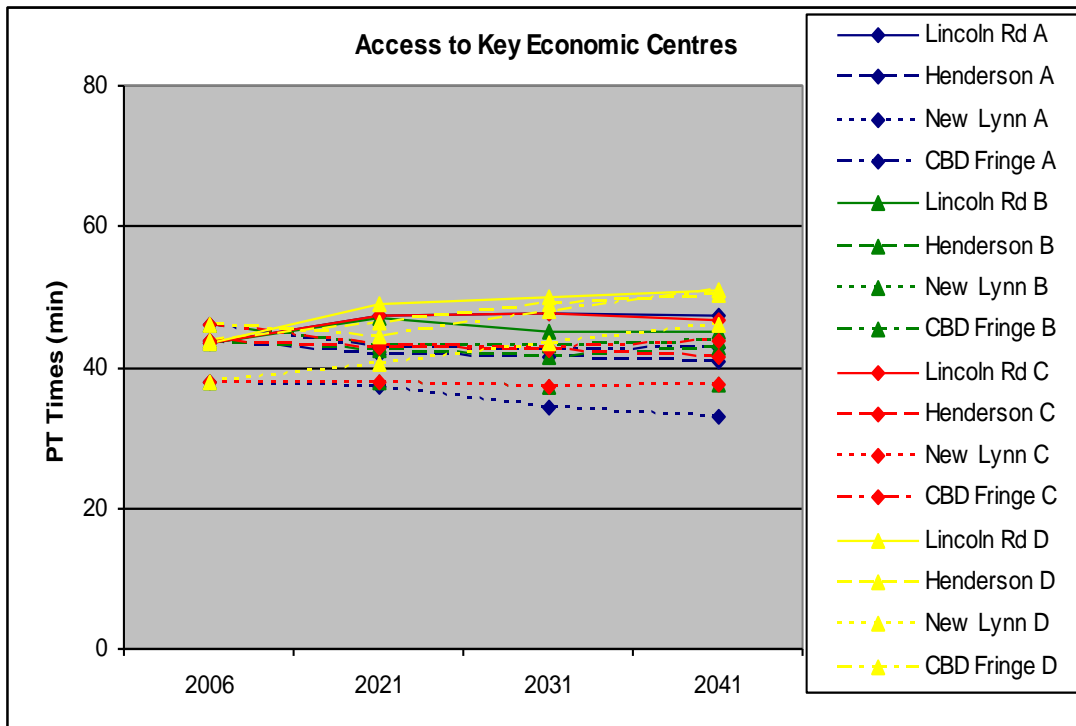
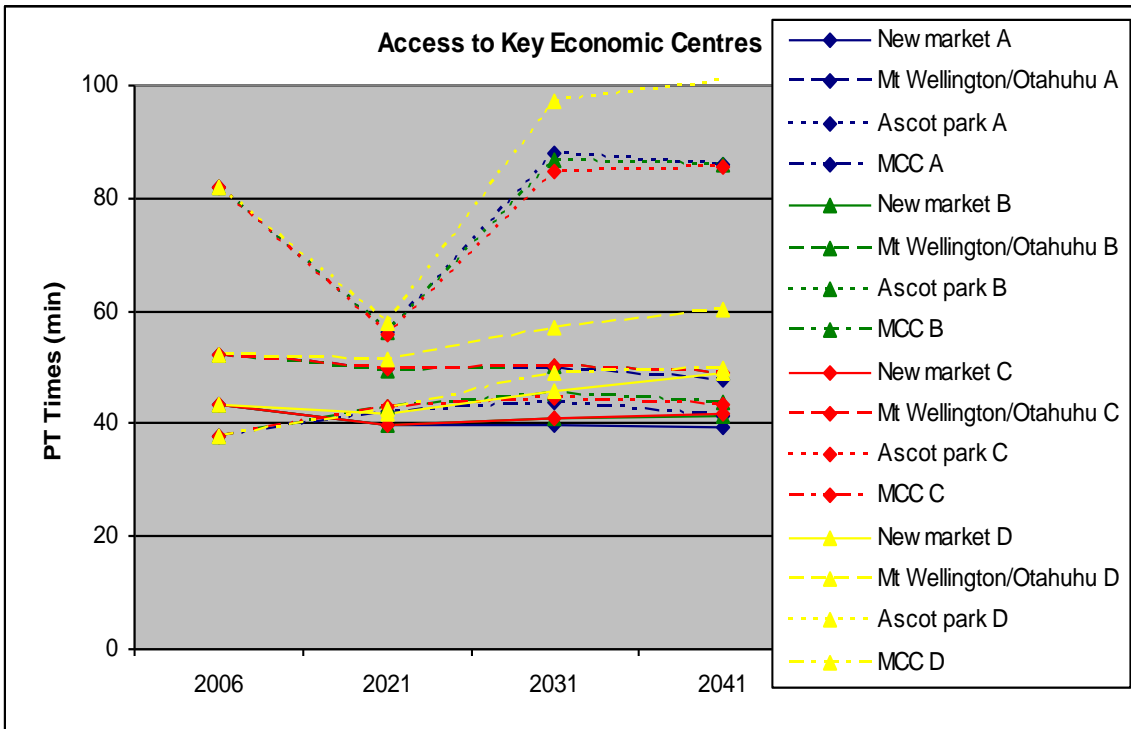


Figure 88 Access to key economic centres



Improved access to labour pool

Figure 89 Access to labour pool within 30 minutes by car

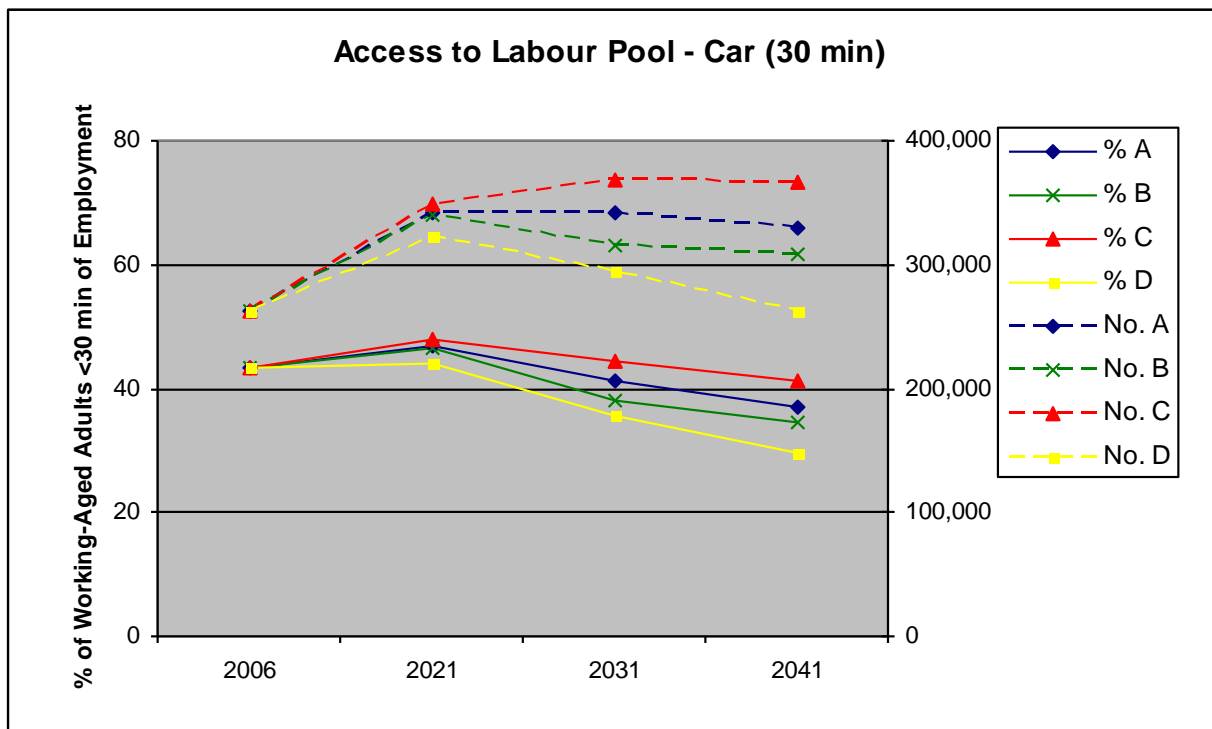


Figure 90 Access to labour pool within 30 minutes by car (north and central)

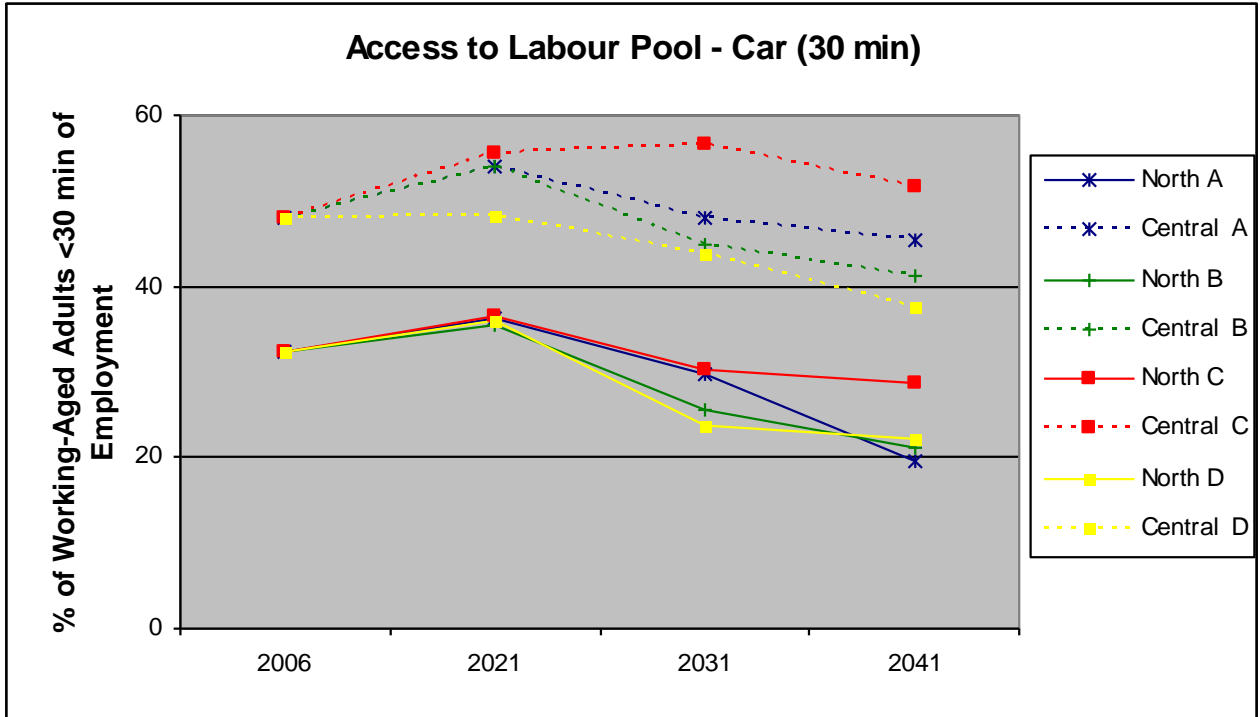


Figure 91 Access to labour pool within 30 minutes by PT

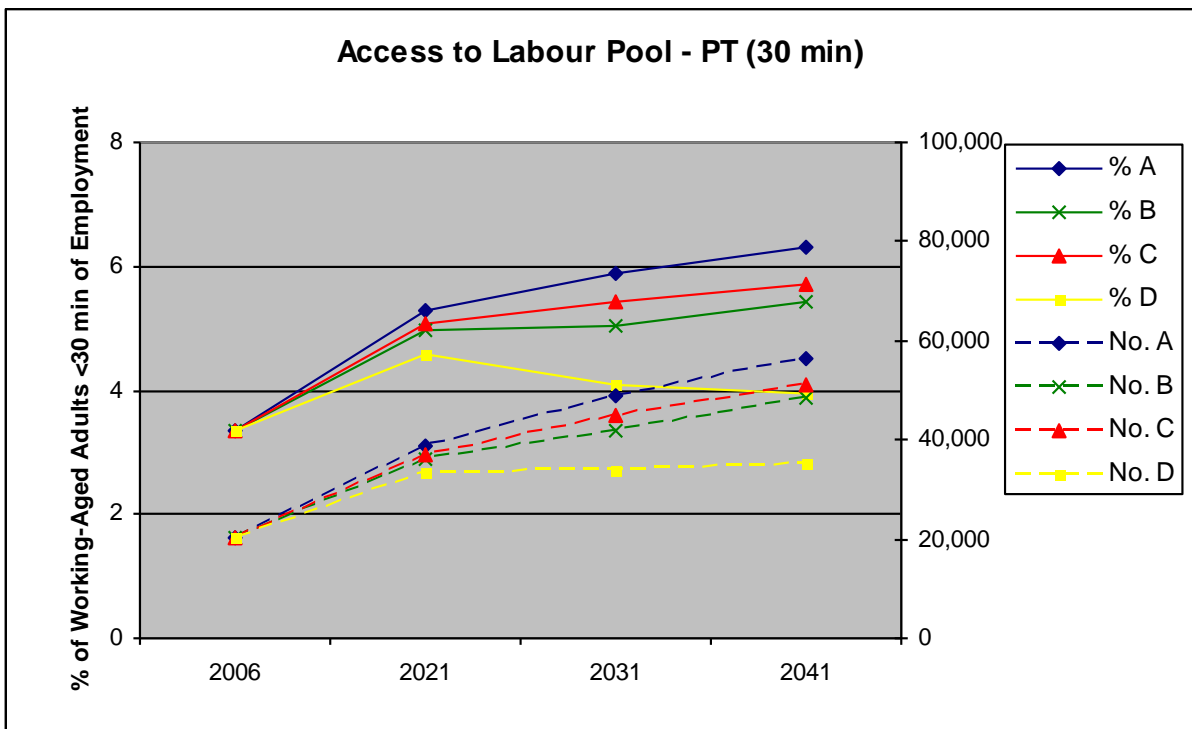


Figure 92 Access to labour pool with 30 minutes by PT (north and central)

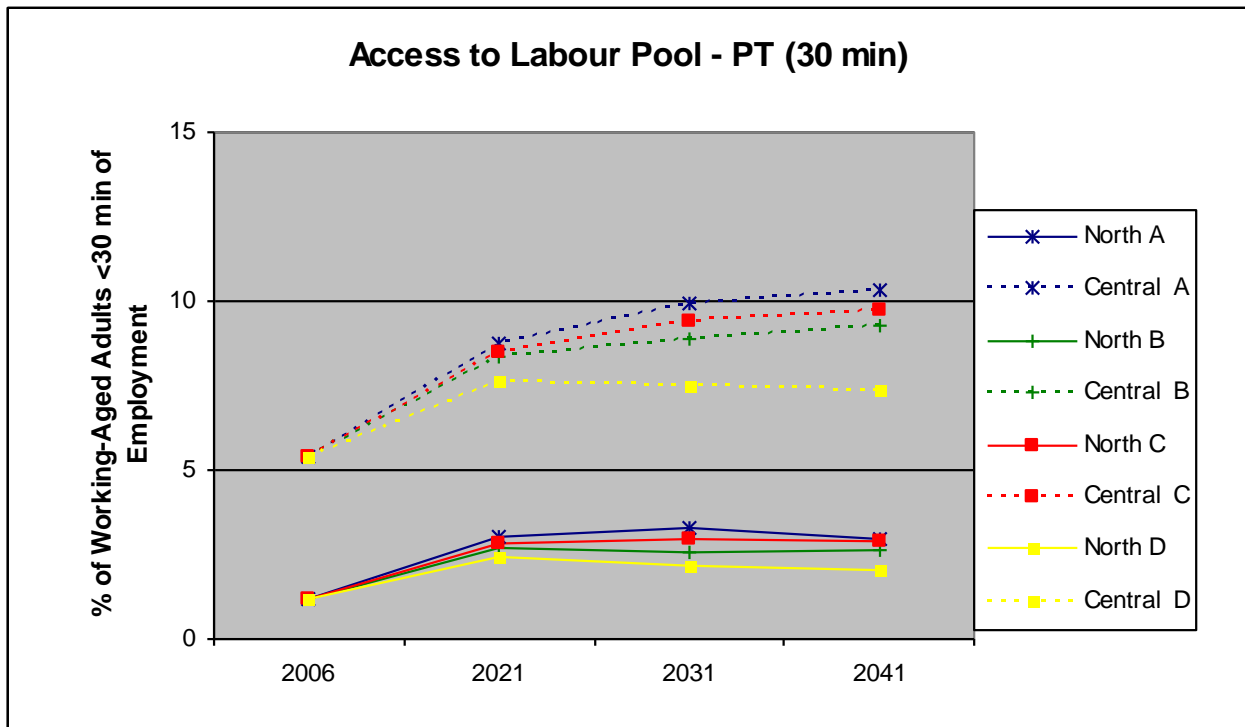


Figure 93 Access to labour pool within 30 minutes by car (west)

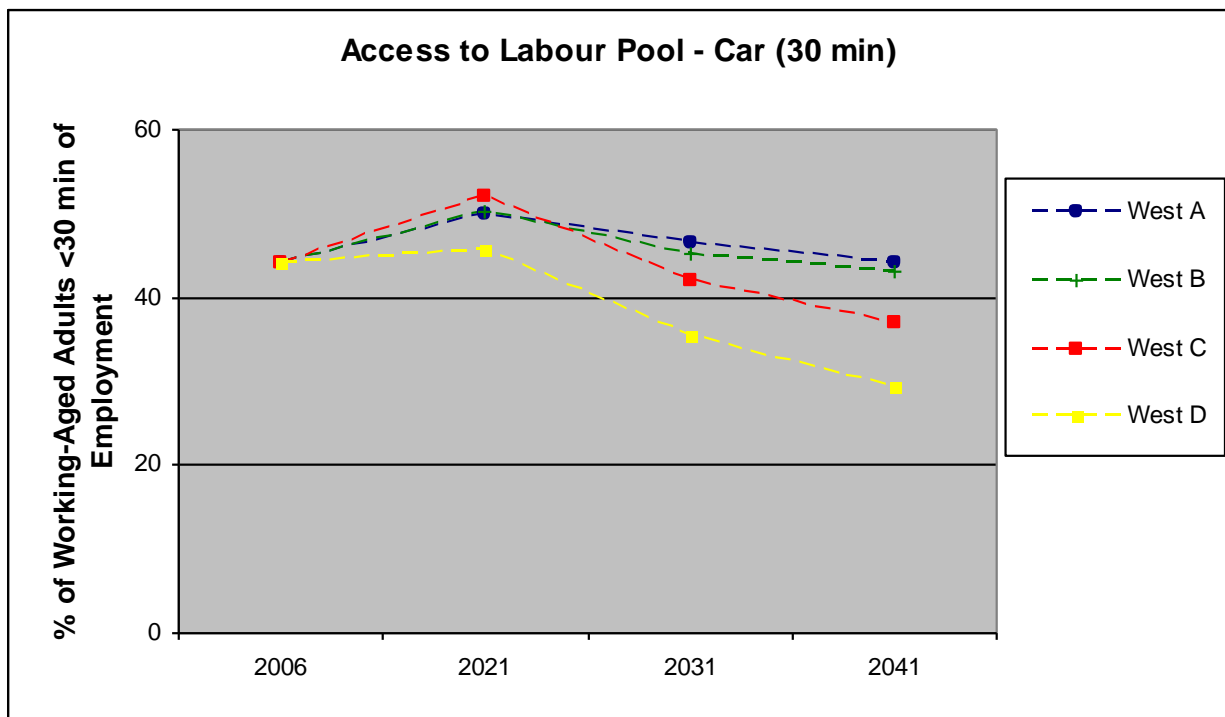




Figure 94 Access to labour pool within 30 minutes by PT (west)

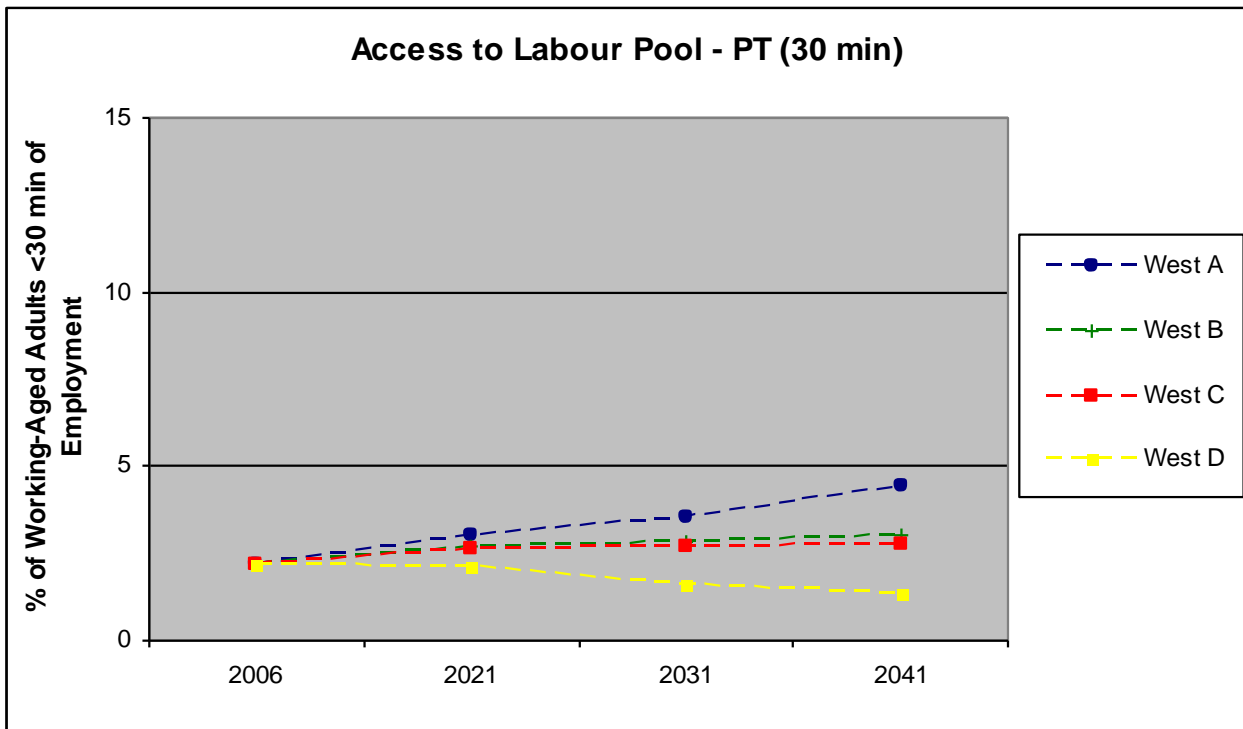


Figure 95 Access to labour pool within 30 mins by car (south)

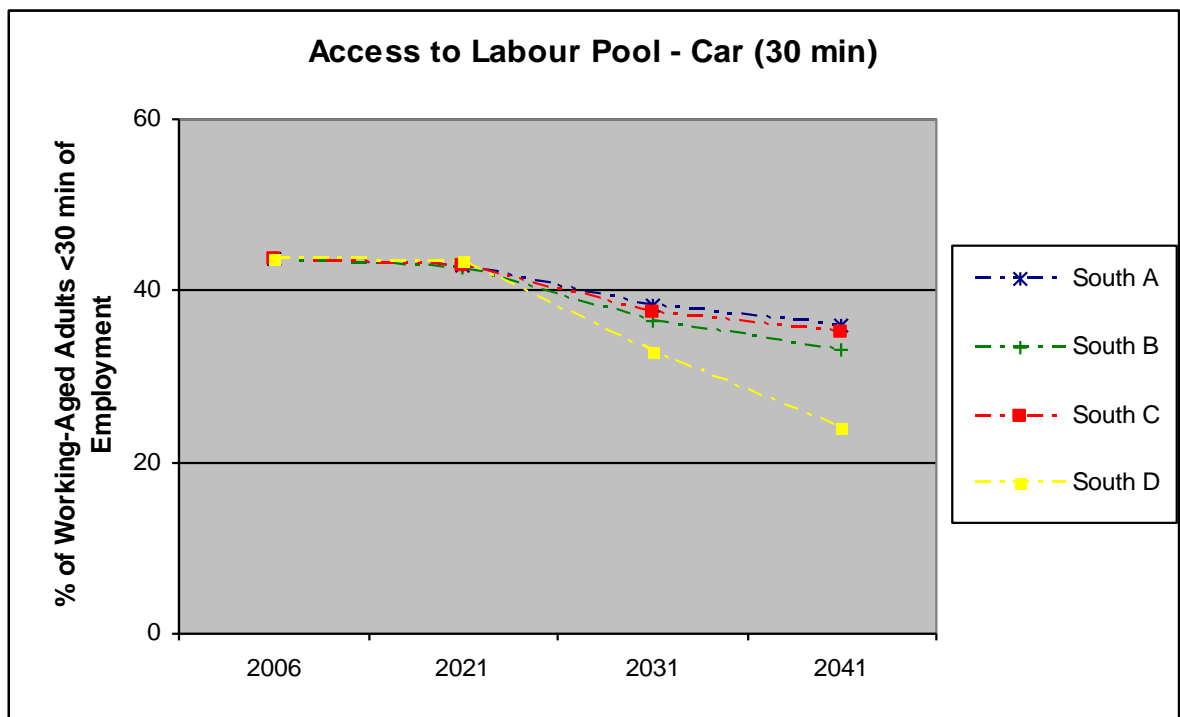


Figure 96 Access to Labour Pool with 30 mins by PT (south)

