

# Future Land Use and Transport Planning Project

Evaluation of Future Land Use and Transport Scenarios



April 2010

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# 1 Executive Summary

## 1.1 The Future Land Use and Transport Planning Project

The Future Land Use and Transport Planning Project (Futures Project) seeks to identify a long term spatial vision for the region, including the location of future development and supporting infrastructure, able to accommodate 2.3 million people by 2051. This report focuses on the third round evaluation of three land use and transport scenarios to determine which spatial form could best meet agreed regional outcomes.

## 1.2 The scenarios

Each of the three scenarios represents a different urban form. These incorporate varying levels of intensification, growth beyond metropolitan urban limits, and locations for future residential and employment growth. However, they fit into two broad categories; the compact scenarios (Scenario 1 and 4) and the Expansive Scenario (Scenario 5)<sup>1</sup>. The way that each of the scenarios differs is highlighted in the following table.

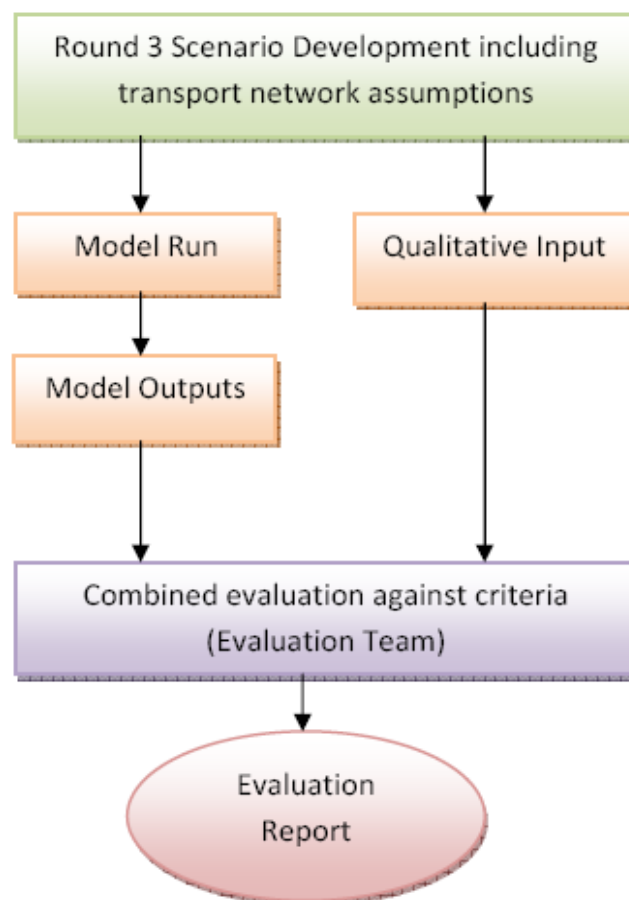
Compact scenarios		Expansive scenarios
Scenario 1	Scenario 4	Scenario 5
<ul style="list-style-type: none"> <li>• All growth focused within the existing MUL and future urban area</li> <li>• Growth concentrated in centres on the RTN</li> <li>• No residential infill</li> <li>• No additional business land</li> <li>• Minimal countryside living</li> <li>• A strong PT focus</li> </ul>	<ul style="list-style-type: none"> <li>• All growth focused within the existing MUL and future urban area</li> <li>• Growth concentrated in centres throughout the urban area</li> <li>• Residential infill</li> <li>• No additional business land</li> <li>• Countryside living provided</li> <li>• A moderate PT focus</li> </ul>	<ul style="list-style-type: none"> <li>• Growth dispersed with about 50 per cent outside current MUL</li> <li>• Growth dispersed to areas where there is strong market demand – coastal and high amenity areas.</li> <li>• Residential infill</li> <li>• 2000 hectares of additional greenfield business land</li> <li>• Countryside living provided</li> <li>• A strong road focus</li> </ul>

<sup>1</sup> The three scenarios were derived from earlier rounds of the Futures Project when five scenarios were evaluated. Scenarios 2 and 3 were not carried forward.

In developing the scenarios, it was intended that all of the scenarios would have similar infrastructure costs. However the additional roading costs needed to support the Scenario 5 land use, means this scenario required significantly more roading infrastructure investment.

### 1.3 Evaluation process

The evaluation process assessed how well the scenarios would deliver against agreed long term outcomes for the region. The diagram below illustrates the third round evaluation process.



Evaluation criteria were developed by identifying high level goals and outcomes from such agreed strategies as the Auckland Sustainability Framework and the Regional Growth Strategy. The resultant criteria were grouped under the four wellbeing headings – environmental, social, economic and cultural. An expert evaluation team assessed each of the scenarios against the criteria, collating and analysing the outputs from the integrated transport models (ATM2), plus qualitative advice from expert groups, workshops, and advice from stakeholders.

## 1.4 Evaluation results

The following table sets out the scores, of the Evaluation Team, for the individual criteria under the four wellbeings (environmental, social, economic and cultural).

Criteria	Scenario 1	Scenario 4	Scenario 5
<b>Economic wellbeing</b>			
Improved travel reliability	✓	0	x
Improved accessibility to economic activity	xx	x	xx
Improved access to labour pool	✓✓	✓✓	✓
Increased productivity	✓✓✓	✓	✓✓
To enable land extensive business sectors (Group 1) to grow in appropriate areas	x	x	✓
Minimised infrastructure costs	x	x	xx
Protection of productive rural land	0	0	xx
Energy resilience	x	x	xx
Feasibility from current market perspective	xxx	xx	✓✓
<b>Environmental wellbeing</b>			
Reduced greenhouse gas emissions	xx	xx	xxx
Protection or enhancement of marine values	x	x	xxx
Protection or enhancement of stream corridors	x	x	xxx
Identify, protect and enhance terrestrial ecosystems	x	x	xxx
Avoidance of hazards	x	x	xx
Improved air quality (impact on public health)	xx	xx	x
Water quality and human health	xx	xx	xxx
<b>Social wellbeing</b>			
Improved accessibility	✓✓	✓	x
Improved accessibility for deprived households	✓✓	✓	0
Housing choice	✓	✓	✓✓
Ageing in place	✓	✓	0
Greater housing affordability	x	x	x
Improved levels of physical activity	✓✓	✓✓	✓
Improved access to local employment opportunities	0	0	xx
<b>Cultural wellbeing</b>			
Protection of cultural heritage, cultural landscapes and waahi tapu	0	0	x
Economic opportunities for tangata whenua	✓	✓	✓✓
Preserving the mauri	x	x	xx

The above table shows how each scenario scored for each individual criterion. While the scores provide a useful indicator of the relativities between the scenarios, the evaluation signalled that there were strong inter-relationships between the scenarios and the criteria they are measured against. For example a scenario that improves overall regional accessibility, not only improves economic productivity (economic wellbeing), it is also likely to improve many deprived households access to health facilities (social wellbeing).

Therefore the findings drawn from the results of this evaluation are thematic and tend to cover a number of criteria across the wellbeings. They signal some important messages for Auckland's future spatial form. The broad findings are:

#### *Improving accessibility*

The results clearly showed the compact scenarios as providing the most enhanced accessibility. Improvements to regional and local accessibility were a feature of all the scenarios. Improvements to accessibility also provided benefits to the environment, economic and social wellbeings.

#### *Economic performance*

All scenarios drive agglomeration of business services in the CBD and CBD Fringe; however Scenario 1 performs the best for agglomeration because it also provides the highest levels of accessibility. 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, although the compact scenarios (particularly Scenario 1) generally remain better at 2041 than they were at 2006. There is a regional need for additional greenfield land to cater for the future growth of Group 1 business activities. This evaluation determined that this shortage is best addressed by the expansive scenario, as it provides an additional 2000 hectares of greenfield land for Group 1.

#### *Infrastructure costs*

The compact scenarios utilise current infrastructure more efficiently, thus reducing the need for additional infrastructure investment. Transport infrastructure costs are greatest, with the expansive scenario requiring the greatest additional investment in the transport network. The expansive scenario would require additional road infrastructure worth approximately \$31.4 billion compared with around \$15 billion for the compact scenarios. Yet despite the additional investment in transport infrastructure, the expansive scenario provided the worst accessibility compared with the compact scenarios.

#### *The state of the environment*

All scenarios show deterioration against the environmental criteria, compared with the base year 2006. The significant difference between the scenarios is that the compact scenarios concentrate development within the existing urban footprint; an already degraded environment, thereby avoiding impacts on high quality environments outside the metropolitan urban area.

#### *Effects on greenhouse gas emissions*

All scenarios increase greenhouse gas emissions. Therefore none of the scenarios achieve the Government's national policy reduction targets for transport related greenhouse gas emissions by 2040. Carbon dioxide emissions from transport are less under the compact scenarios than the expansive scenario.

#### *Housing choice and affordability*

Greater housing choice is provided by the expansive scenario due to a greater range of housing types (attached and detached) plus the additional suburban, rural, and coastal housing locations available. Housing affordability deteriorates across all scenarios, including the expansive scenario even though it provides around 50 per cent more urban area compared with the compact scenarios.