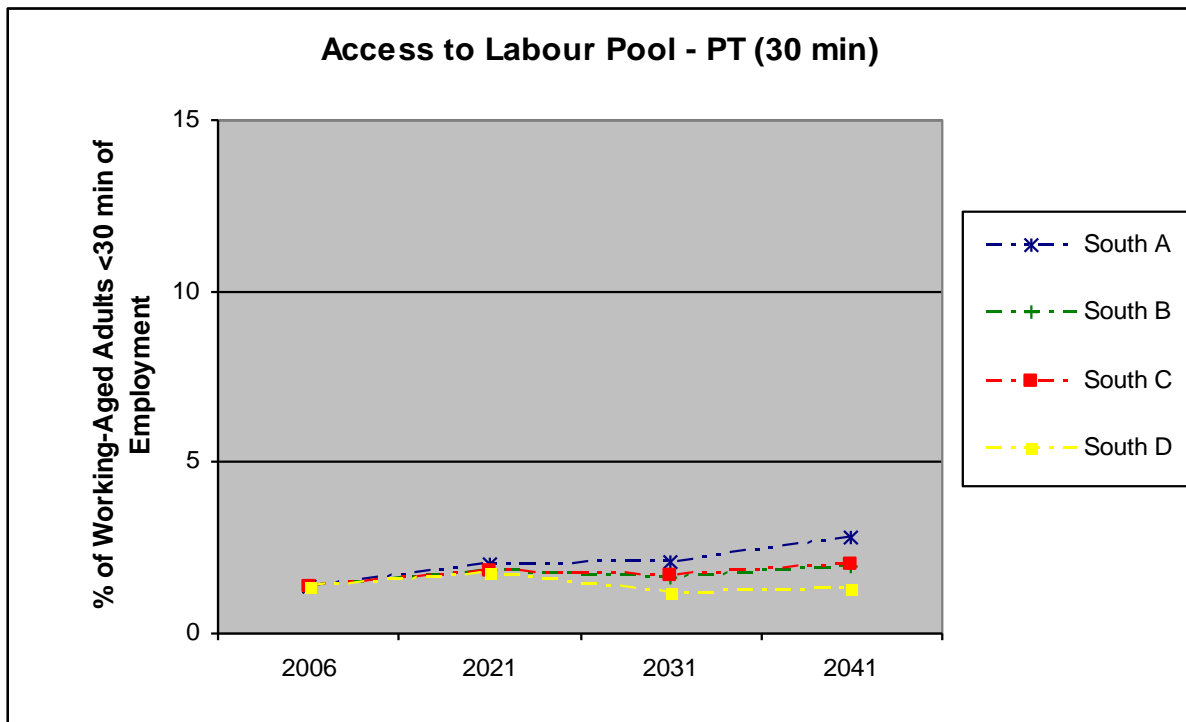


Figure 97 Access to labour pool within 45 mins by car (north and central)

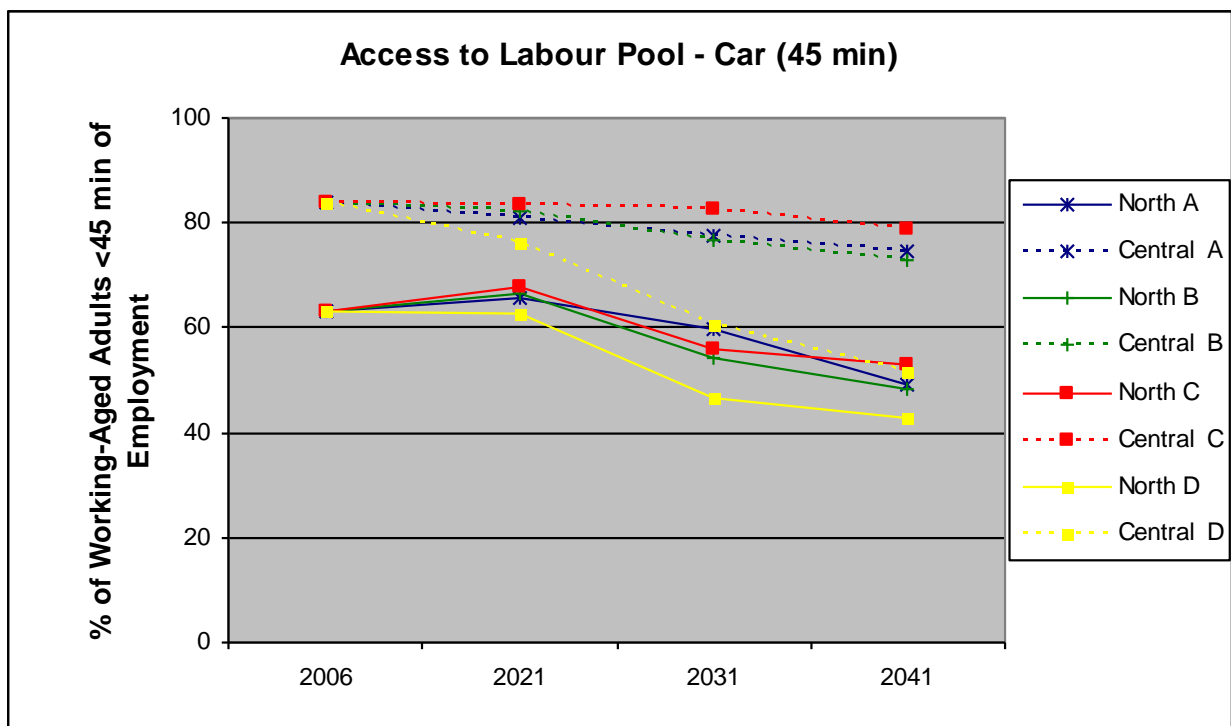


Figure 98 Access to labour pool within 45 mins by PT (north and central)

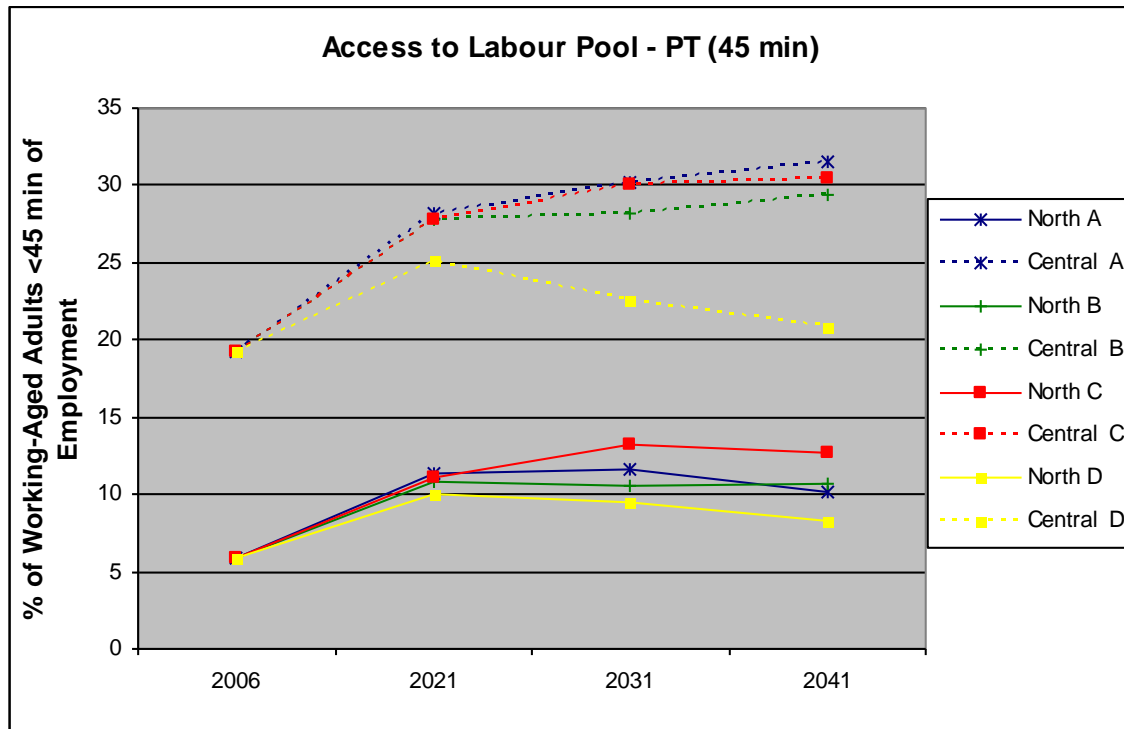


Figure 99 Access to labour pool with 45 mins by car (west)

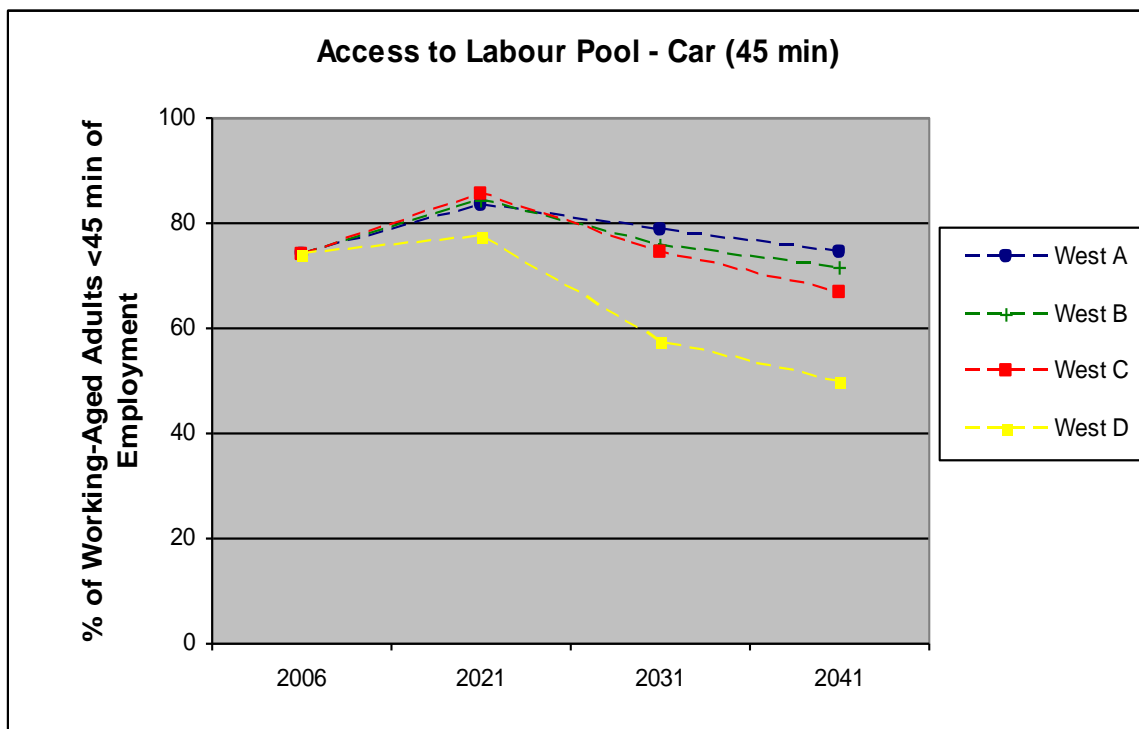


Figure 100 Access to labour pool within 45 mins by PT (west)

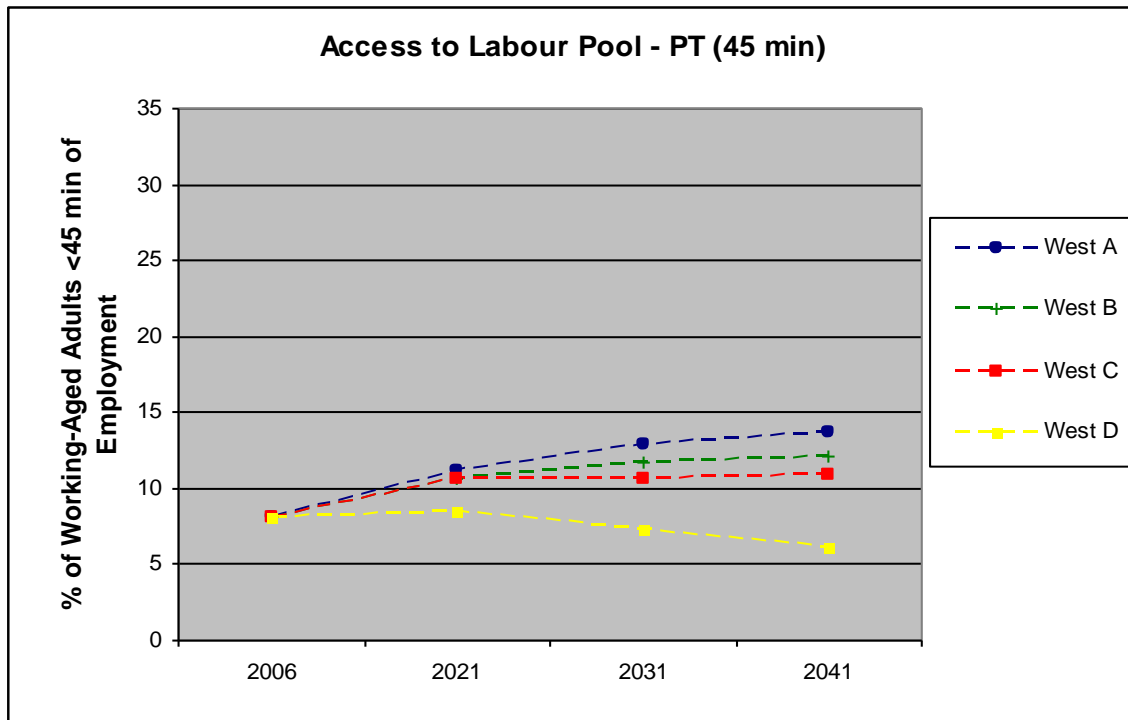


Figure 101 Access to labour pool within 45 mins by car (south)

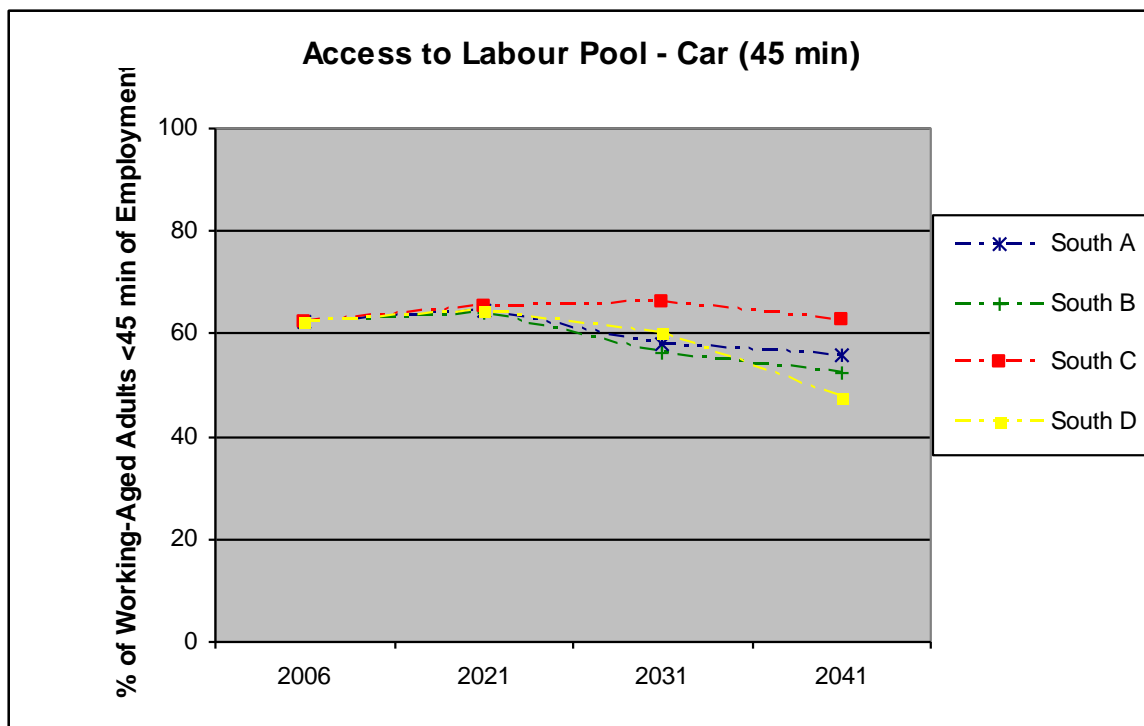
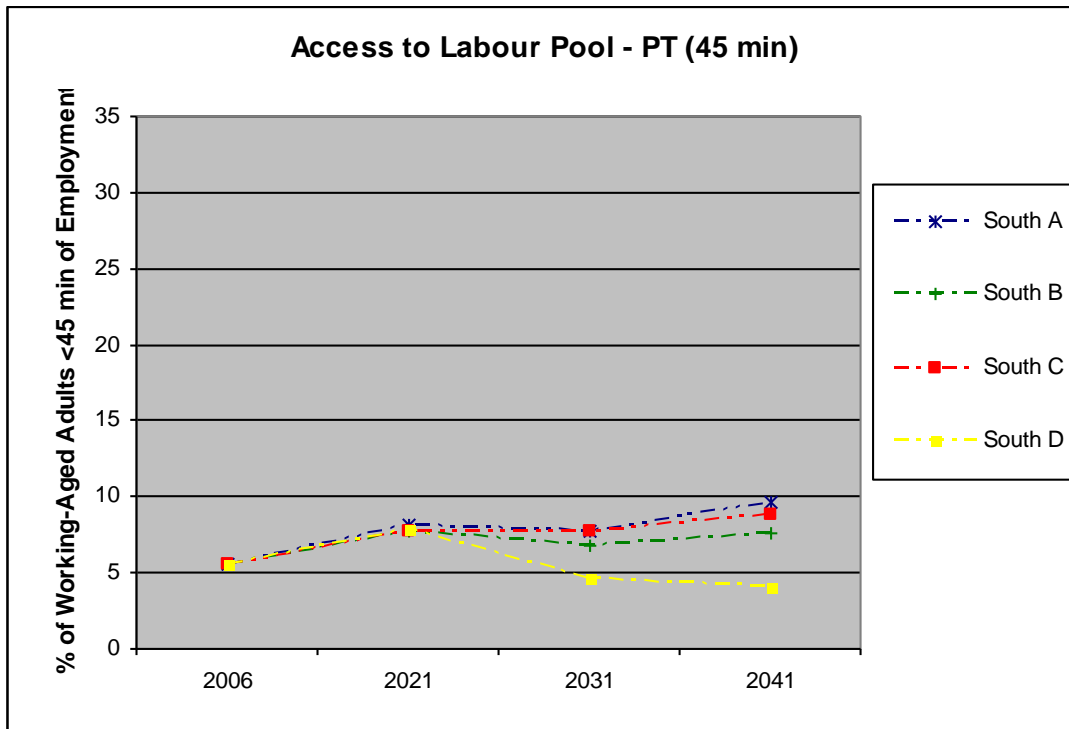
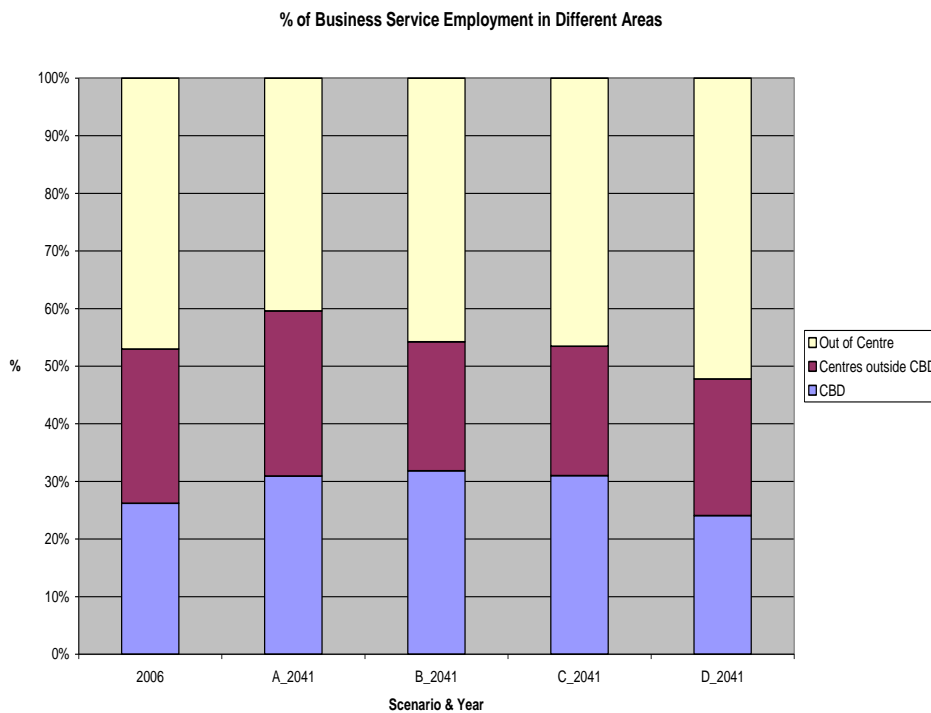


Figure 102 Access to labour pool within 45 mins by PT (south)

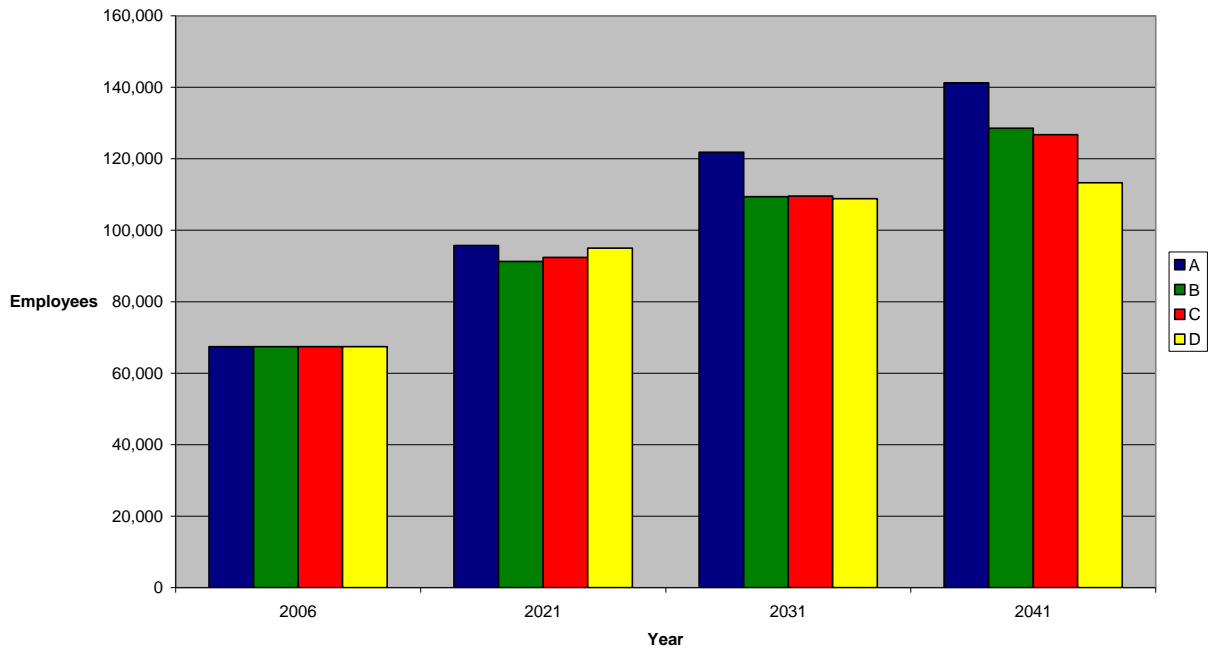


Increased productivity

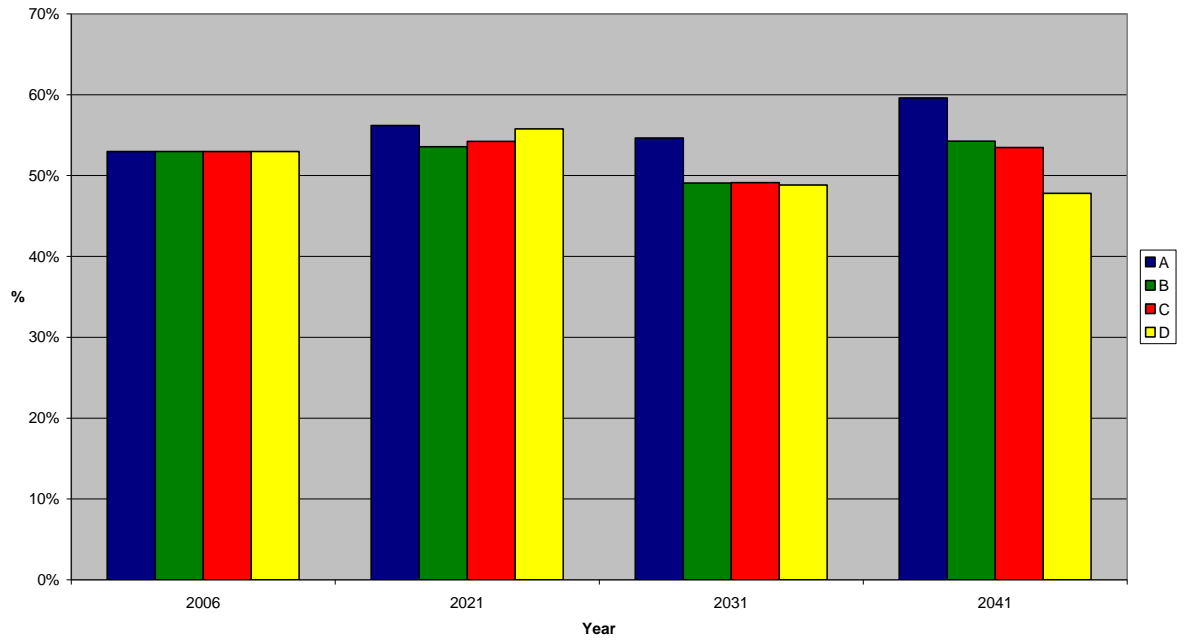
Figure 103 Productivity graphs



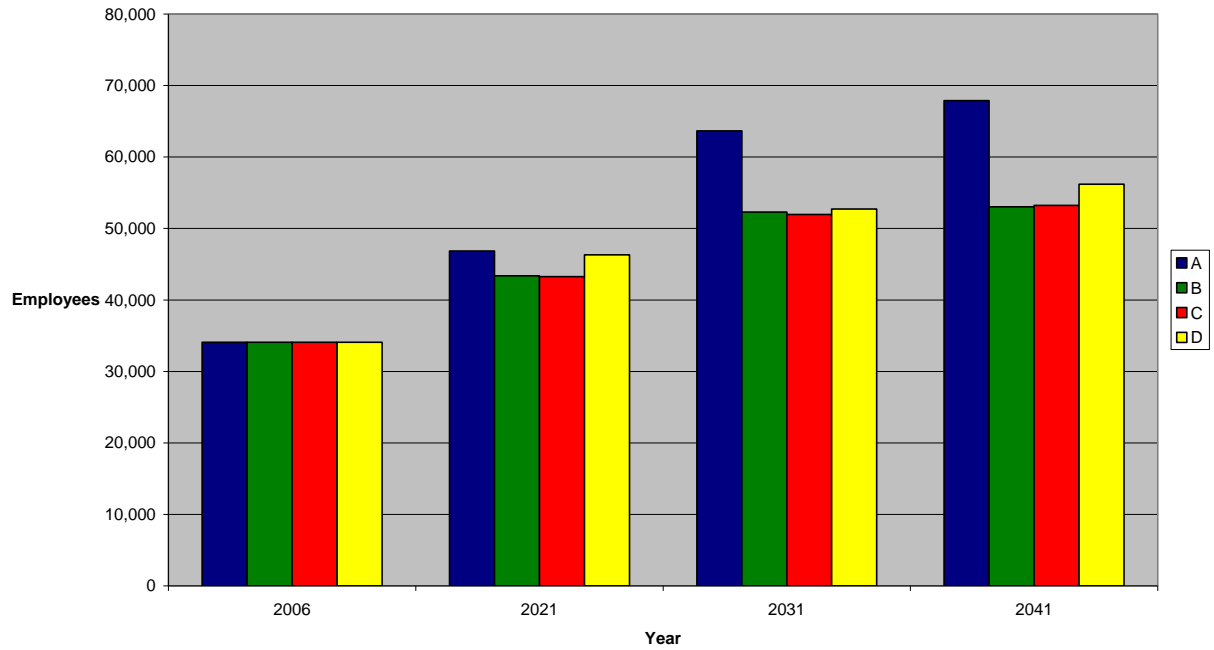
**Total Business Services Employment in Centres**



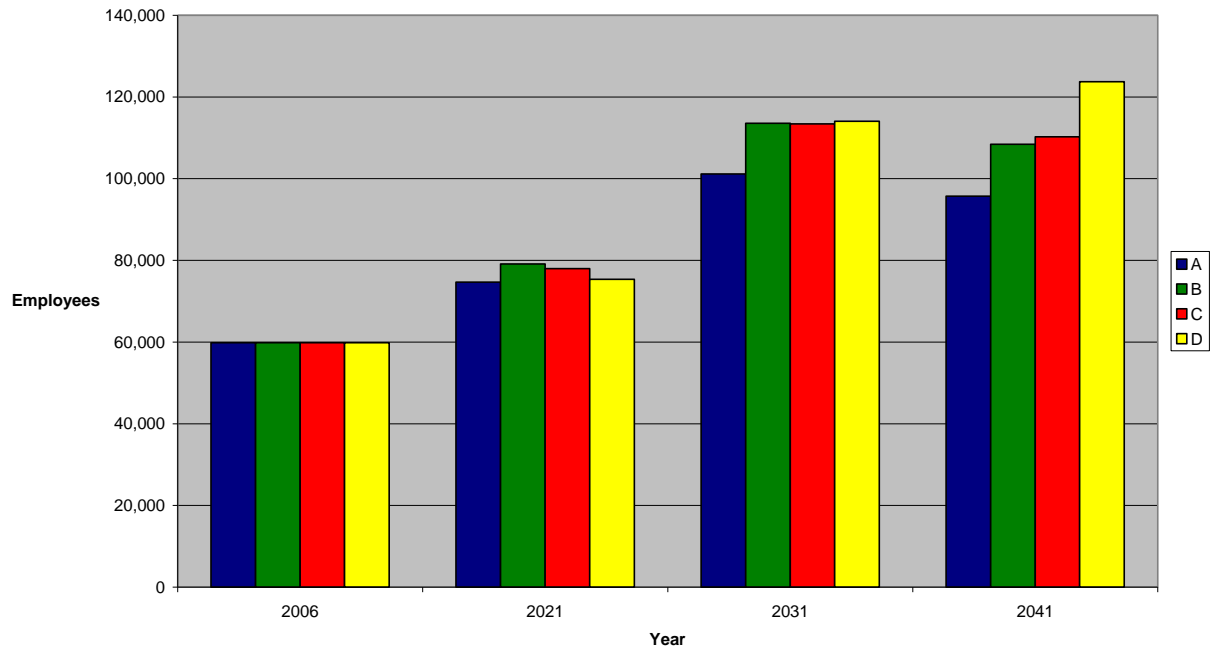
**% of Business Service Employment in Centres**



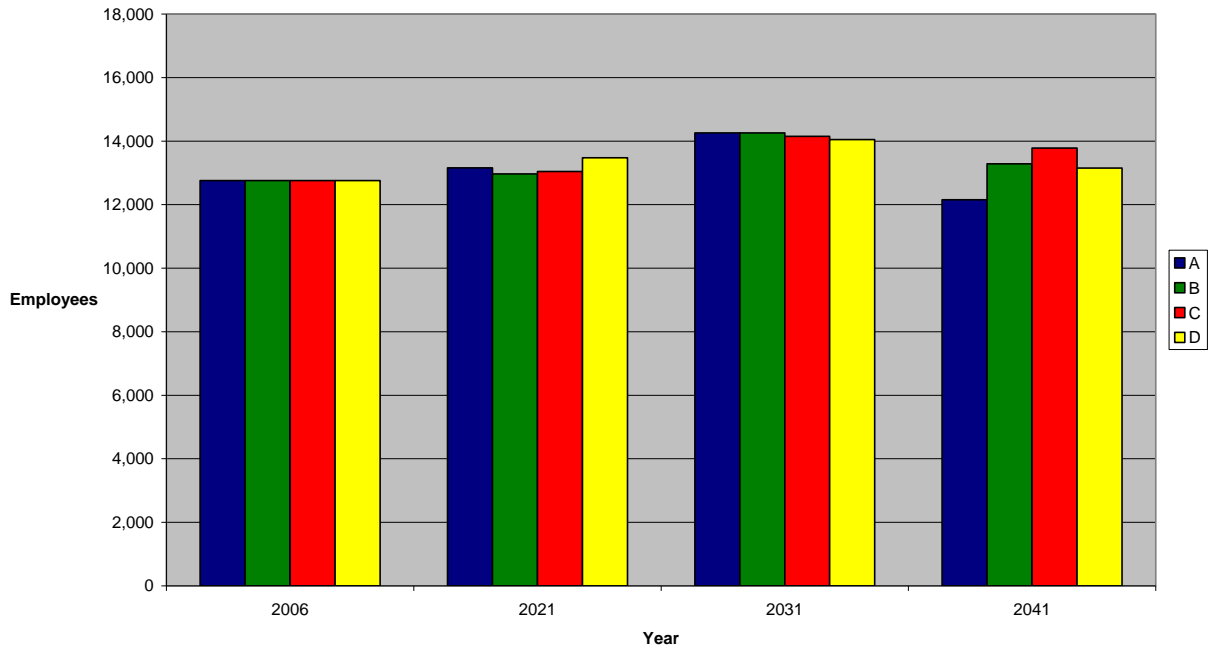
**Total Business Services Employment in Centres, excluding CBD**



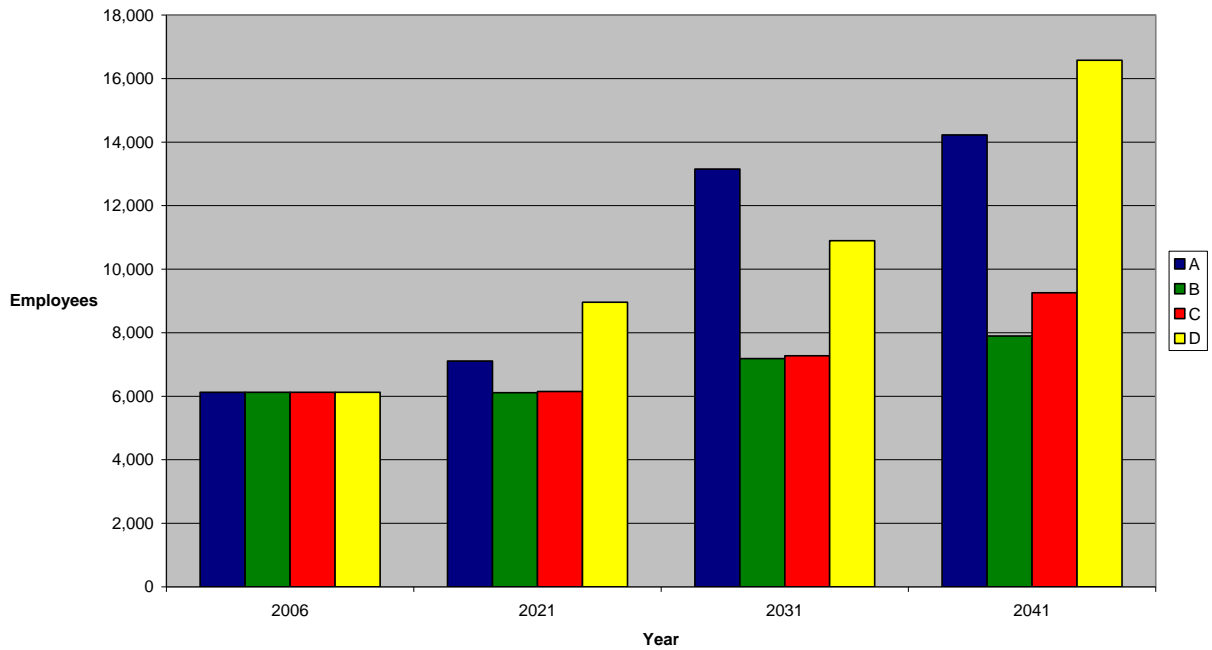
**Total Business Services Employment Outside Centres**



**Business Services Employment - CBD Fringe**

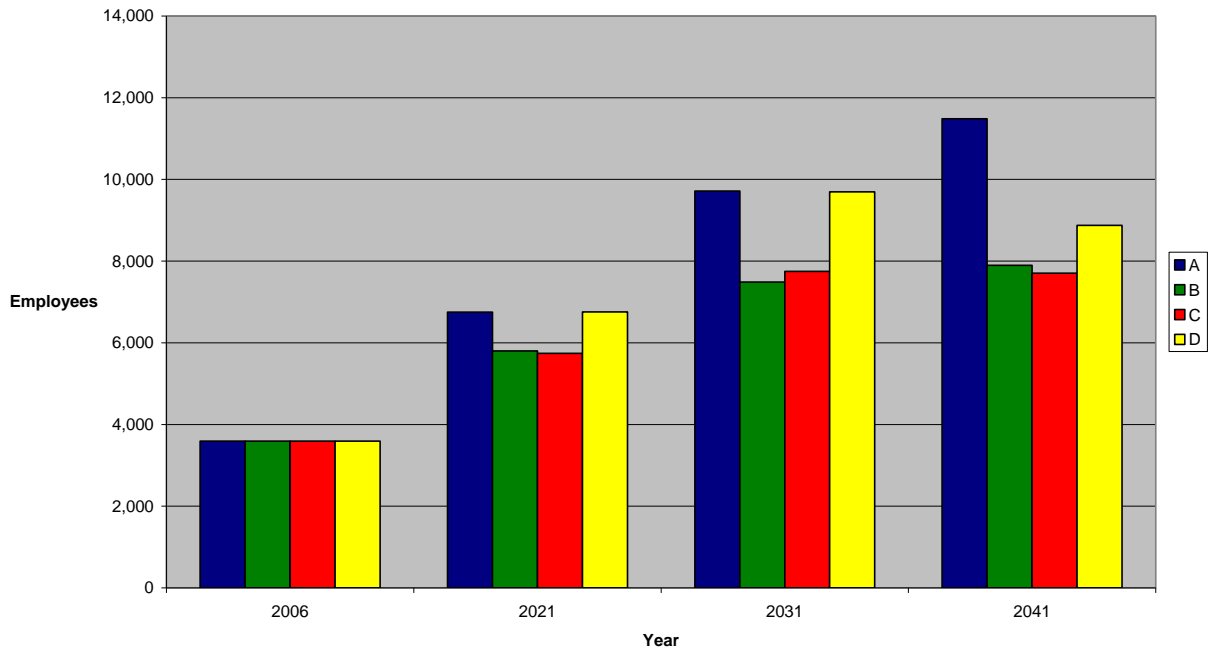


**Business Services Employment - Newmarket**

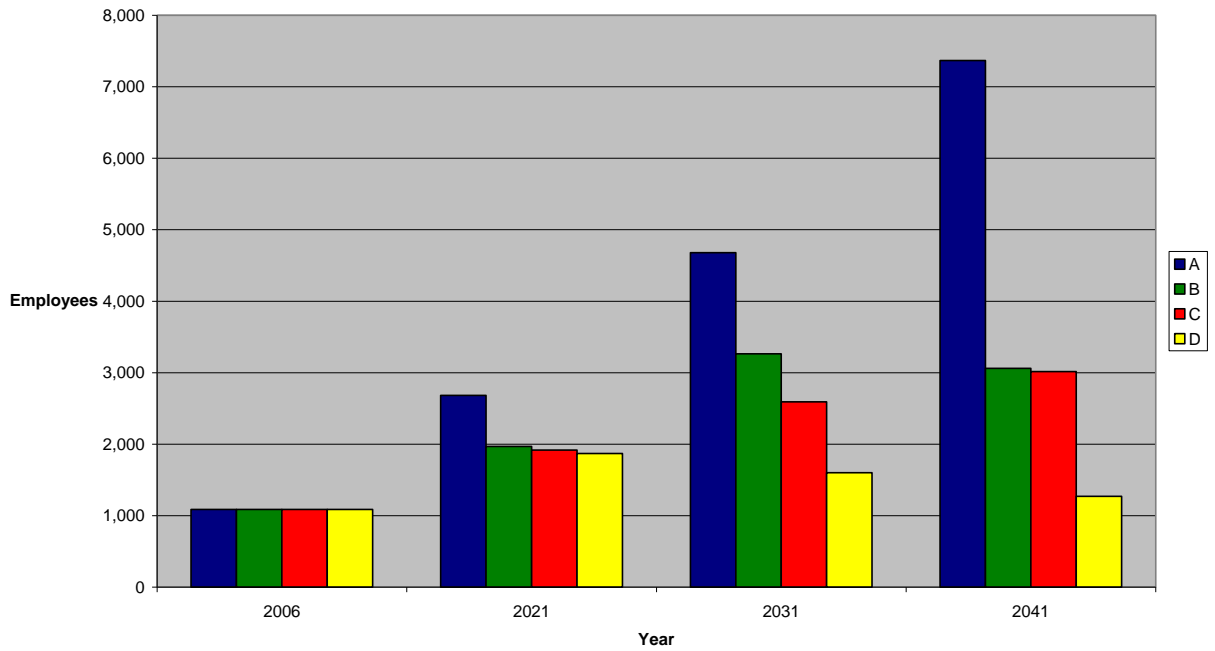




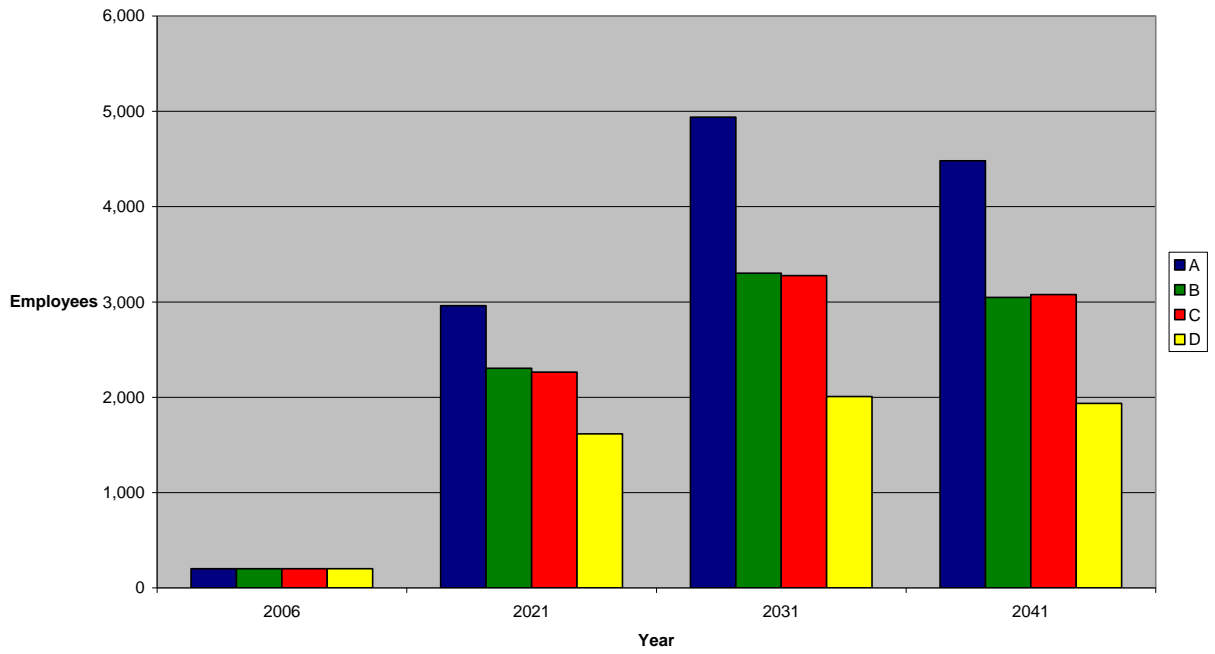
**Business Services Employment - Takapuna**



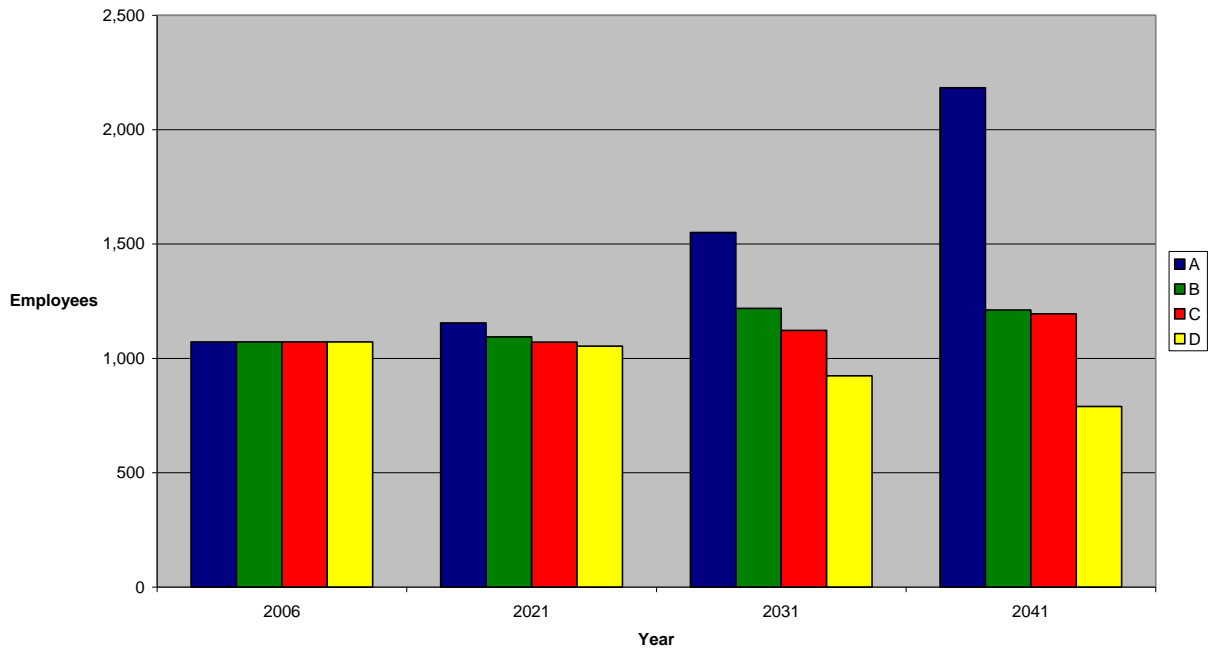
**Business Services Employment - Manukau City Centre**



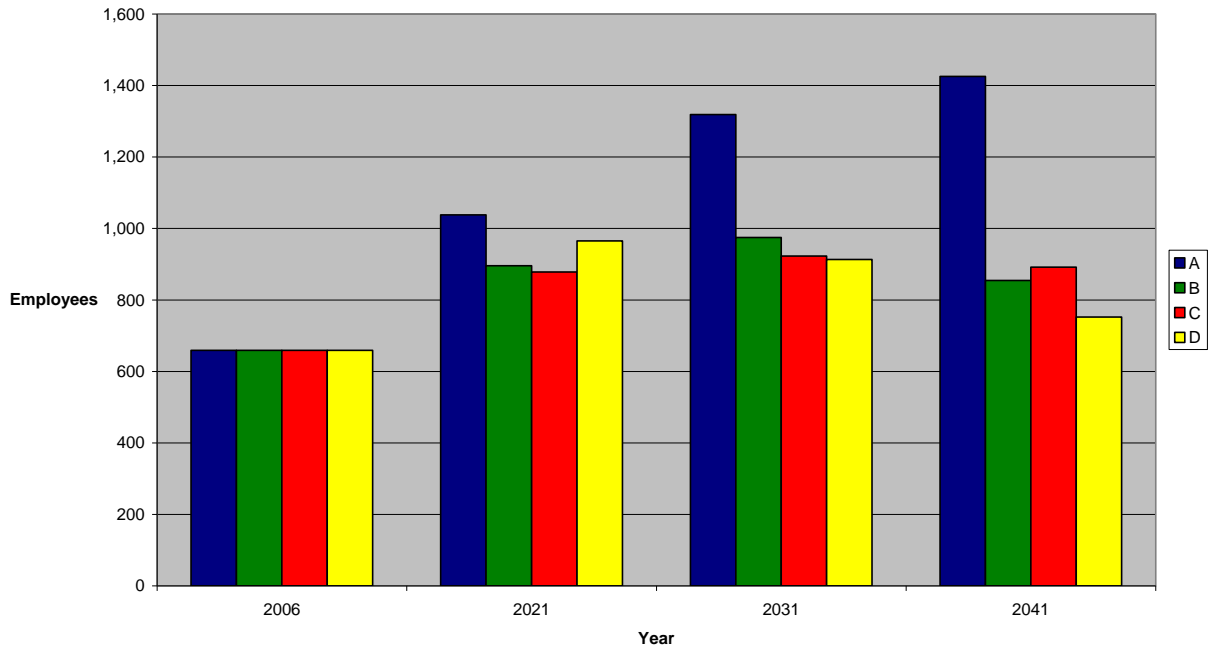
**Business Services Employment - Albany**