### *Risks to heritage and cultural values*

All scenarios present risks and opportunities for heritage and cultural values, for example the compact scenarios increase risks for built heritage while the expansive scenario affects landscape values. In terms of tangata whenua it will be important 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 tangata whenua are understood.

### *Market feasibility*

Market commentators viewed the expansive scenario as most feasible because it is the closest to a business as usual approach; most familiar to both developers and the market. They also considered that the levels of intensification contained in the compact scenarios are likely to be difficult to achieve, except for in a few main centres that have high accessibility and good amenity. There is strong market demand for industrial growth in the south of the region from businesses with a national or international focus.

## 1.5 Conclusions

The evaluation findings provide the basis for conclusions about which spatial form could best meet Auckland's agreed regional outcomes.

### *The impacts of growth*

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 an optimum spatial form, which is supported by timely investment in infrastructure, will ameliorate some of the worst adverse effects of growth.

### *Spatial form*

Overall, a compact urban form is preferable for Auckland's future urban form. For most criteria the compact scenarios perform the best by having, for example:

- less impact on the environment, by avoiding pristine and valued environmental areas and better protecting stream corridors and marine values;
- improved regional productivity by enabling firms to better access skilled labour and key ports;
- provision of a strong network of centres enabling better social cohesion and access to social facilities.

The results point to a spatial form that is based predominantly on compact principles, but that includes some flexibility to accommodate new greenfield areas for Group 1 business sectors.

### *The importance of land use and transport integration*

The expansive scenario required significantly more transport infrastructure investment than the compact scenarios, but it did not perform as well in terms of land use and transport integration. While a compact urban form would require less additional investment in transport

infrastructure, 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 for a future integrated land use and transport are:

- A need for a strong network of centres, including local centres, which provide opportunities for greater accessibility and can enhance social cohesion.
- Supporting the transport network with associated residential and employment growth as this leads to improvements in overall accessibility and regional productivity.
- Ongoing and long term investment in transport infrastructure, particularly passenger transport, to support a changing urban form and to ensure accessibility improvements continue over the long term.

#### ***Land use planning is necessary but not sufficient***

While agreeing that a compact urban form is important, it will need to be supported by a suite of other, equally important mechanisms:

- A strong focus on implementation supported by appropriate policy. Additional implementation measures will also have to be considered, examples include development incentives, private-public partnerships, council-led exemplar projects.
- Comprehensive investment in core infrastructure, for example passenger transport, new roads, wastewater, water supply, power supply. It is important that this investment is signalled in advance and it's planning and roll-out is aligned with land use decisions.
- Central and local government policy interventions; for example those that can support local activities to achieve national guidelines or standards, such as introducing emission standards for vehicles.

This evaluation has shown that in order to achieve agreed regional outcomes, Auckland requires a compact urban form which retains some flexibility to cater for future growth pressures. This needs to be reinforced through comprehensive planning, investment and roll-out of core infrastructure, as well as a suite of supporting national and local policy interventions.

## 1.6 The future

The establishment of the Auckland Council signals a sea-change in planning for Auckland. The development of a Spatial Plan for Auckland, plus an Infrastructure Plan, provides a unique opportunity to implement the findings of this evaluation report.

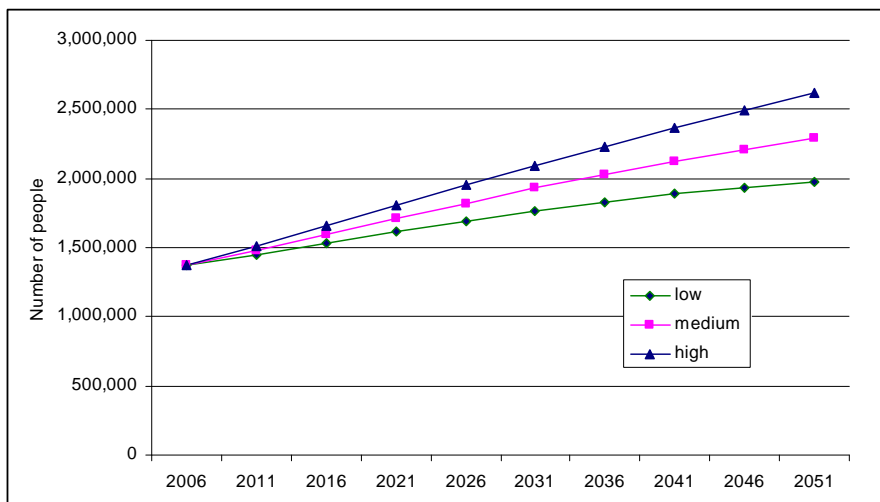
It is intended that the outcomes from this project, along with a range of other work, will provide the basis for technical advice on the future spatial form of Auckland to the incoming Auckland Council from November 2010.