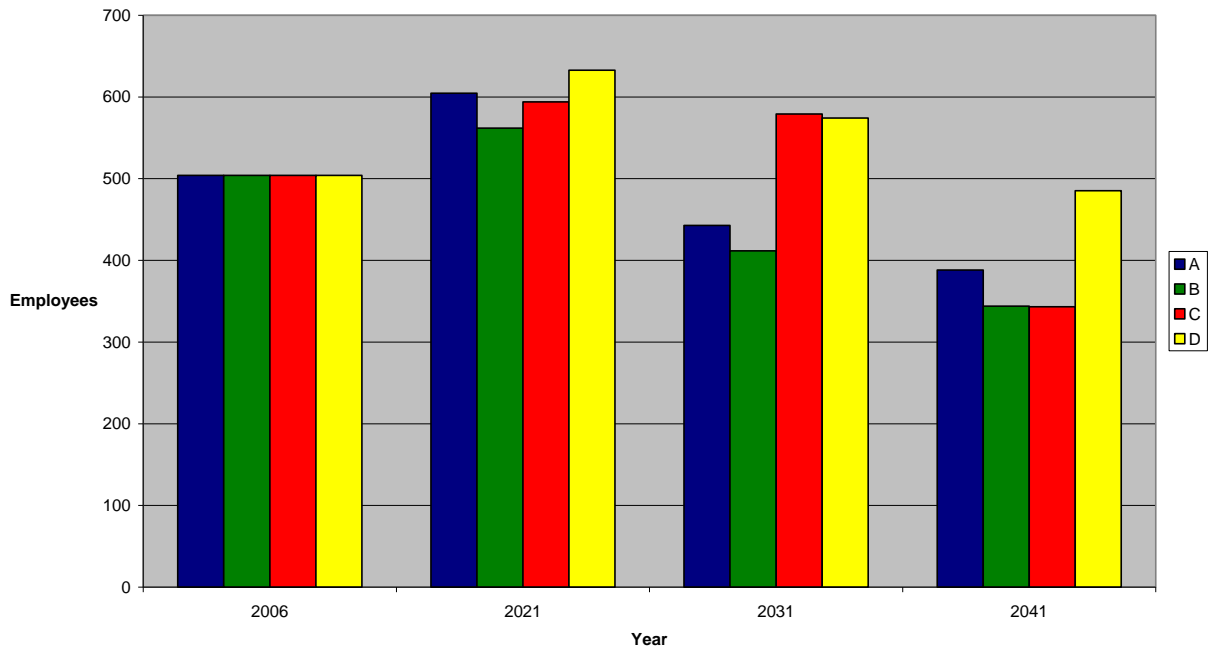
**Business Services Employment - Henderson**



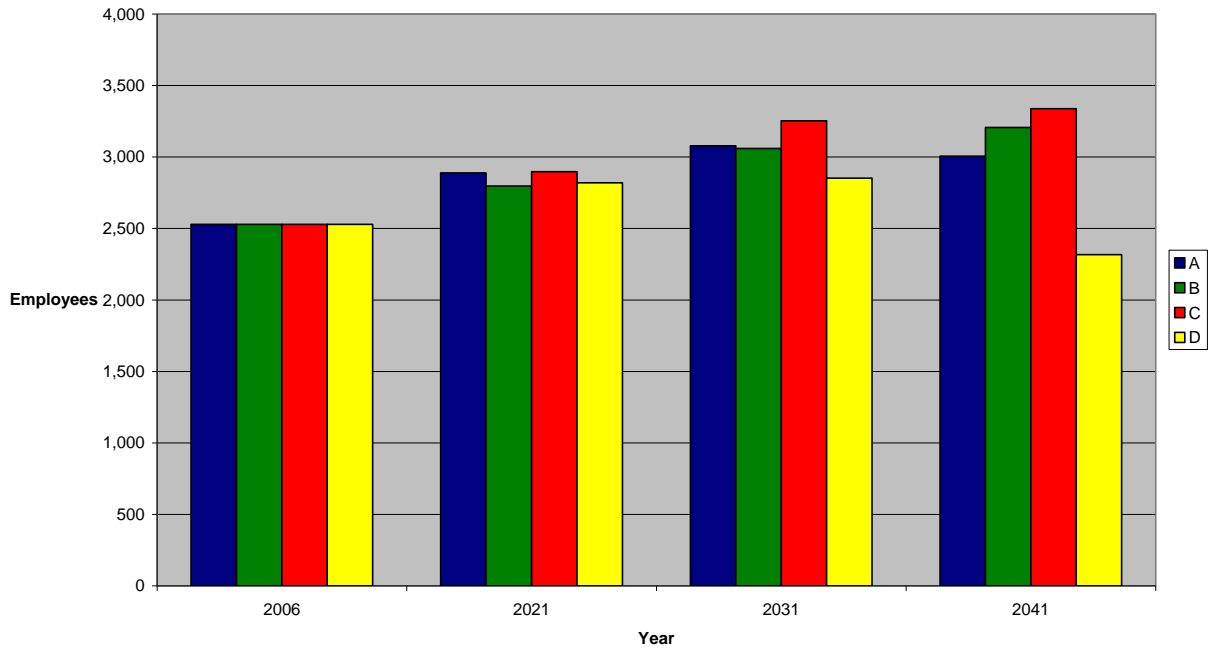
**Business Services Employment - New Lynn**



**Business Services Employment - Onehunga**



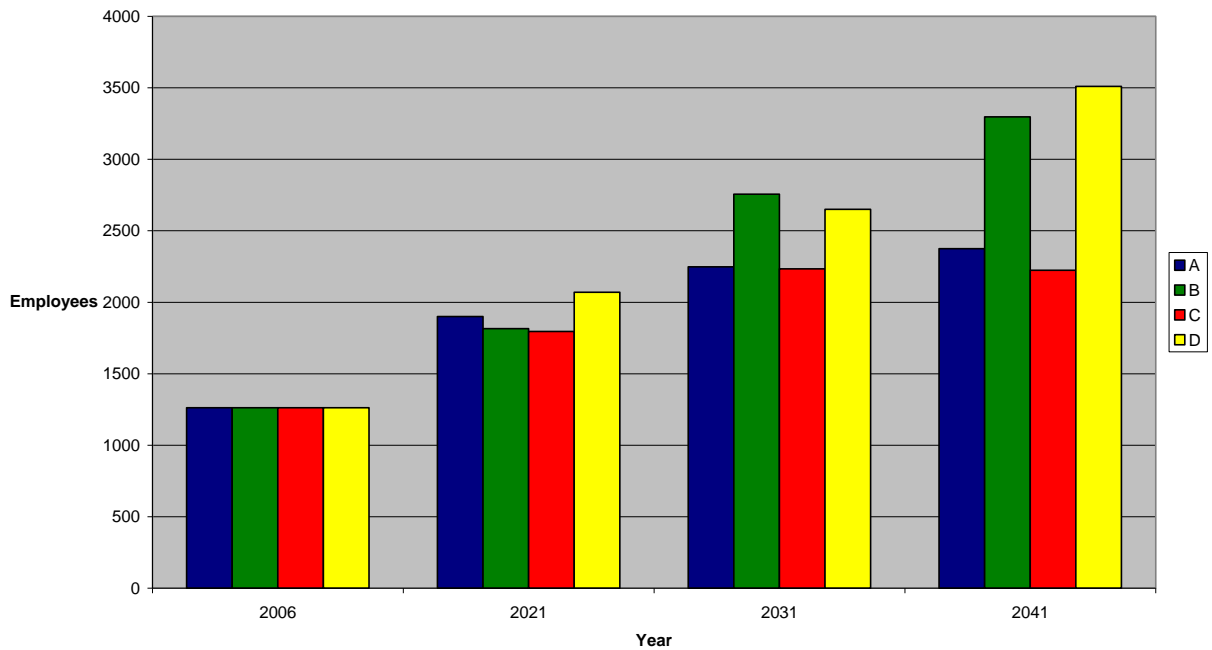
**Business Services Employment - Airport and Surrounds**