## 2 Introduction

### 2.1 The growth challenge

The Auckland region faces a considerable growth challenge. Recent projections indicate a likely future population of 2.3 million people living in the region by 2051 (medium series - Figure 1). This growth trend is not new, however continued growth puts considerable pressure on Auckland's natural environment and the infrastructure that is required to support the additional population.

Figure 1 Population projections



Source: Statistics NZ Population Projections (2006 base)

In recognition of the need to carefully manage Auckland's growth, in 1999 the Auckland Regional Growth Strategy (RGS) was adopted by all of Auckland's councils. The RGS sets a vision for how the region's growth can be sustainably managed over 50 years. It aims to balance our social, environmental, cultural and economic outcomes to ensure Auckland in 2050 will be a great place to live, work and play.

Although there is a strategy in place to manage Auckland's growth, strong challenges remain. In 2007 a review of the RGS, entitled 'Growing Smarter – An Evaluation of the Auckland Regional Growth Strategy'<sup>2</sup> identified that although significant progress had been made, greater effort was needed to accelerate implementation of the RGS. Recent population projections have exacerbated the need for well thought out planning that will enable Auckland to rapidly respond to the growth challenge.

<sup>2</sup> Growing Smarter – An evaluation of the Auckland Regional Growth Strategy 1999. ARC July 2007.

## 2.2 Strategic overview and purpose of the Futures Project

Given Auckland's strong growth context, it is crucially important that a response to this growth is included in proposed changes to two of the region's key strategic planning documents; the Auckland Regional Land Transport Strategy (RLTS) and the Auckland Regional Policy Statement (RPS). Accordingly, in 2008, the Future Land Use and Transport Project (Futures Project) commenced with the task of developing a future land use capable of accommodating a projected population of 2.3 million people by 2051.

Originally the intention for the Futures Project was to arrive at a long term spatial vision for the region, including the location of future development and supporting infrastructure. This was then to be incorporated, through appropriate objectives and policies, into the RLTS and RPS, and subsequently into the relevant district plans and sector agreements. Central government has announced the future development of a Spatial Plan for Auckland that provides broad direction for Auckland's future growth and infrastructure investment. Completion of the Futures Project will provide a suite of up-to-date, robust, technical information that can be applied to the Spatial Plan.

The approach developed in the Futures Project has been to develop and evaluate a series of land use scenarios that illustrate different ways that growth could be accommodated in the region. The scenario development and evaluation was guided by a range of agreed principles already developed for the Auckland region, these include such principles as; protection of environmental values, enhancing economic productivity, integration of land use and transport planning. These were incorporated into both the development of the various land use scenarios and the evaluation criteria.

A major advantage of the Futures Project has been the modelling of the scenarios using the integrated land use and transport ATM2 model. In effect a transport model (ART3) and a land use model (ASP3) 'talk' to each other by passing information back and forth as the system models land use and transport changes over time. While complex and time consuming, the model outputs provide a robust analysis of the land use and transport changes likely to occur as growth occurs in the region. Evaluating these model outputs against agreed criteria provides the basis for determining a future spatial form for the region.

To date, the Futures Project has included three rounds of scenario development, modelling and evaluation. Each round took learning's from the previous evaluation to fine-tune the next scenario development, modelling and evaluation. The final third round evaluation is the focus of this report.

## 2.3 Purpose of this report

This third round evaluation signals the culmination of the scenario development and evaluation component of the Futures Project. This report describes the third round evaluation and provides a comprehensive assessment of how well the three scenarios deliver on the long-term outcomes that the region seeks to achieve.

It is intended that the outcomes from this project, along with a range of other work, will provide the basis for technical advice on the future spatial form of Auckland to the incoming Auckland Council from November 2010

## 2.4 Structure of this report

This report details the results of the third round evaluation of the land use and transport scenarios prepared as part of the Futures Project. The report has the following sections:

- Section one contains an executive summary.
- Section two provides an introduction to the evaluation report; it outlines the growth challenge facing Auckland and sets some context for the Futures Project.
- Section three describes the three land use scenarios, the differences between them, and some basic assumptions associated with the scenarios.
- Section four outlines the evaluation process, including the integrated land use and transport models, the evaluation criteria, and the qualitative input used by the Evaluation Team.
- 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 presents some conclusions from the evaluation, including some recommendations about key aspects that should be contained in any future preferred land use for the Auckland region.