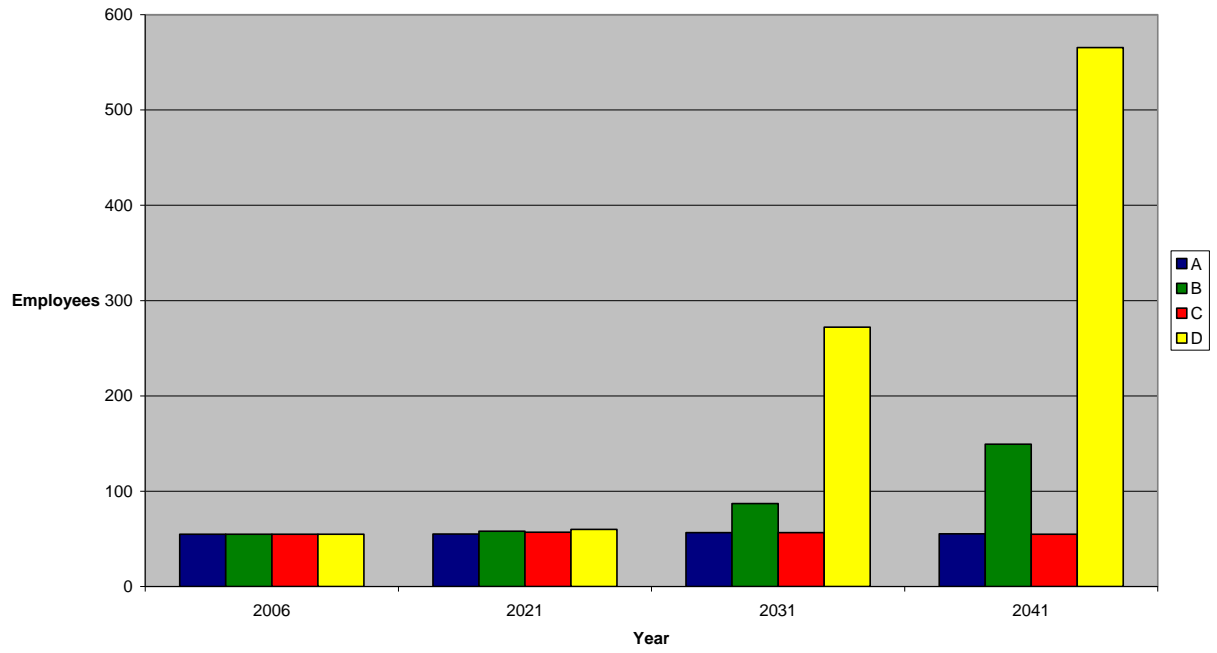
*Group 1 Business land*

**Figure 104 Group 1 Business land (specific sites)**

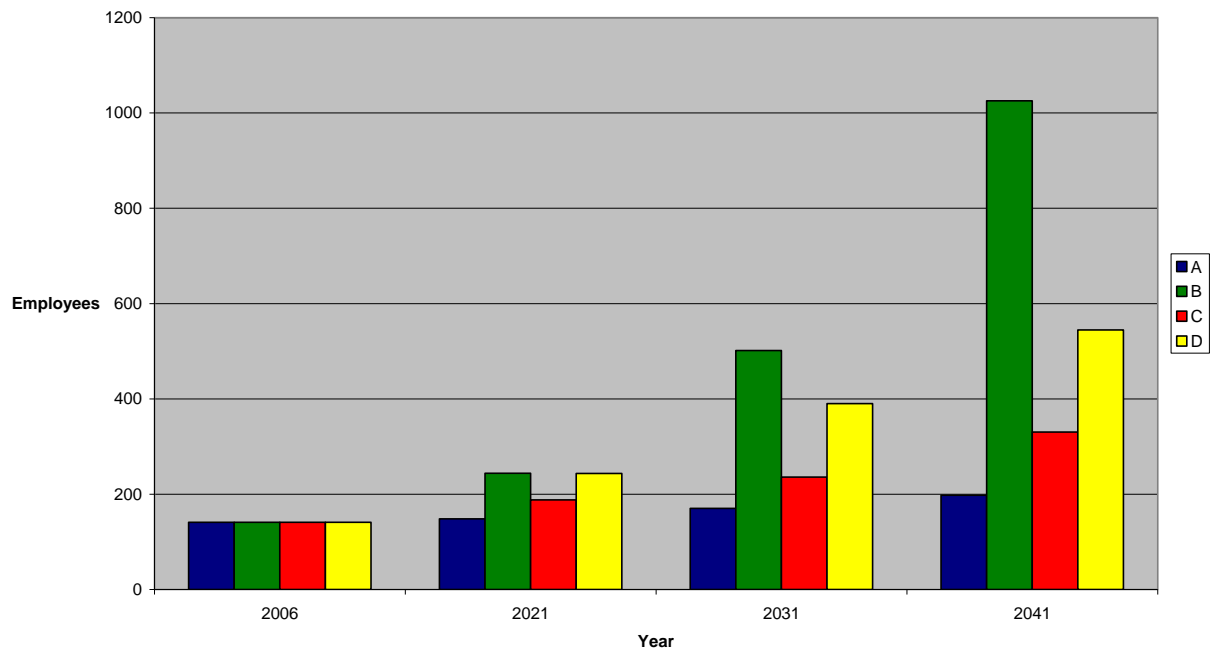
**Silverdale Group 1 Employment**



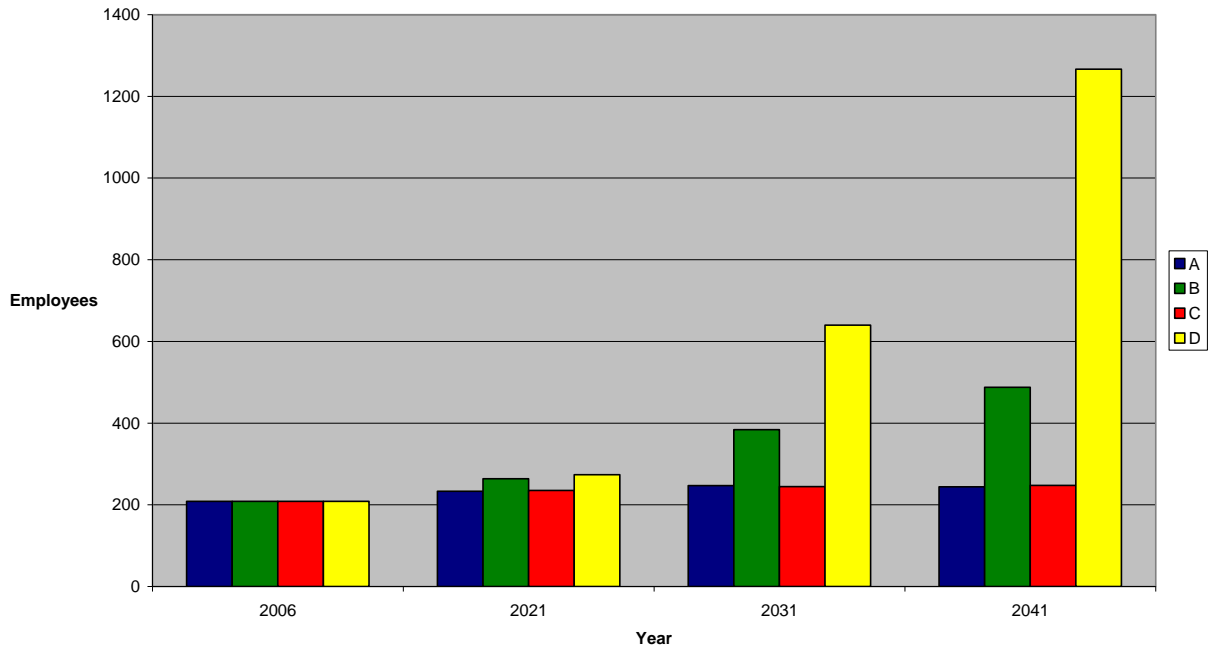
Whenuapai Group 1 Employment



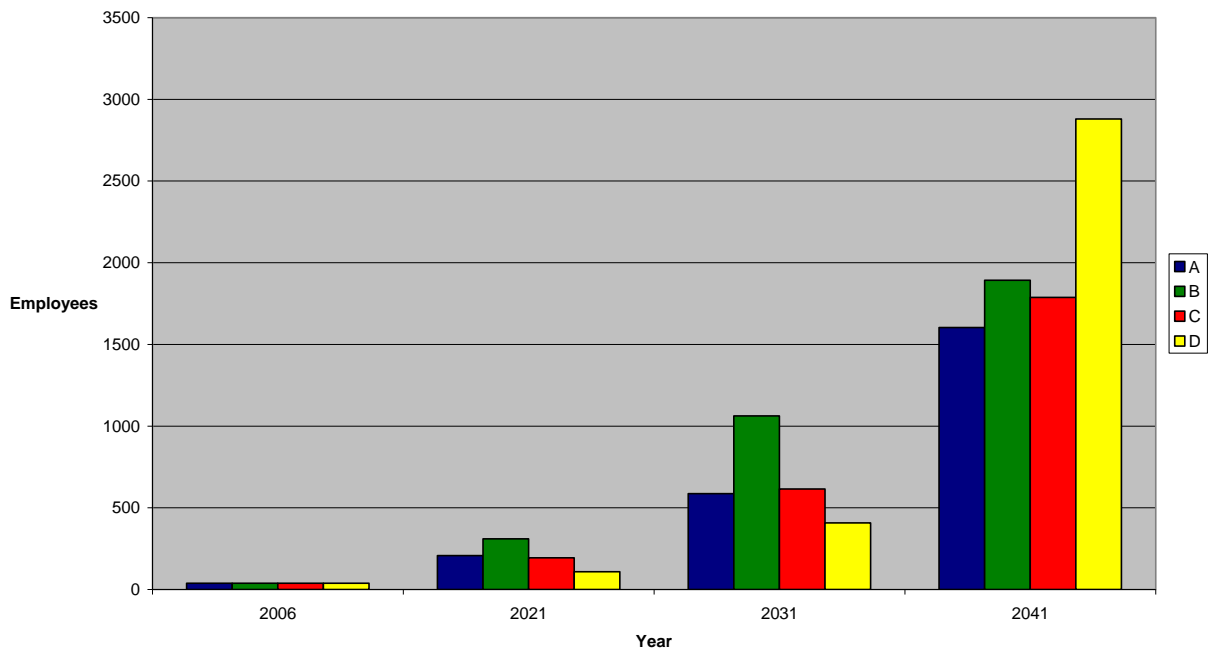
Airport Group 1 Employment



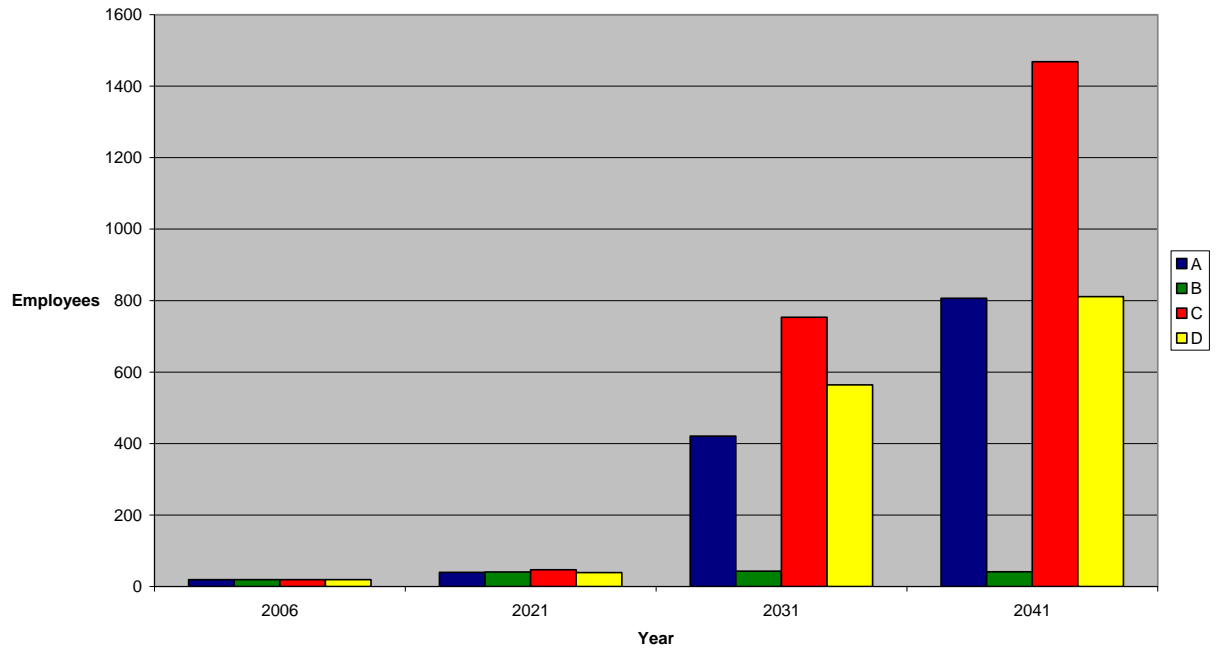
**Drury Group 1 Employment**



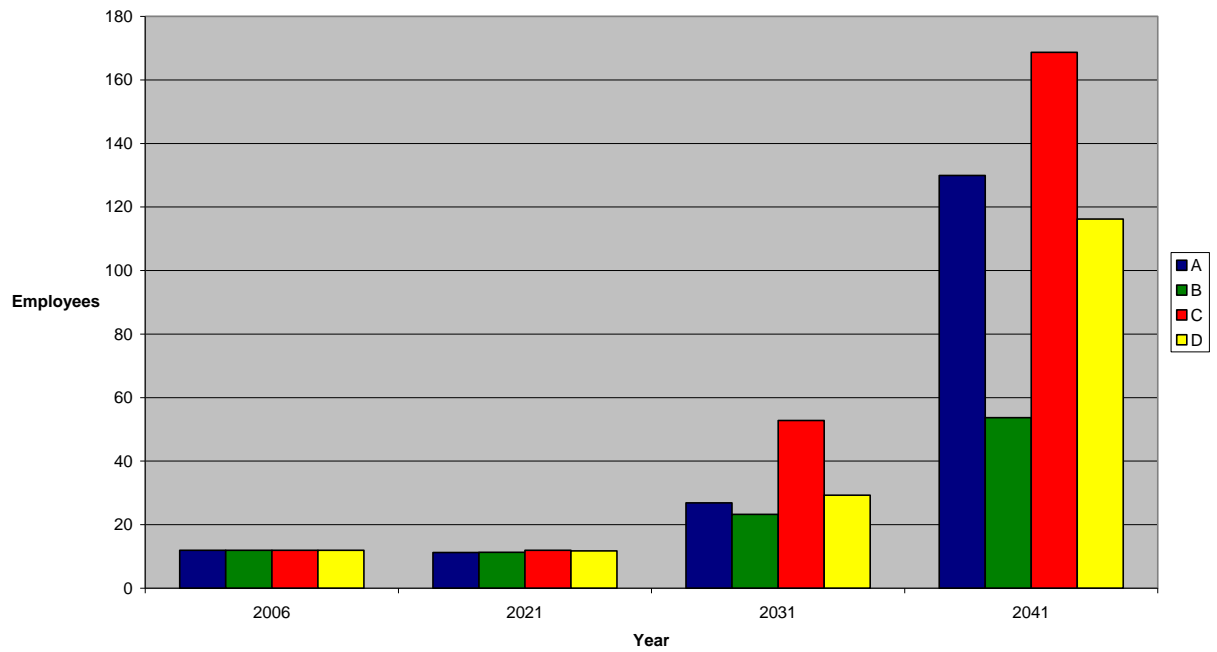
**Paerata Group 1 Employment**



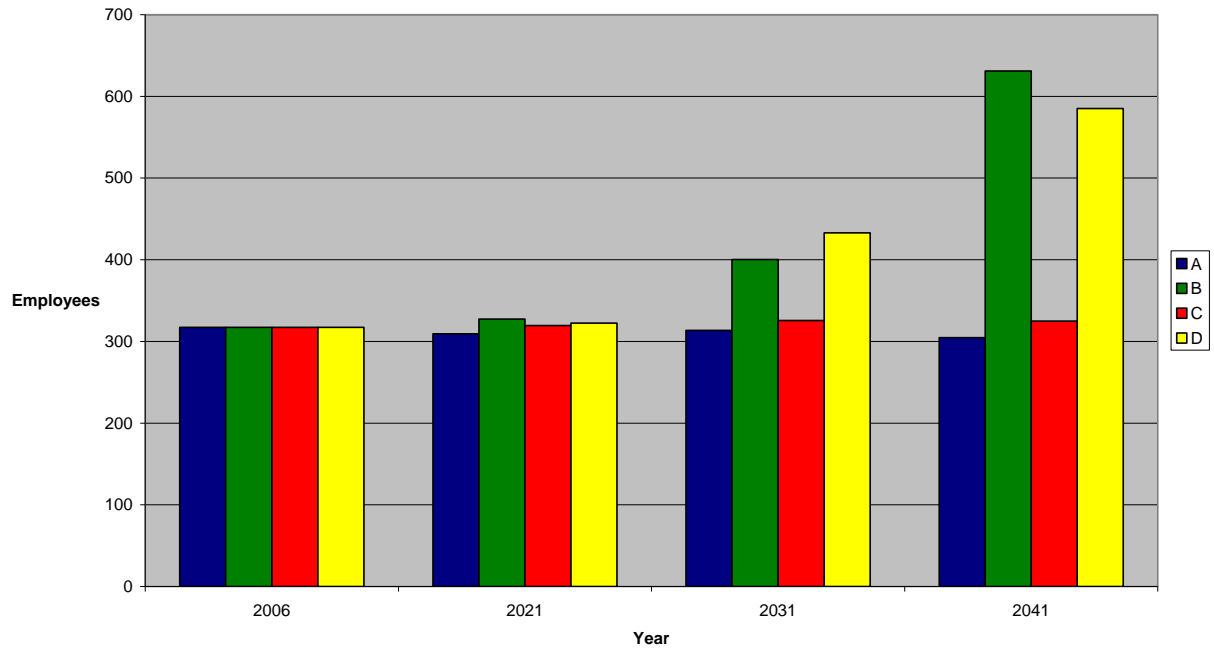
**Redhills Group 1 Employment**



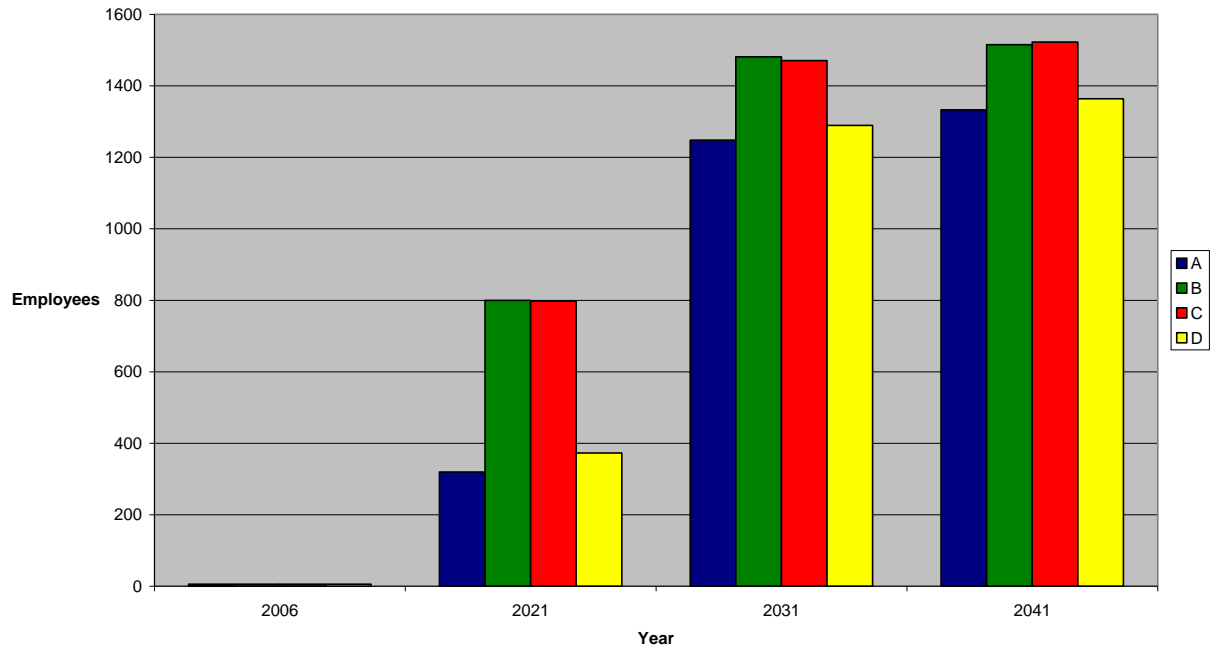
**Hingaia Group 1 Employment**



Puhinui Group 1 Employment

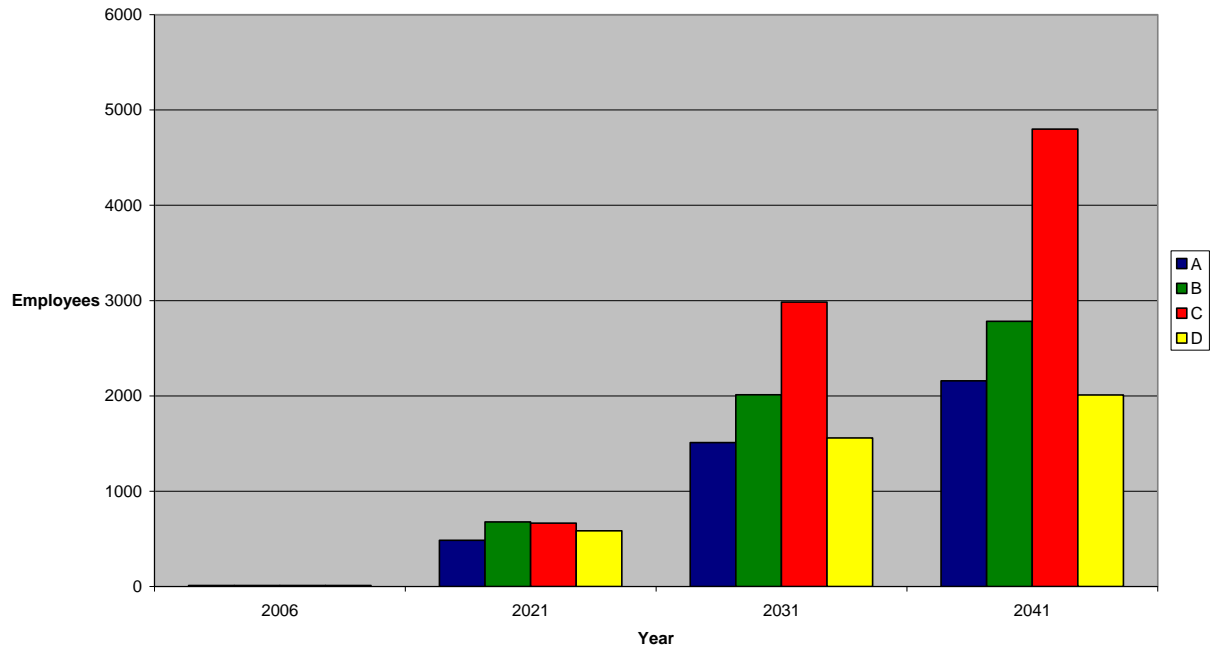


Westgate Group 1 Employment





Hobsonville Group 1 Employment



Takanini Group 1 Employment

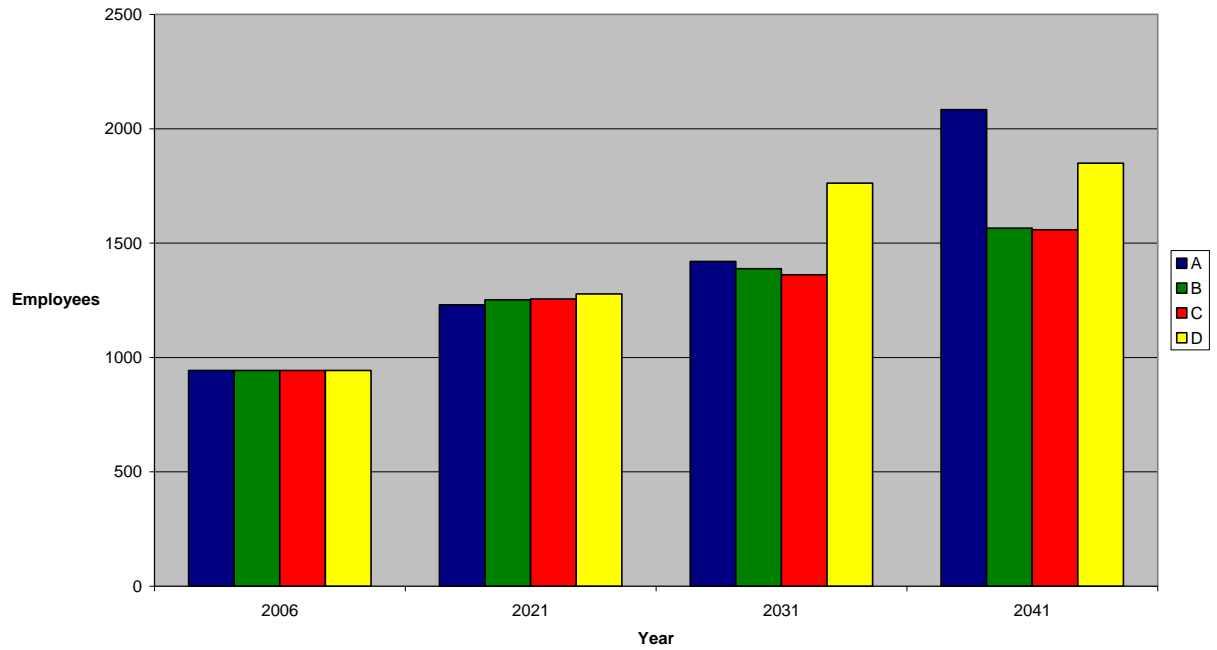


Figure 105 Access to labour pool for Group 1 Business land (specific sites)

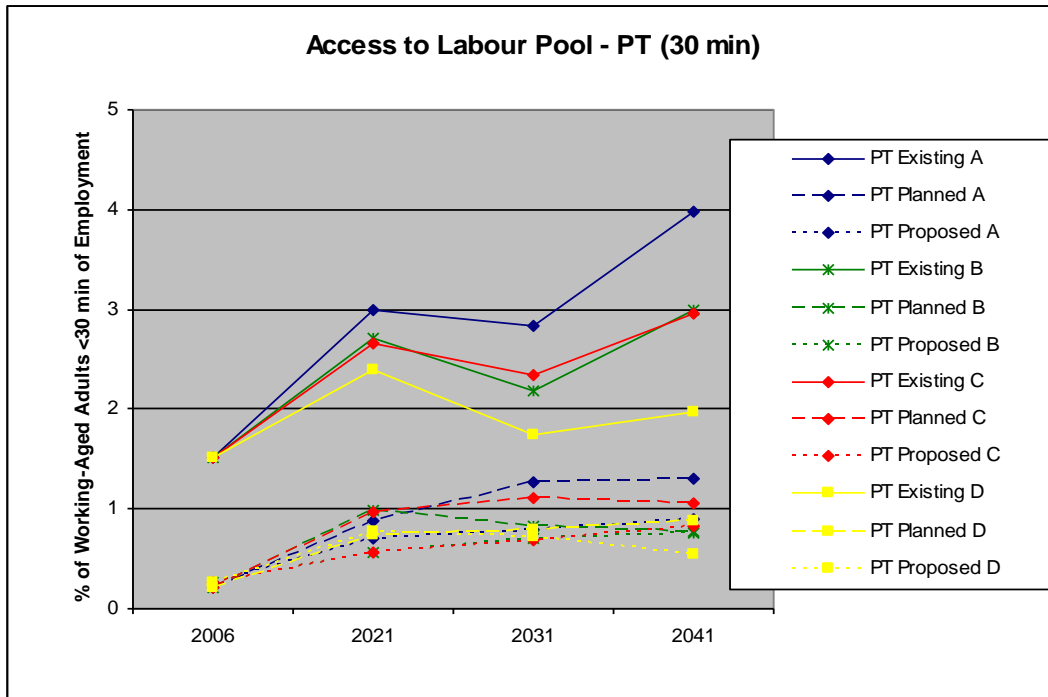
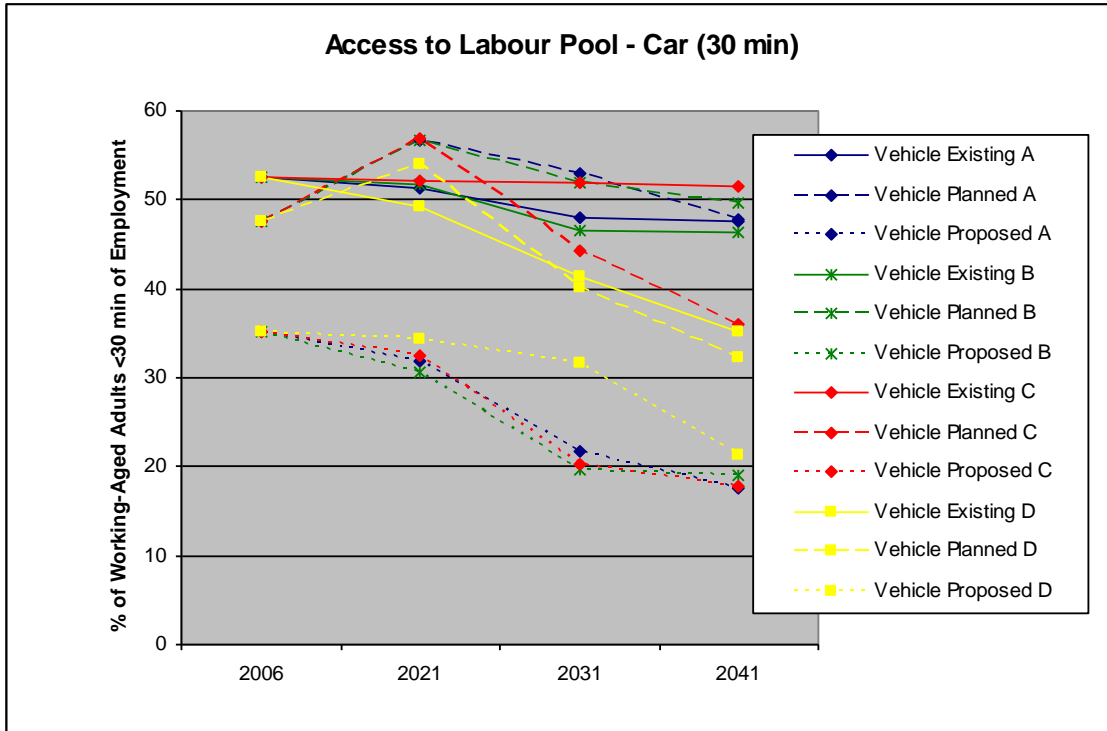
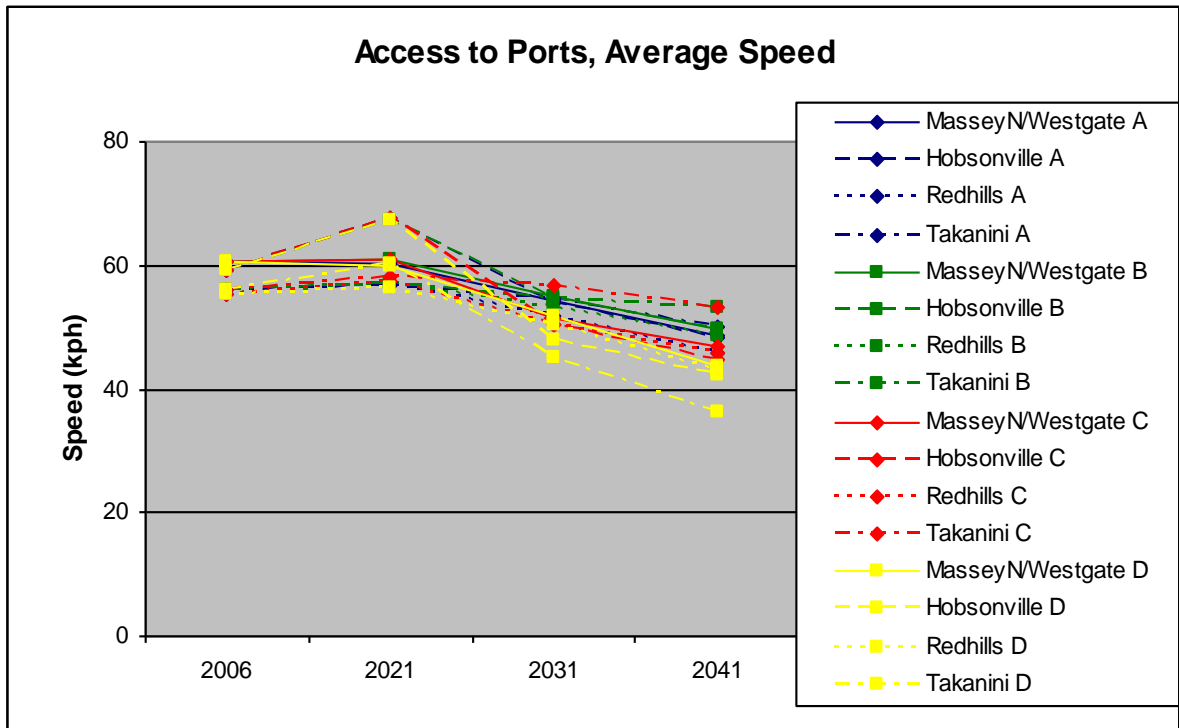
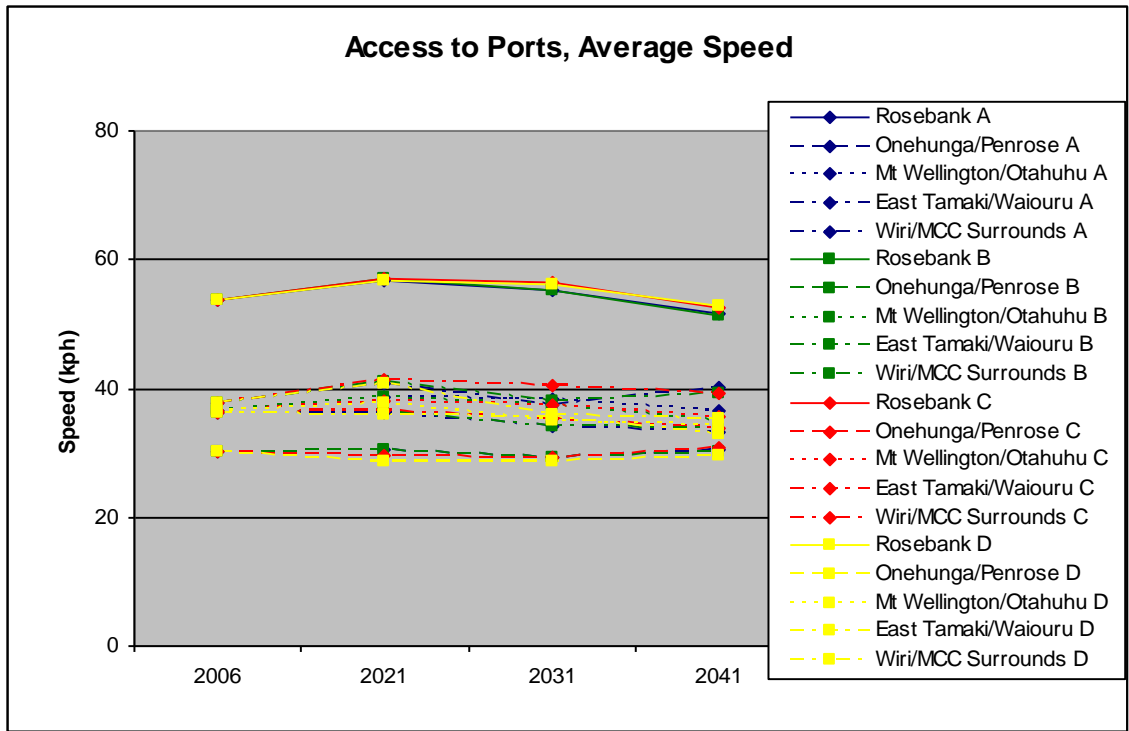
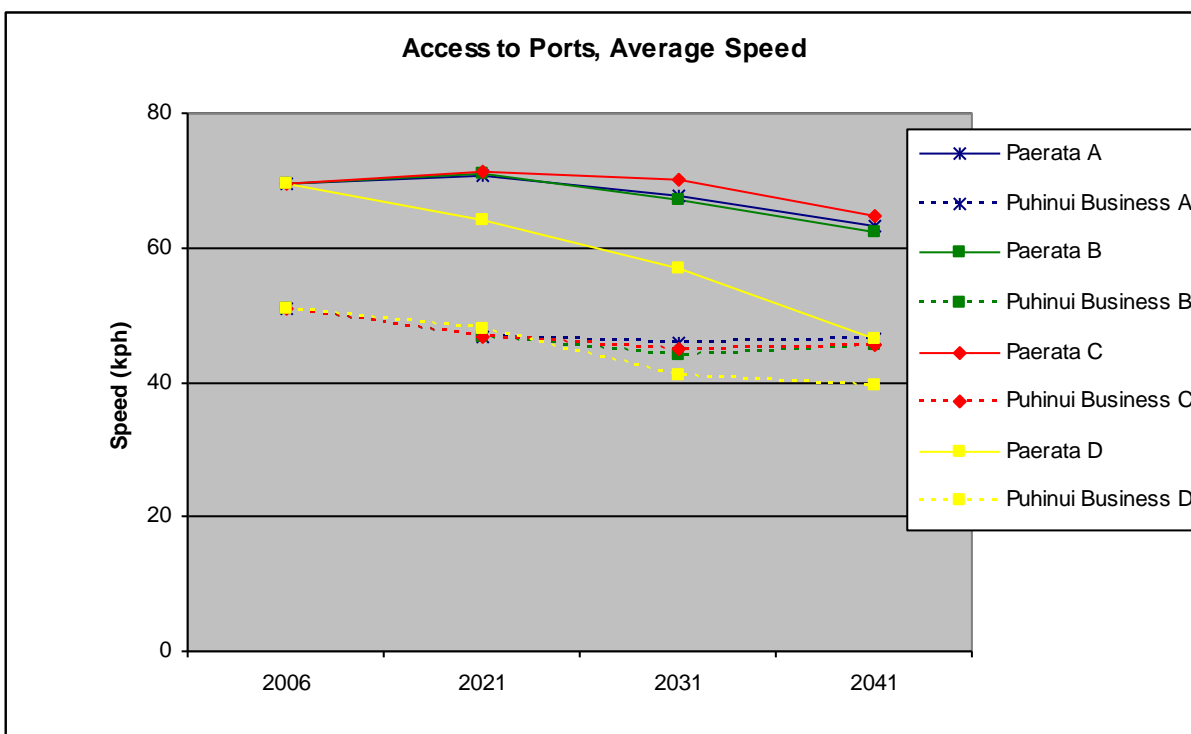
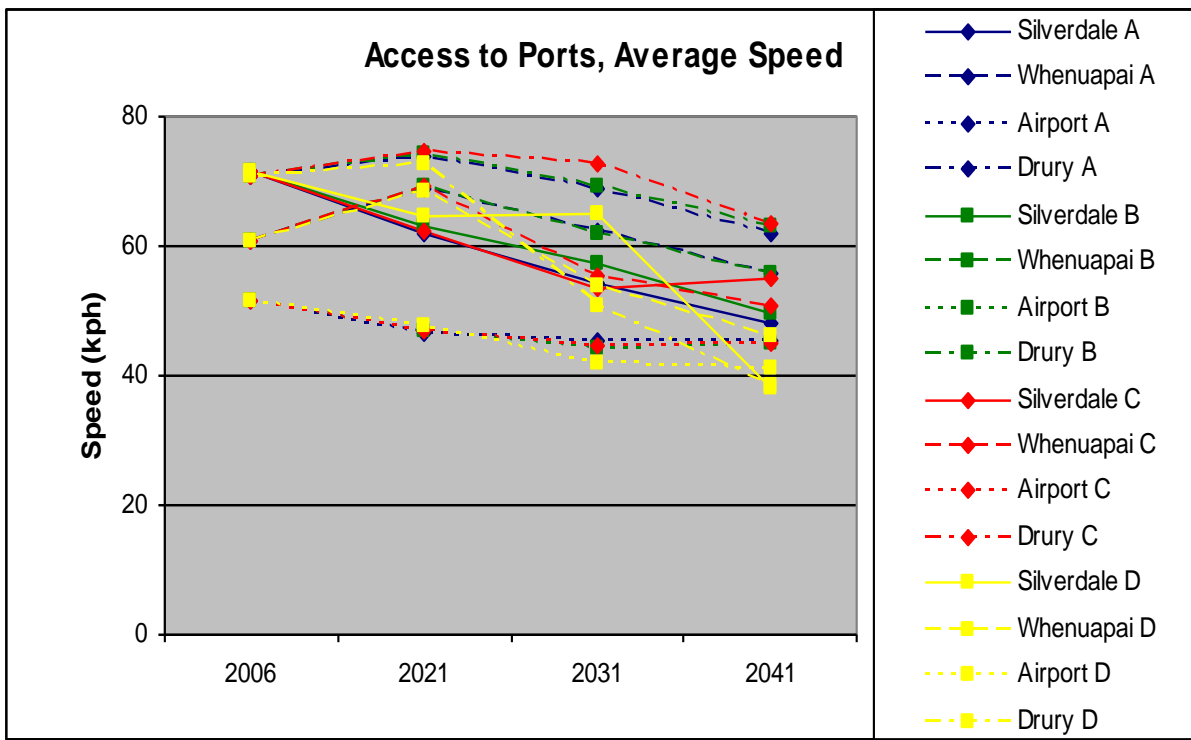
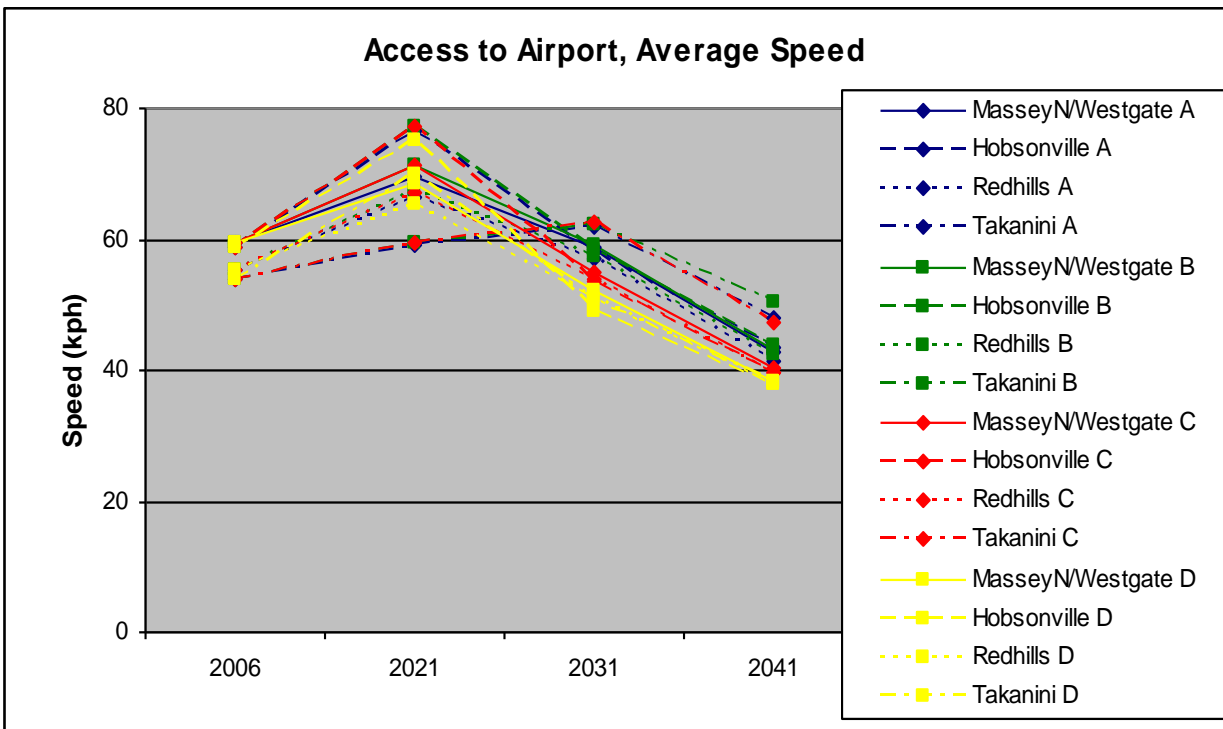
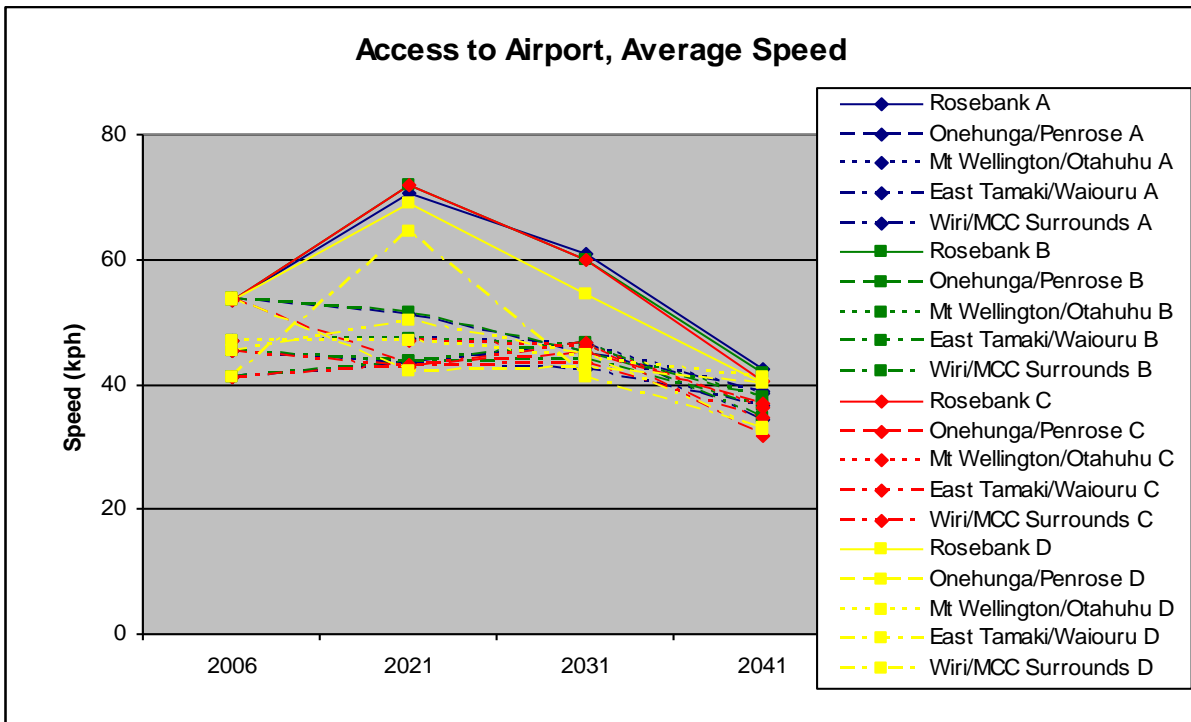
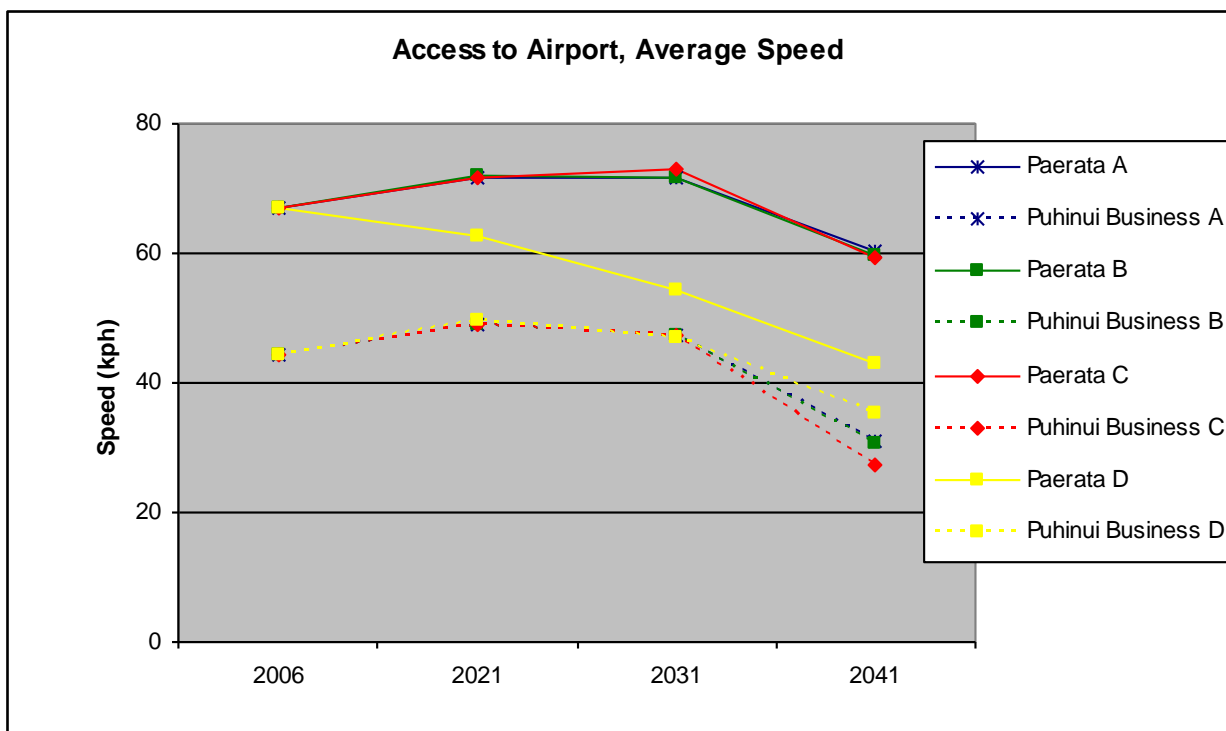
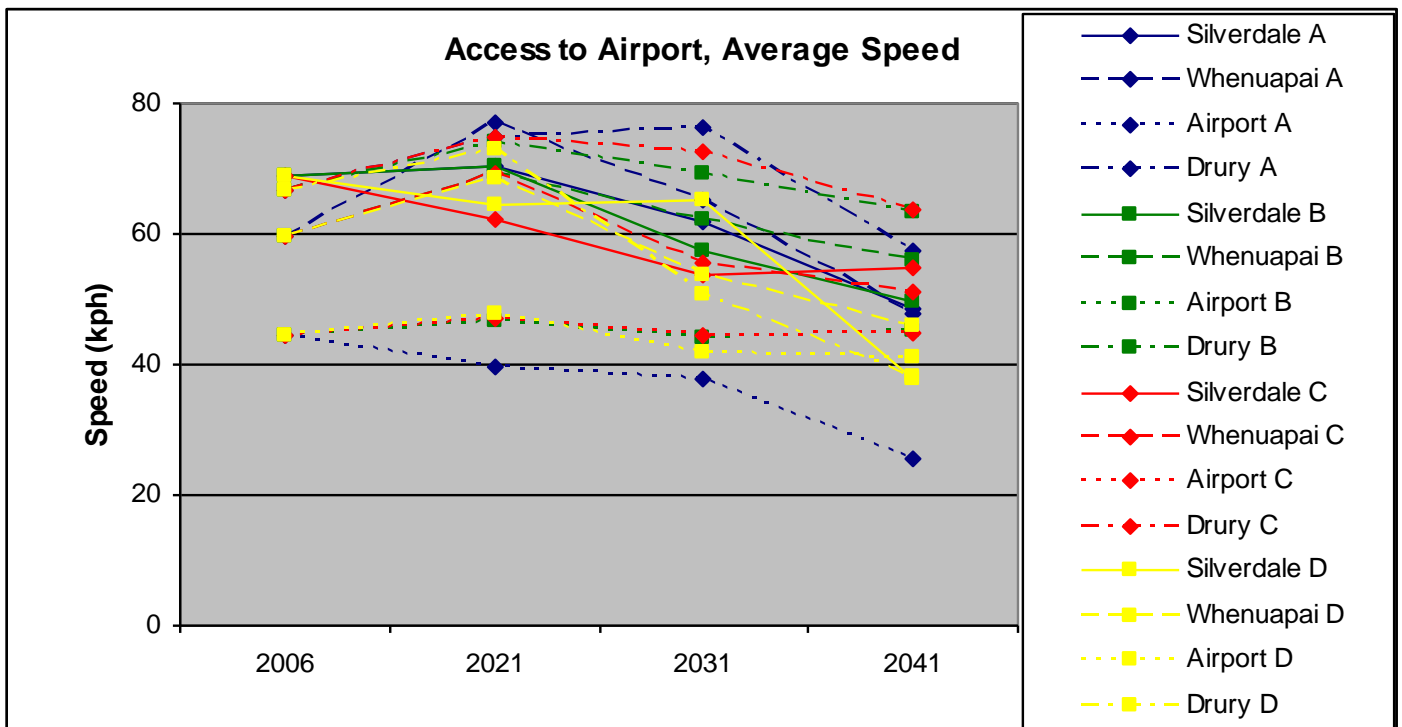


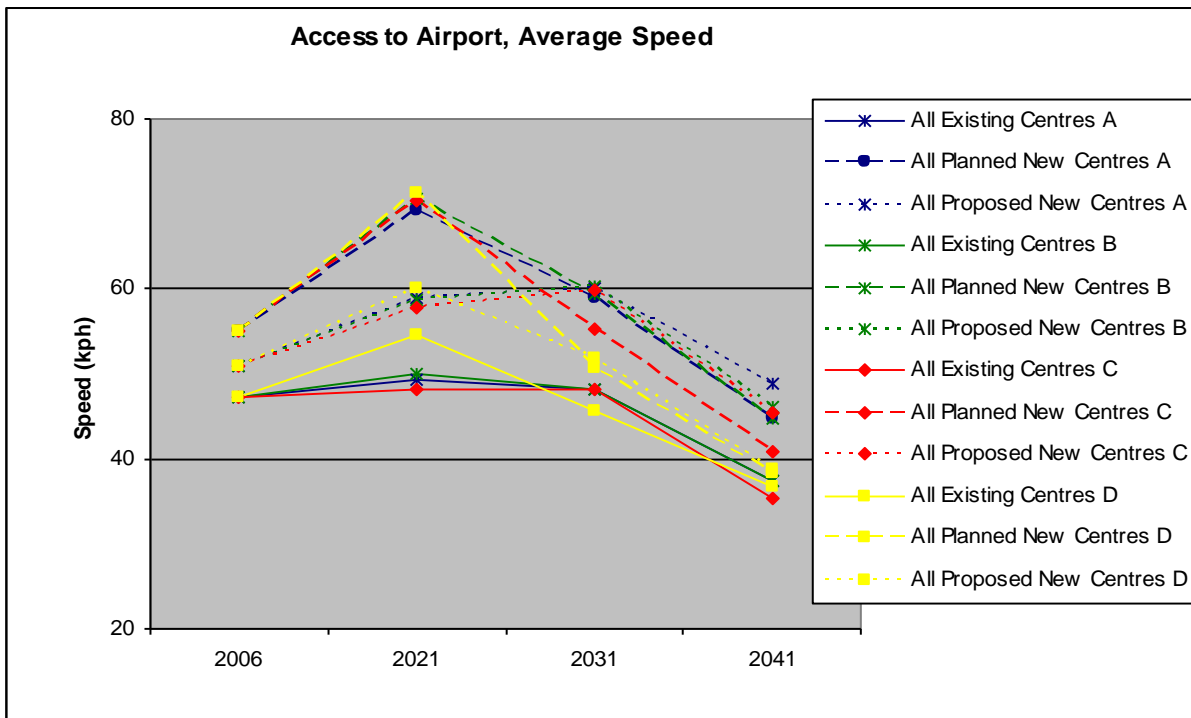
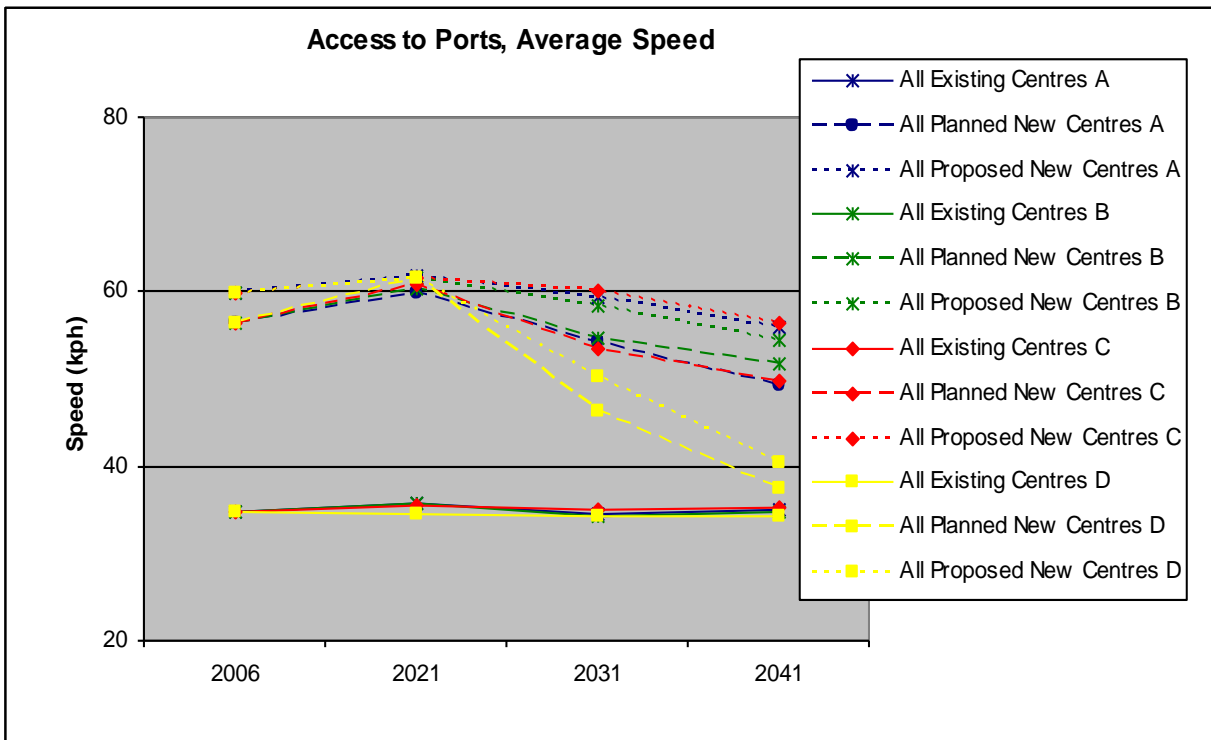
Figure 106 Access to port and airport from Group 1 Business land (specific sites)







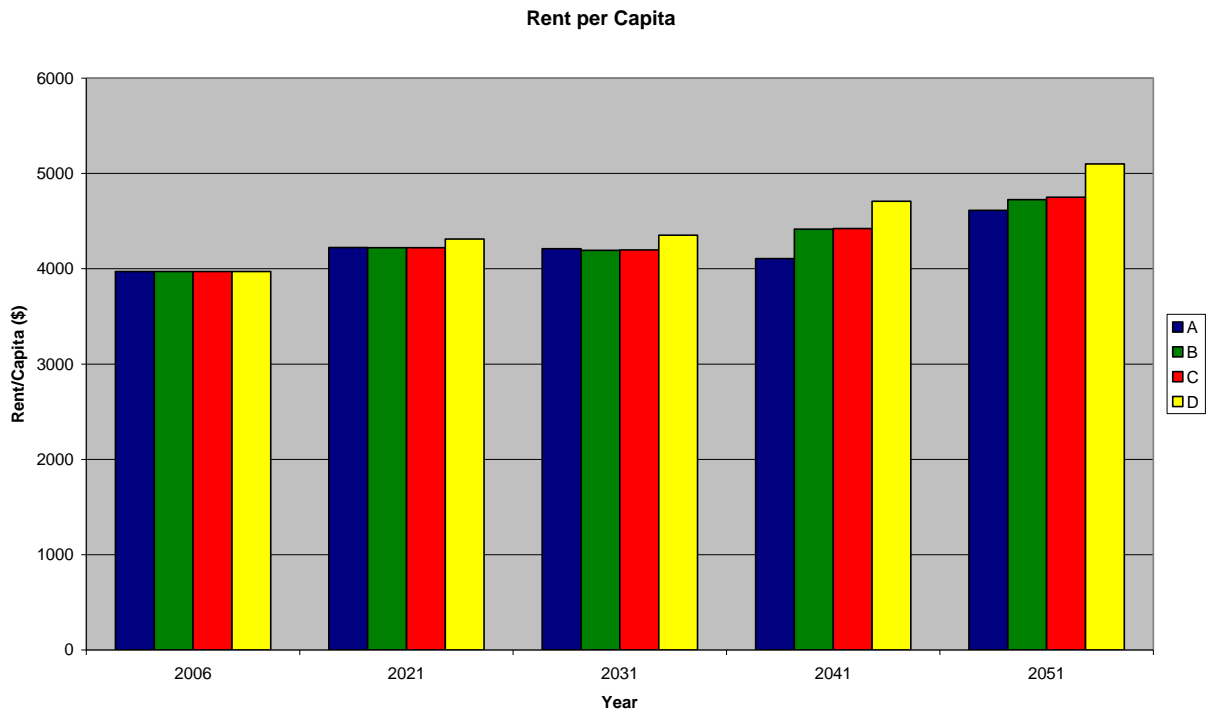




### 15.5.3 Social wellbeing graphs

*Greater housing affordability*

**Figure 107 Rent per capita**



**Figure 108 Total rent paid in the region**

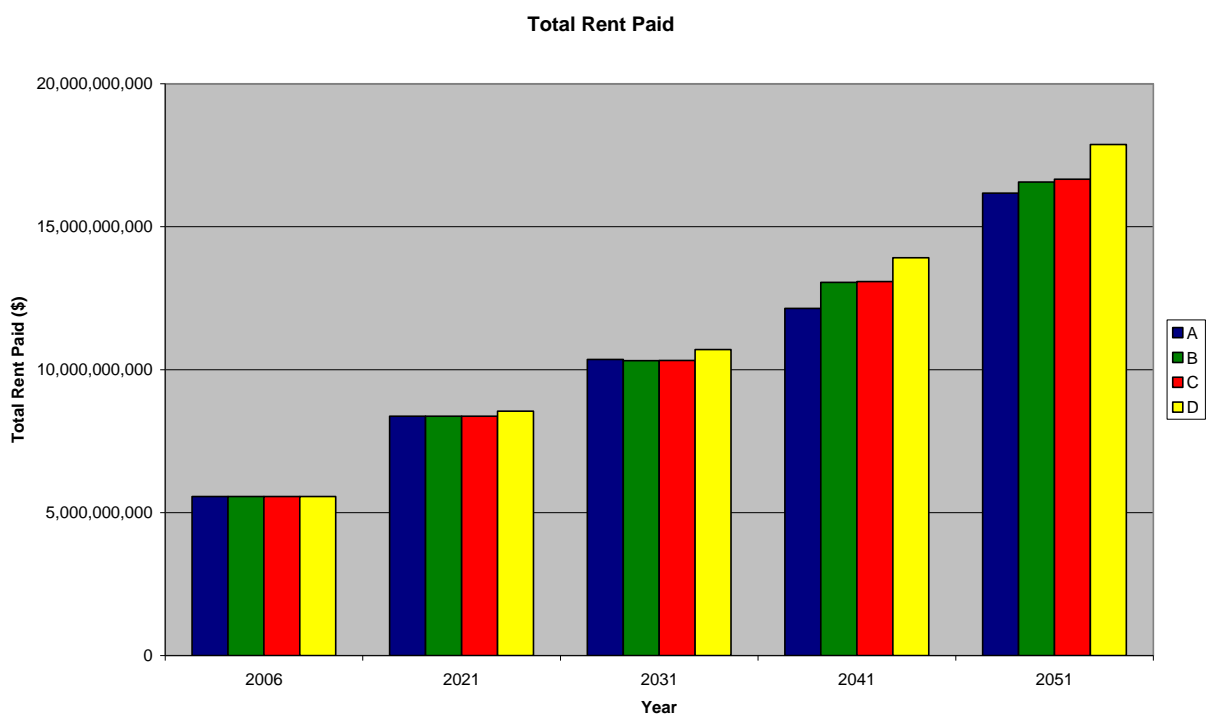




Figure 109 Total daily rent and transport costs

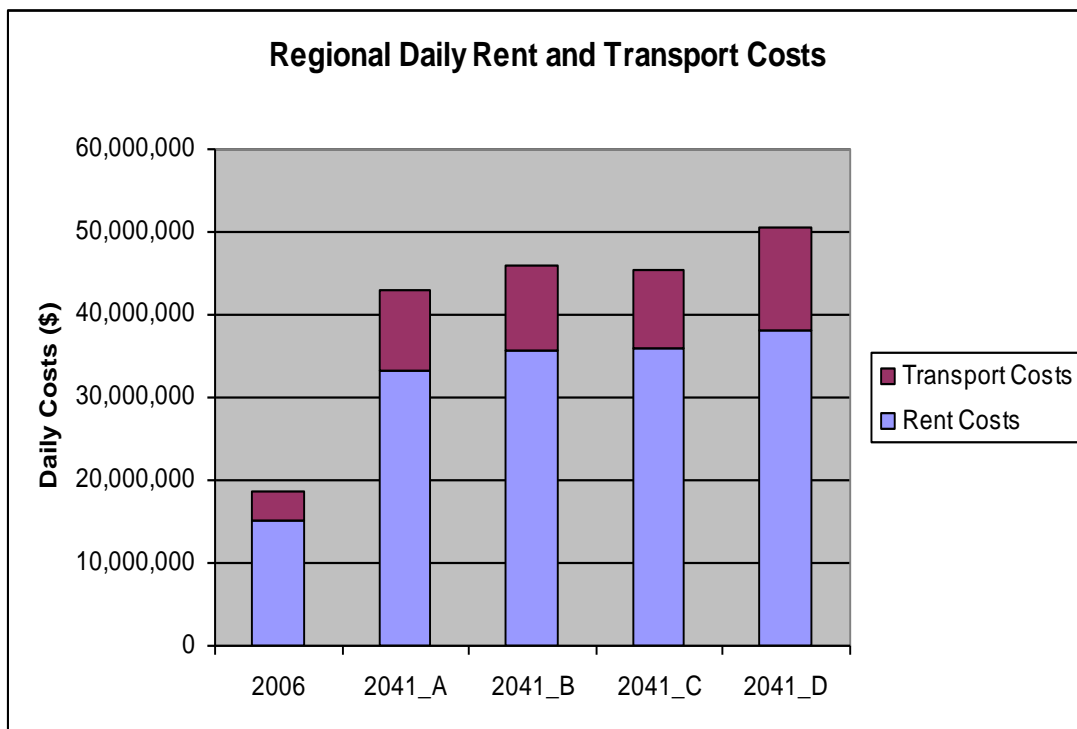


Figure 110 Total daily rent and transport costs per capita

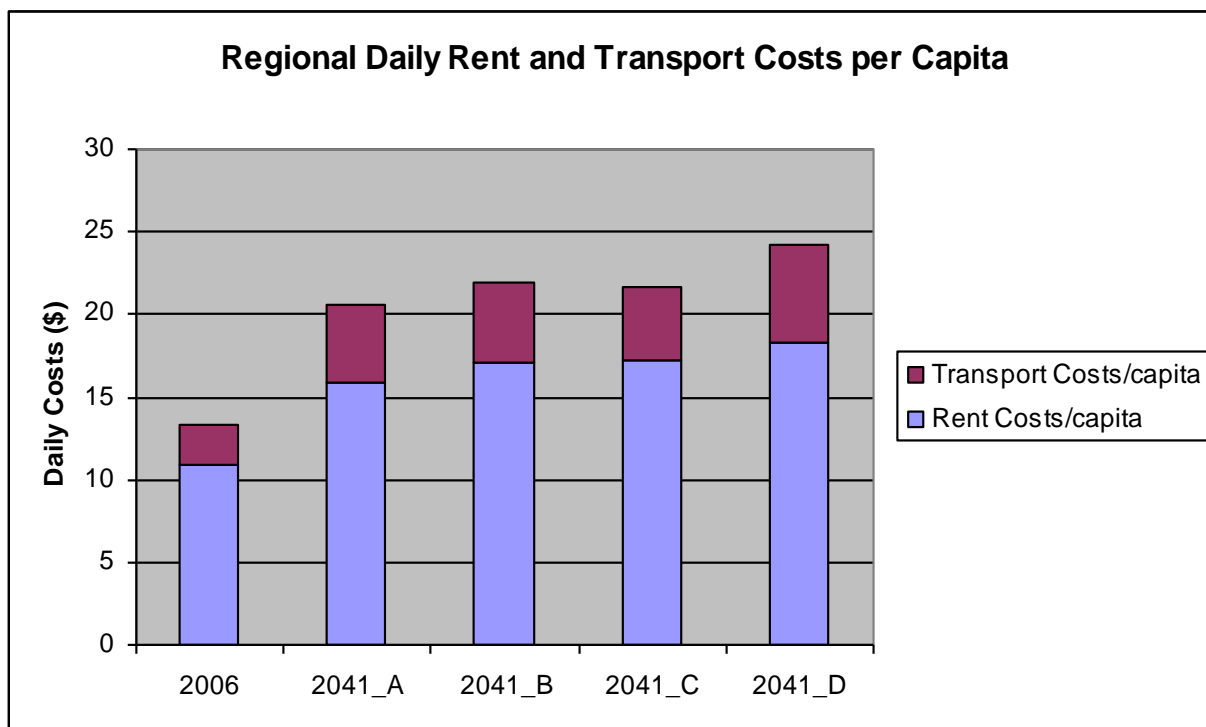


Figure 111 Rent/capita of lower income zones

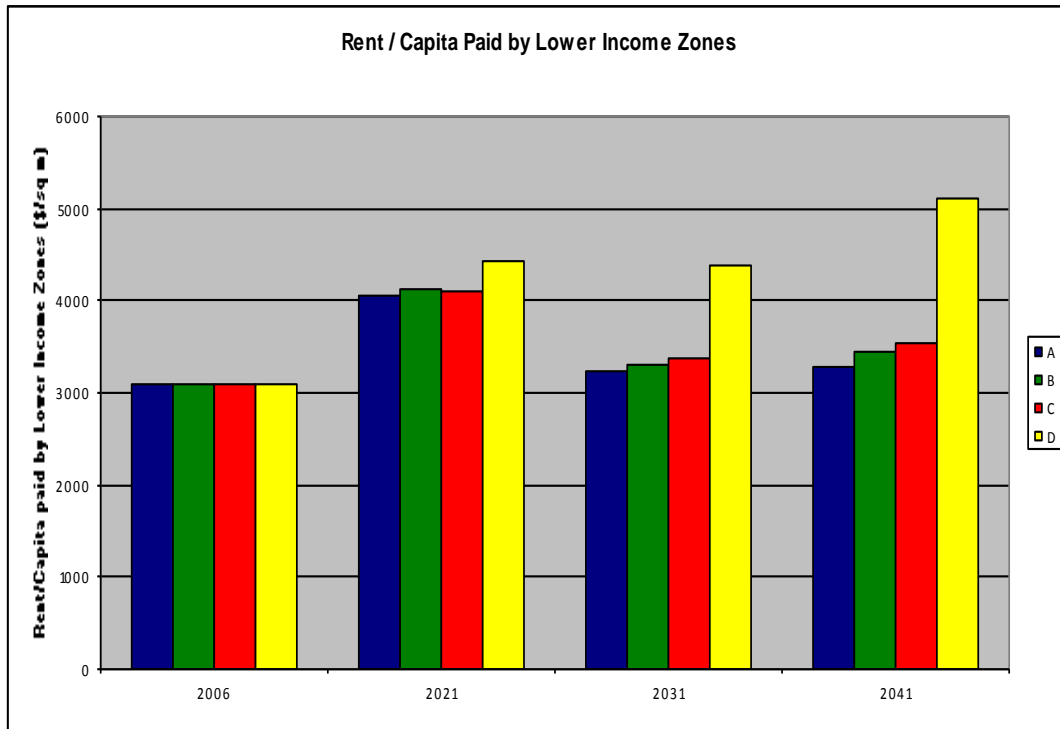


Figure 112 Rent/capita of lower income zones

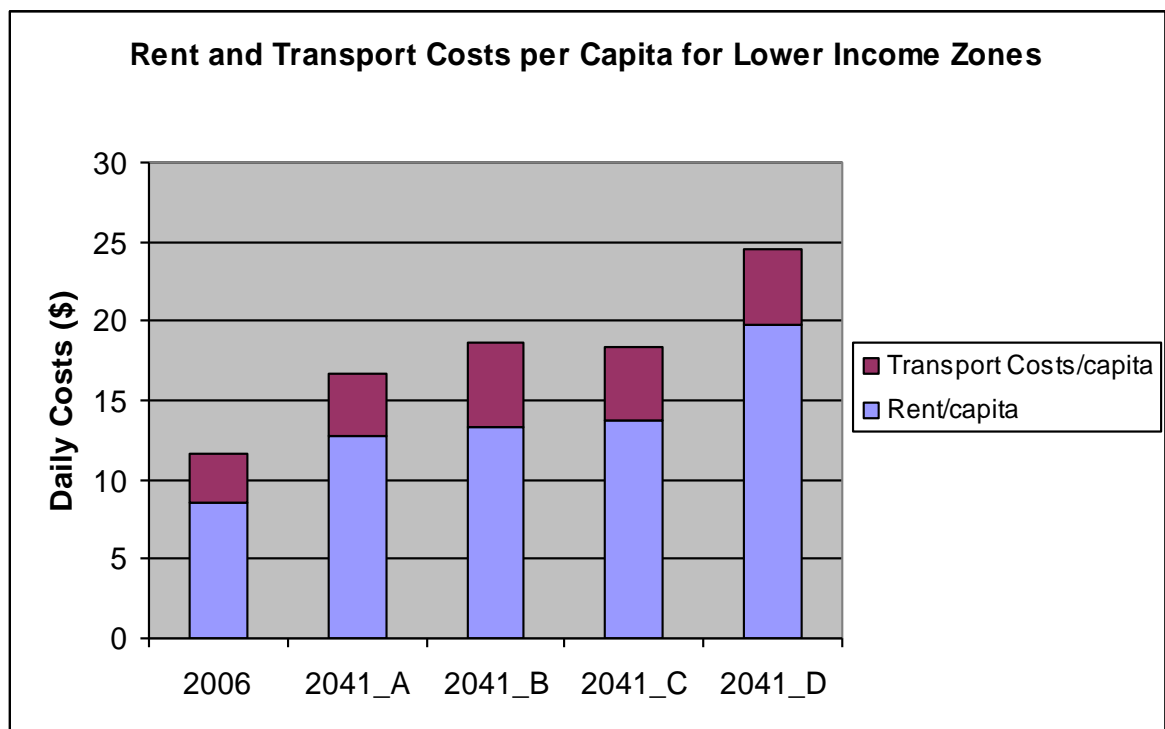


Figure 113 Retail opportunities by car and PT - within 45 minutes



Figure 114 Tertiary education facilities by car and PT - within 30 minutes



Figure 115 Tertiary education facilities by car and PT - within 45 minutes



Figure 116 Regional health facilities by car and PT - within 30 minutes

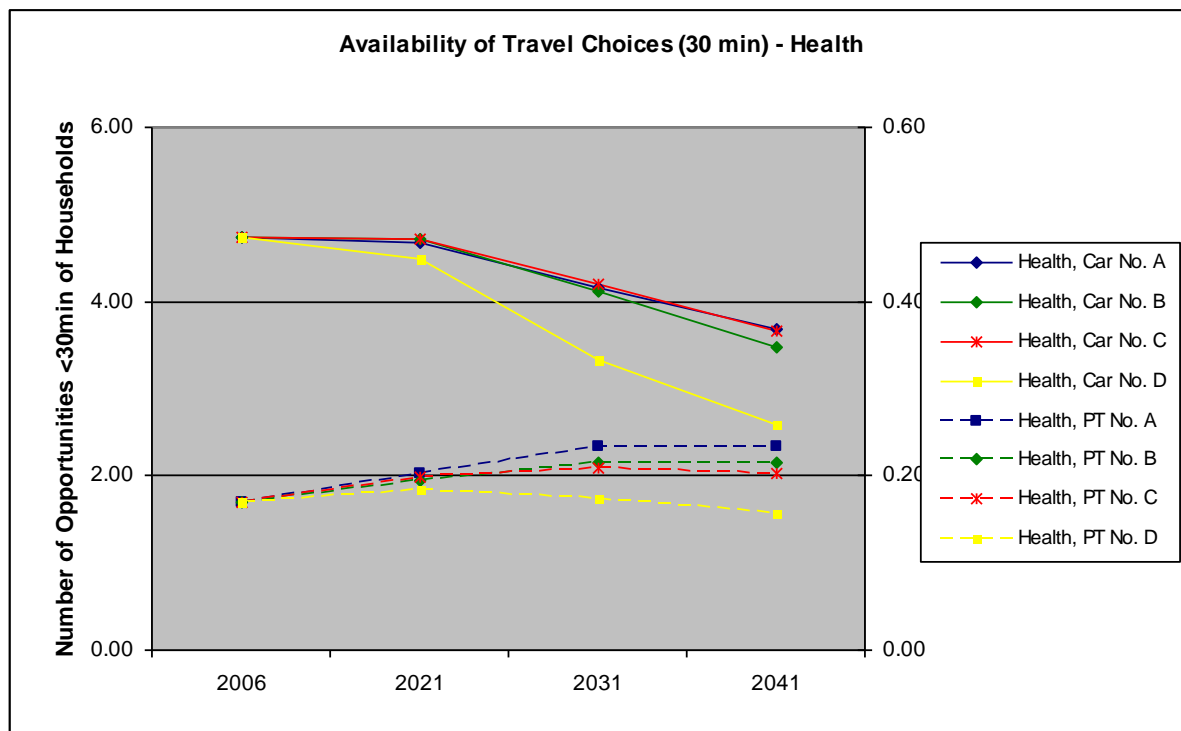


Figure 117 Regional health facilities by car and PT - within 45 minutes

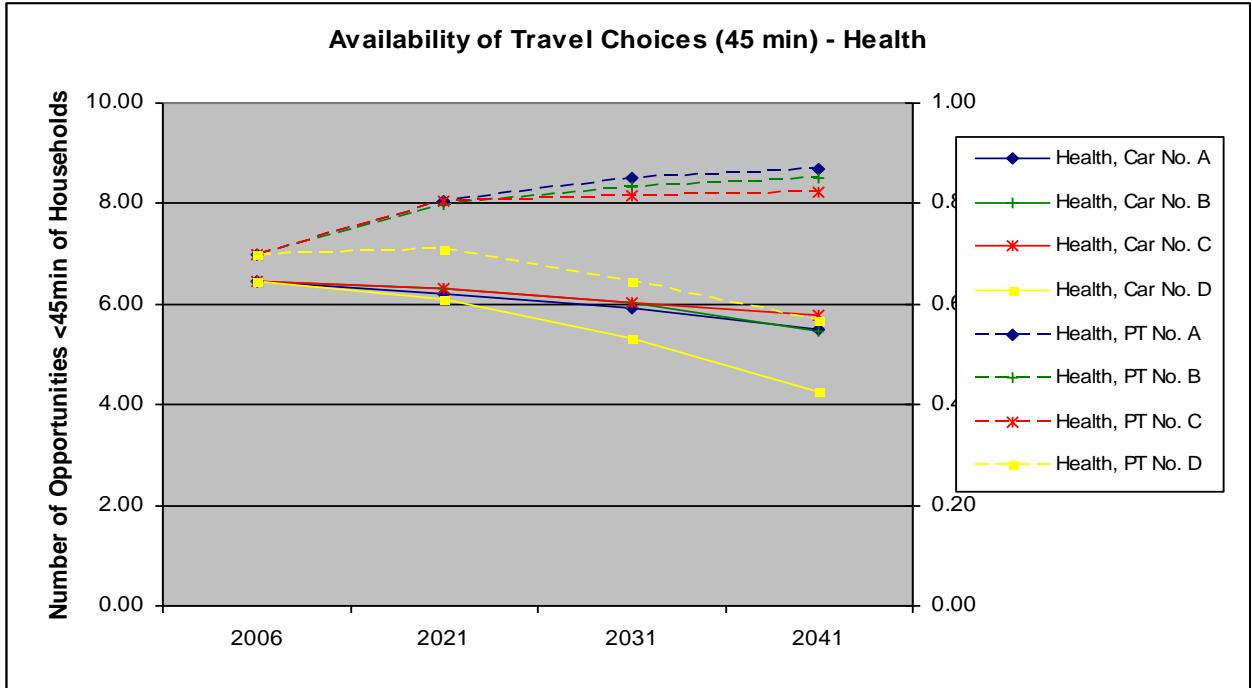


Figure 118 General accessibility, car

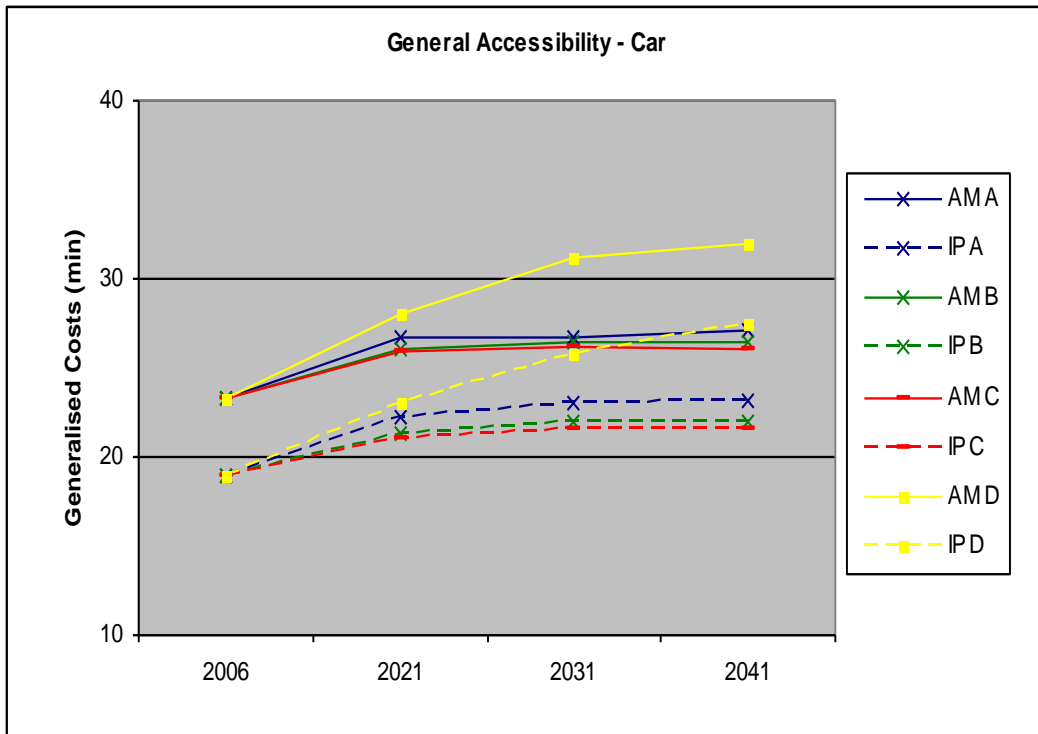


Figure 119 General accessibility - PT

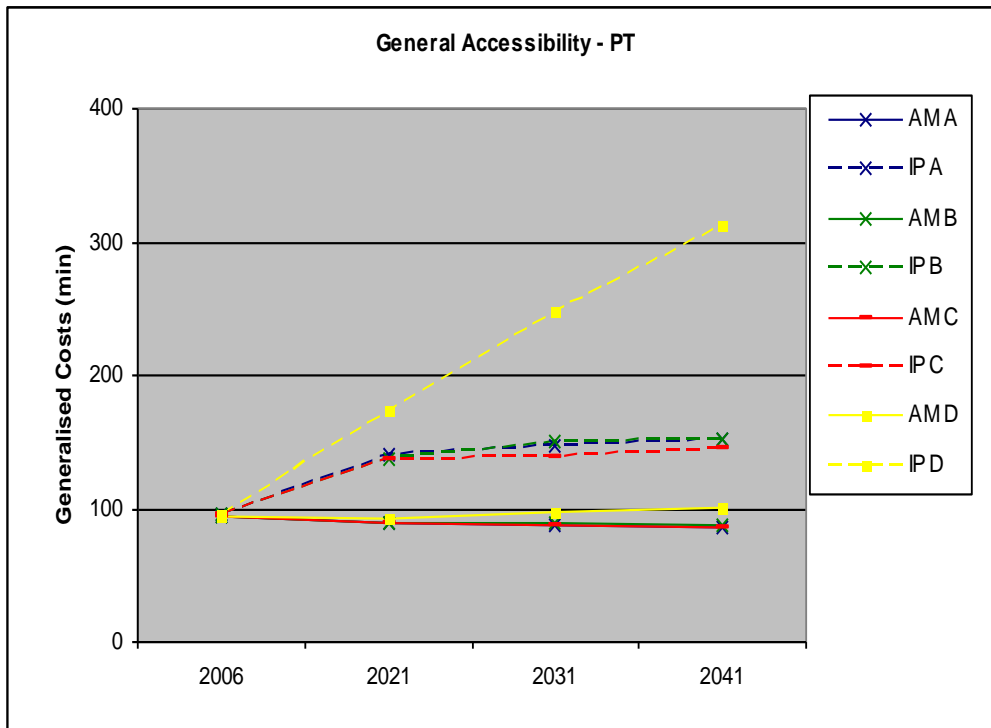


Figure 120 General accessibility - weighted average of car and PT

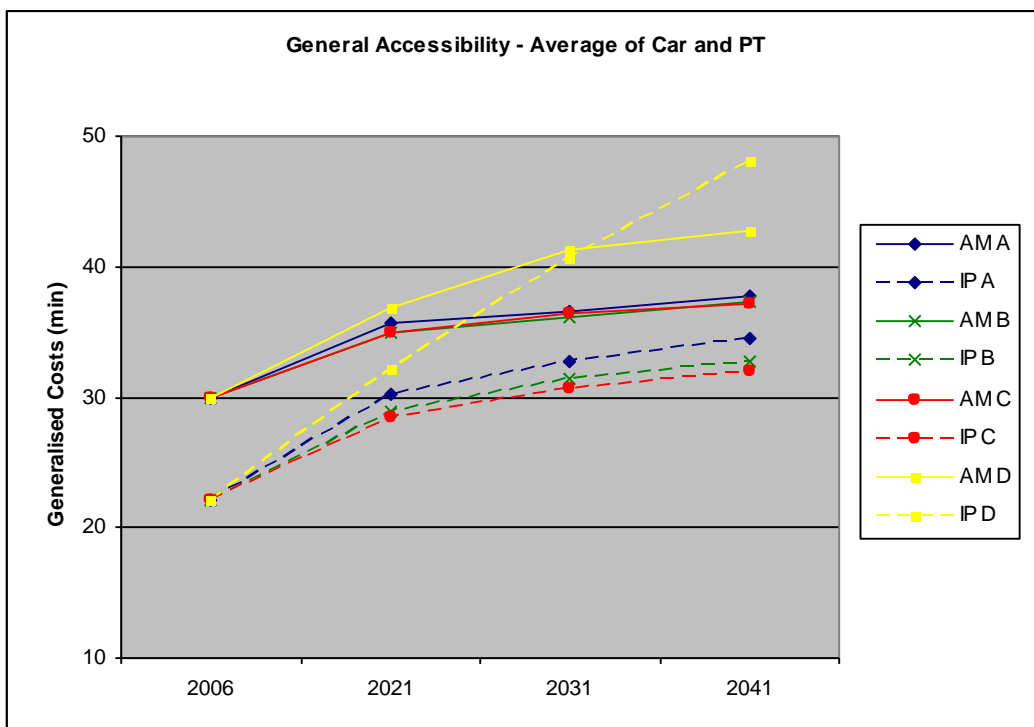


Figure 121 Commuting trip length distribution – region

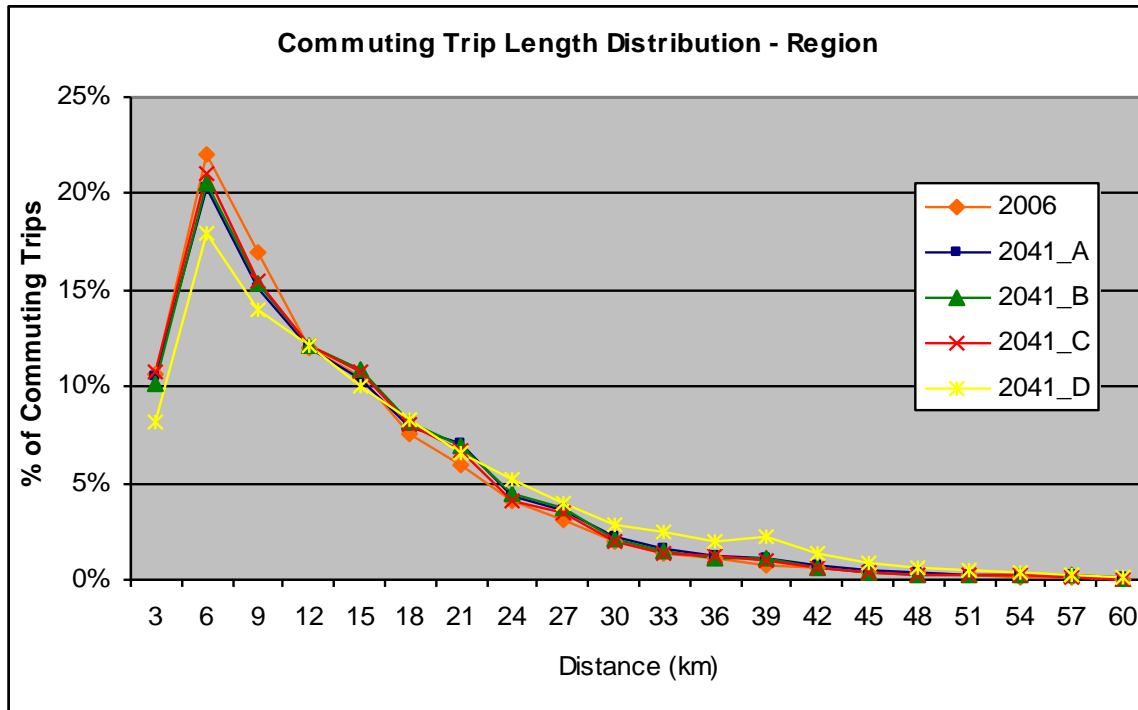


Figure 122 Commuting trip length distribution – from west

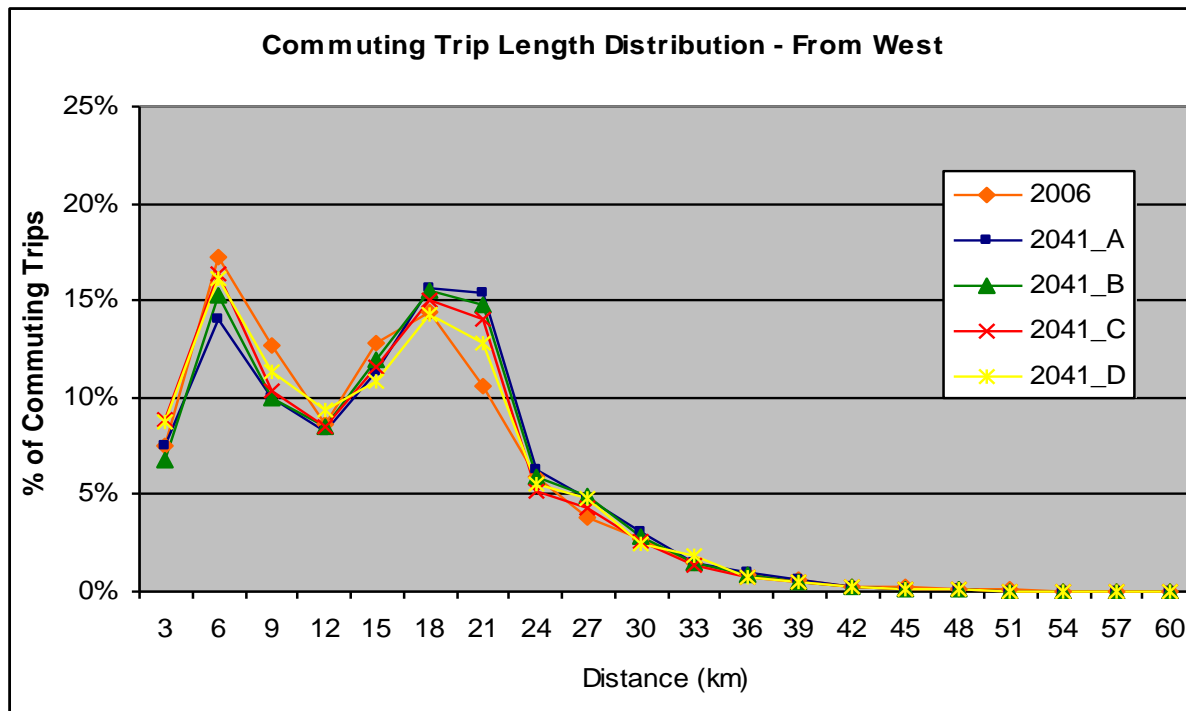


Figure 123 Commuting trip length distribution – from north

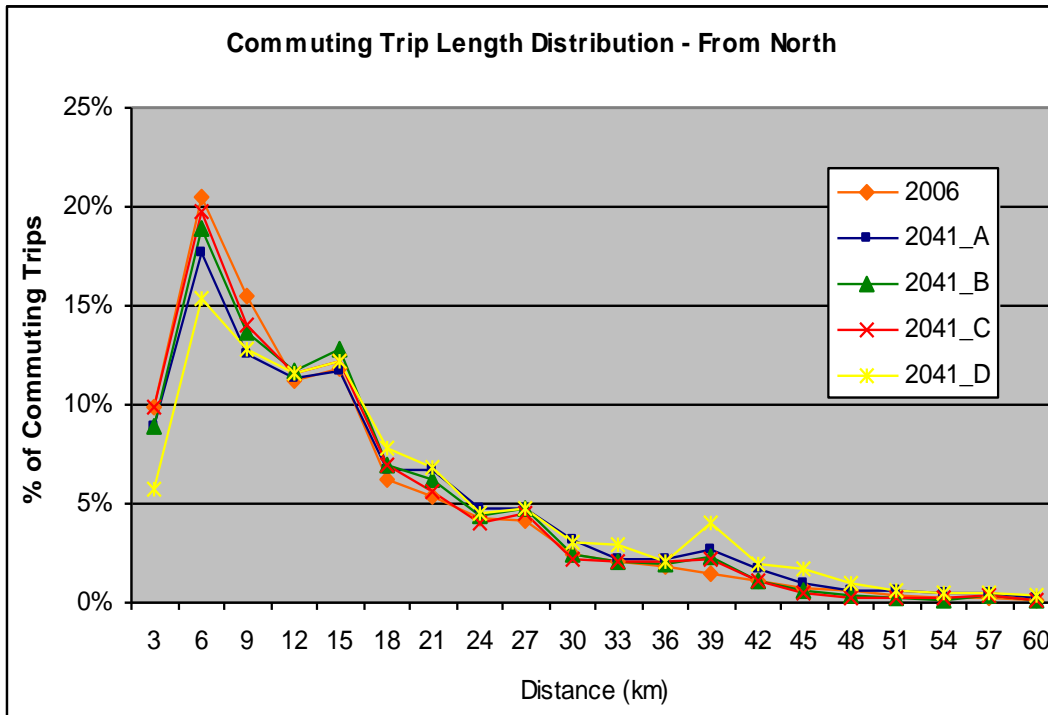


Figure 124 Commuting trip length distribution from central

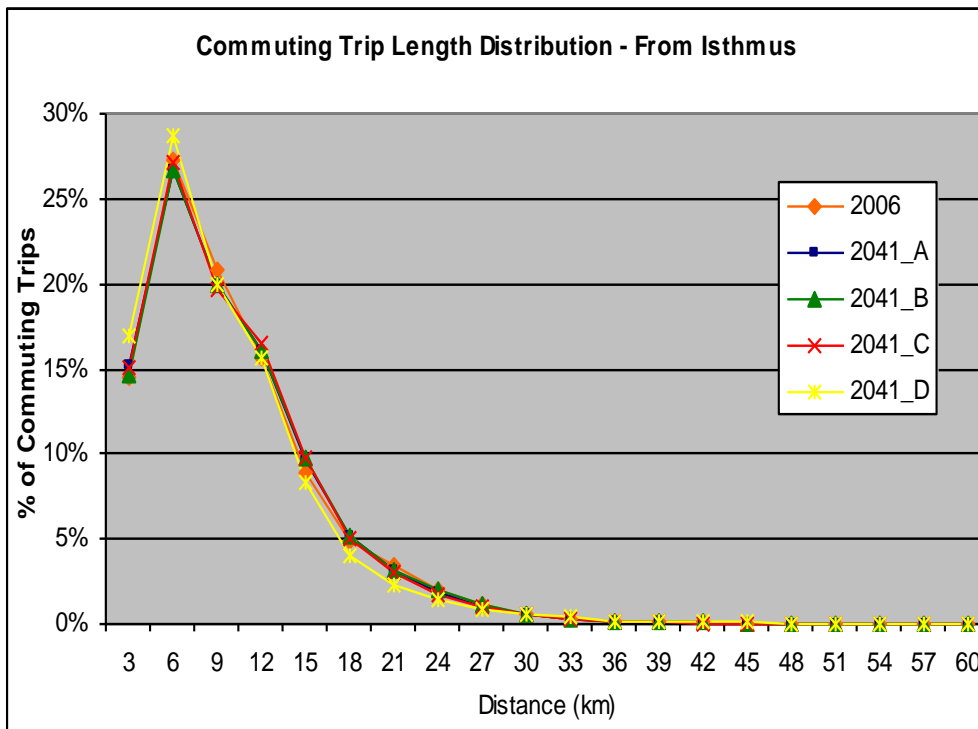
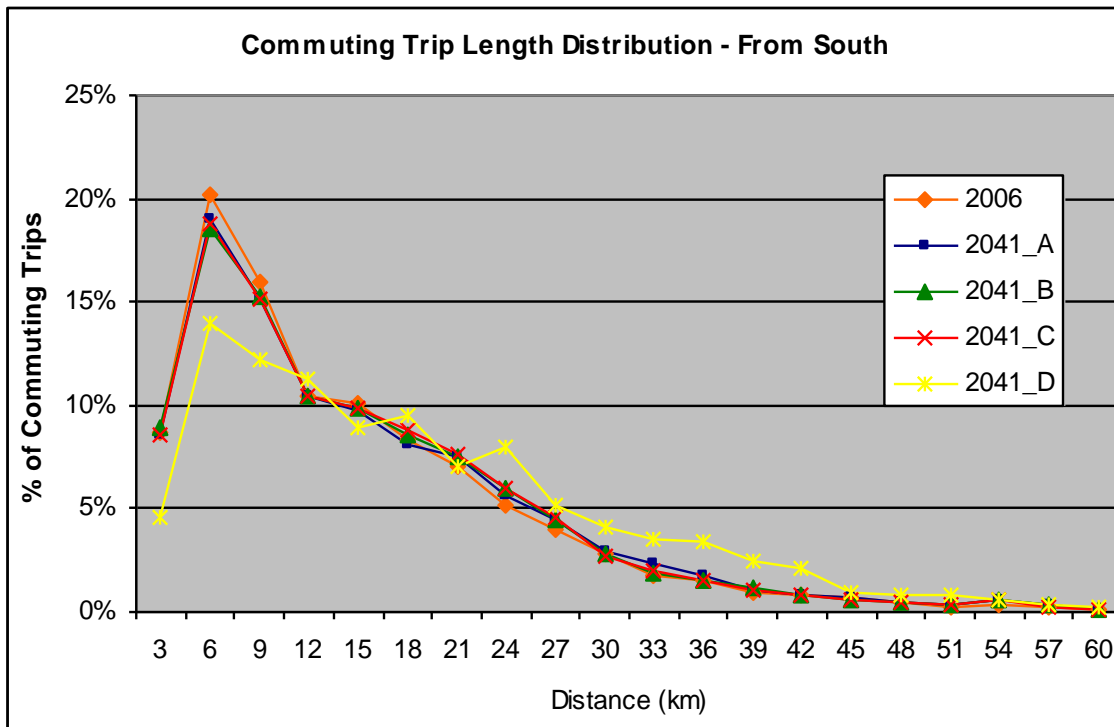




Figure 125 Commuting trip length distribution – from south



*Improved levels of physical activity*

Figure 126 Improved levels of physical activity - share of trips by active modes + PT

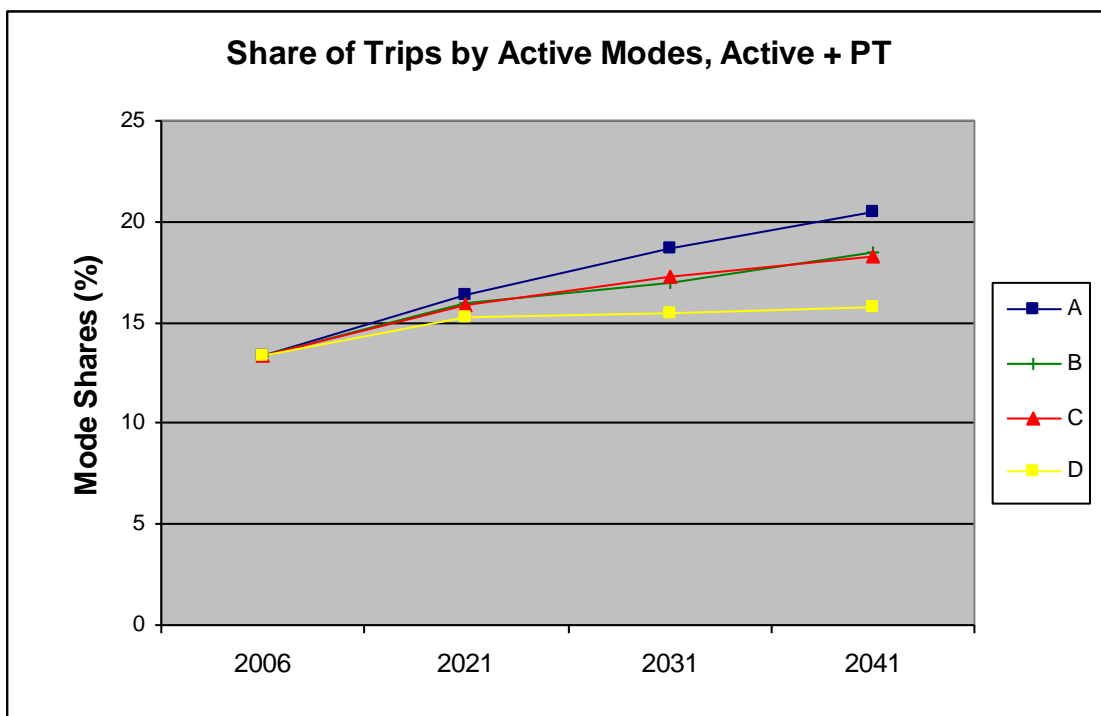


Figure 127 Emissions to air by sector, VOC

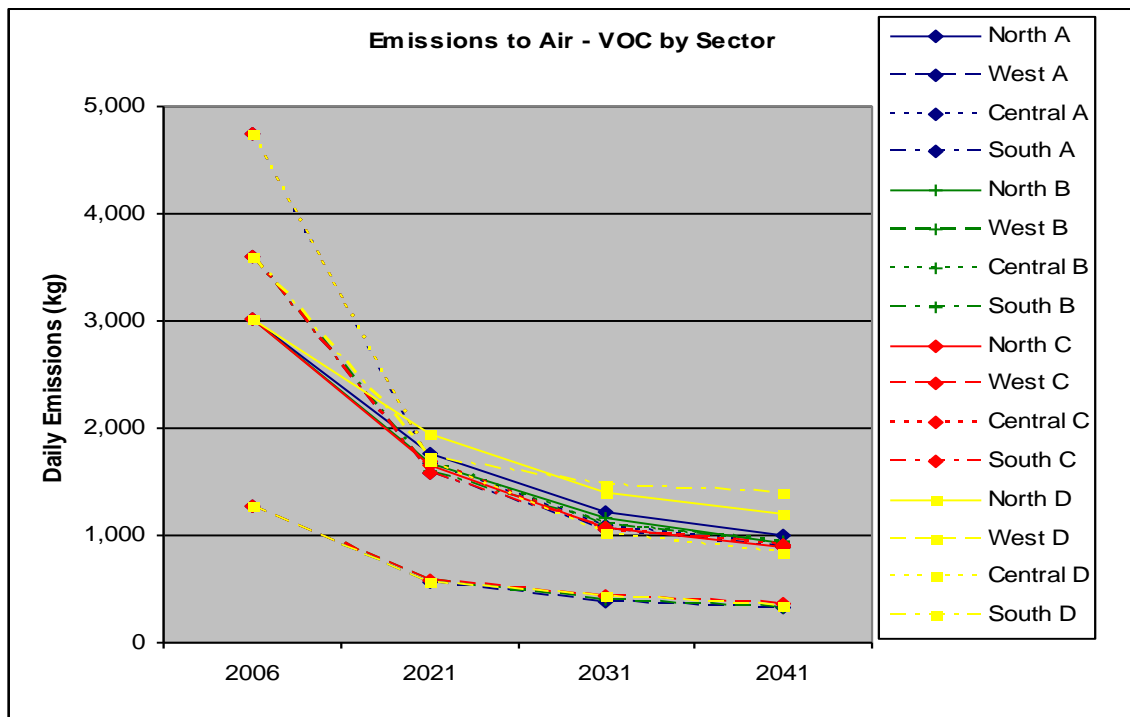


Figure 128 Emissions to air by sector, exhaust PM

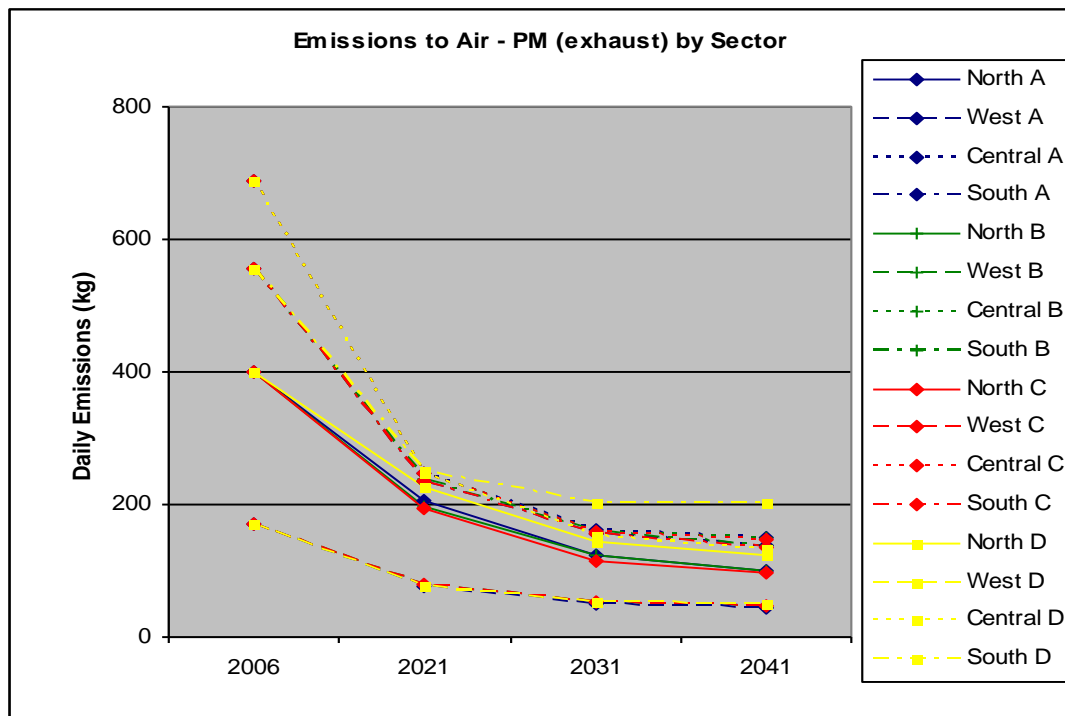


Figure 129 Emissions to air by sector, VOC

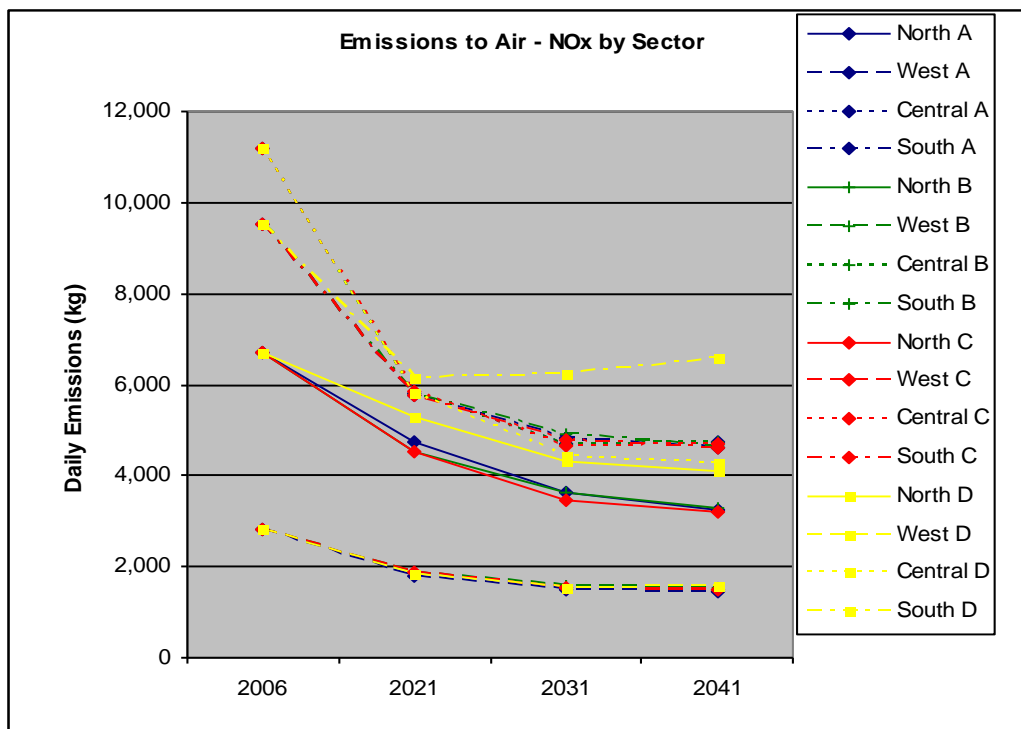


Figure 130 Emissions to air by sector, brake and tyre PM

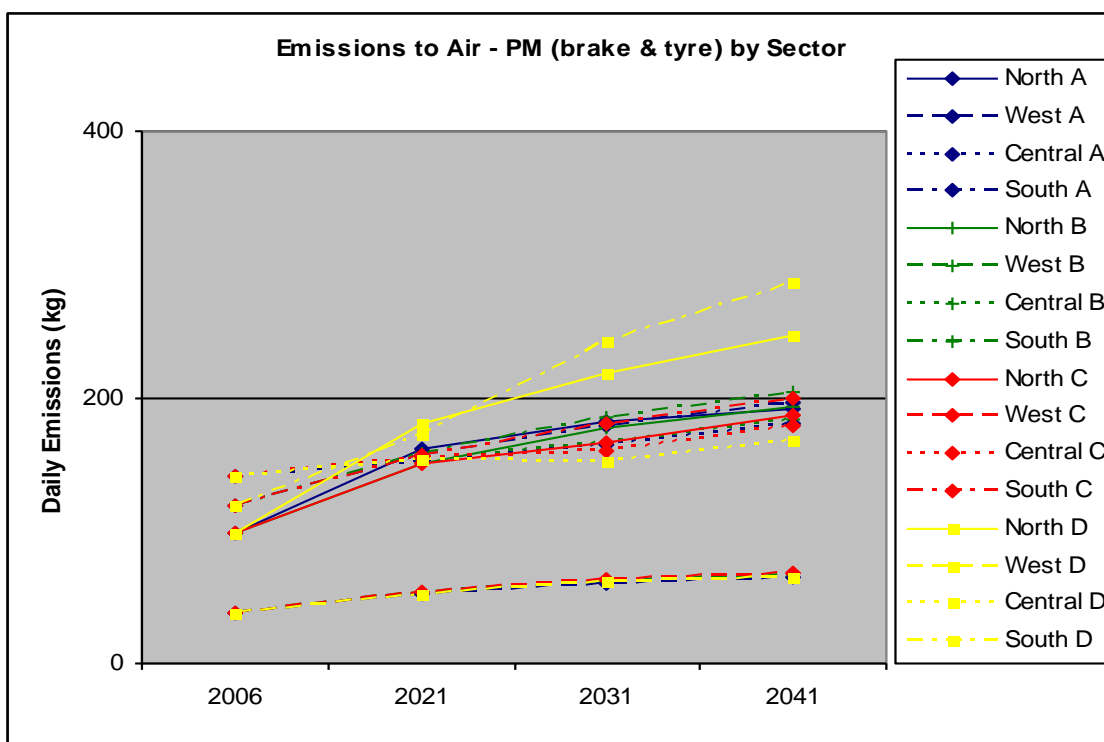


Figure 131 Emissions to air by sector, VOC

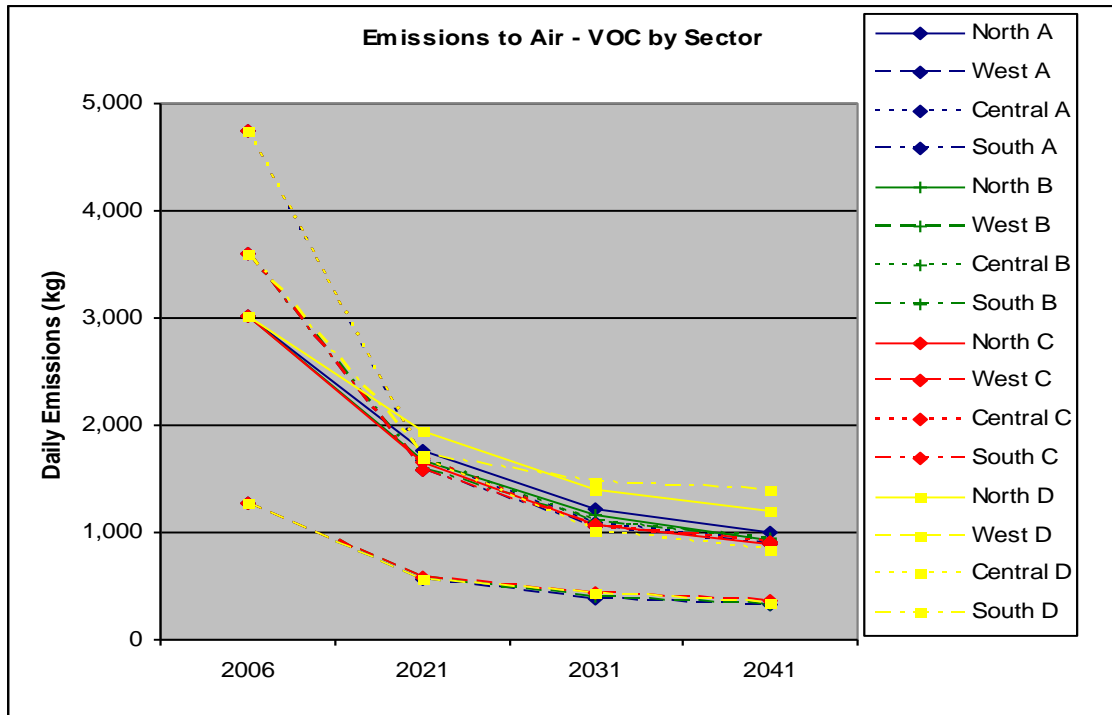


Figure 132 Emissions to air by sector, NOx