# 3 Scenarios

## 3.1 Scenarios for the third round evaluation

There have been three rounds of scenario development and evaluation: The first and second rounds culminated in the development of five separate land use scenarios. For the third round, the evaluation focuses on three scenarios; each exhibiting distinctly different spatial forms. The three scenarios for round three were based on previous round scenarios but updated to further emphasise spatial differences:

- Scenario 1 - Compact Scenario.
- Scenario 4 - Current Policy Scenario.
- Scenario 5 - Expansive Scenario.

The following section outlines the core components of each scenario, including the key differences they exhibit. A map of each scenario is provided in Appendix 1, a more comprehensive narrative for each scenario is contained in Attachment 1.

## 3.2 Scenario 1 - Compact

This intensive development scenario focuses all future growth to 2051 within the existing Metropolitan Urban Limits (MUL). Most of this growth is accommodated in existing and new mixed-use town centres on the Rapid Transit Network (RTN), with increased density including apartments, terraces, and townhouses. These centres are supported by mixed-use corridors that are also served by the Quality Transit Network (QTN). Core characteristics of the Scenario 1 are:

- significant capacity for employment and residential growth in the CBD, the CBD Fringe and in centres along the RTN,
- additional employment and residential capacity provided along Regional Growth Corridors close to the CBD,
- redevelopment of existing business land areas and large brownfield business sites,
- growth of Group 1 business sectors allocated to existing future urban areas. There is no additional greenfield land for Group 1 activities,
- no general residential infill capacity is provided.

The Scenario 1 is different from the other two scenarios in its centralised focus for future growth. Future growth is provided for primarily in the CBD, CBD Fringe and in

higher order centres that are well serviced by the RTN. Growth capacity is purposely limited in other areas of the region.

### 3.3 Scenario 4 - Current policy

Scenario 4 reflects a spatial form informed by Proposed Plan Change 6 (PC6) to the RPS. This in turn reflects planning policy contained in the RGS, sector agreements and district plans. The guiding principle for this scenario is to reflect growth capacities contained in Schedule 1 of PC6, which identifies the region's high density centres, corridors and future urban areas where future growth will be directed. Additional capacity has also been provided as general infill and in future urban areas.

Core characteristics of Scenario 4 are:

- residential and employment capacity provided in those centres identified in PC6,
- additional residential capacity provided through general infill subdivision,
- future growth of Group 1 business sectors directed into the Future Urban Areas contained in PC6.

Scenario 4 differs from the other two scenarios in providing residential and employment capacity in a wide range of centres located throughout the region. These are not necessarily centrally focused, or well serviced by the RTN. Provision for general infill further widens residential growth options.

### 3.4 Scenario 5 - Expansive

Scenario 5 represents a strong market driven spatial form that reflects where existing development pressures currently exist, plus land ownership and market priorities. It is a scenario that does not generally accord with current regional and local planning policy – but one which does reflect past trends. It is an alternative growth option which explores the concept of significant urban expansion resulting from a liberalisation of urban growth boundaries and containment policies.

The main focus of this scenario is that it can accommodate a significant proportion of future residential growth (51 per cent) and employment growth (25 per cent) as urban expansion at the northern, north-western, southern and eastern urban edges, and also in coastal areas further north. It perpetuates Auckland's historic outward growth patterns in areas where infrastructure/accessibility or amenity has directed it. However it also provides significant capacity in centres where there is demand for residential intensification for example apartments in coastal locations or upmarket locations such as Orewa, Mission Bay, Milford, Orakei, Devonport, Howick etc. Additional capacity has also been provided as general infill and an additional 2000 hectares of greenfield land is specifically provided for Group 1 business sectors.

Core characteristics of this scenario are:

- significant amounts of new residential and employment growth outside the current metropolitan urban area,
- growth capacity provided in coastal areas and other locations where there is good amenity and where market demand is strongest,
- strong employment and residential capacity provided for in the CBD,
- less employment and residential growth capacity provided in centres with the balance picked up through greenfield growth,
- additional greenfield land identified for the future growth of Group 1 business sectors.

Scenario 5 differs considerably from the other two scenarios by providing considerable growth capacity outside the metropolitan urban area. In this manner and unlike the other scenarios, it generally does not accord with current regional and local planning policy – but reflects past growth trends and market pressures.

### 3.5 Comparing scenarios

Each of the scenarios represents a different spatial form capable of accommodating 2.3 million people by 2051. This section outlines some of the differences between the scenarios.

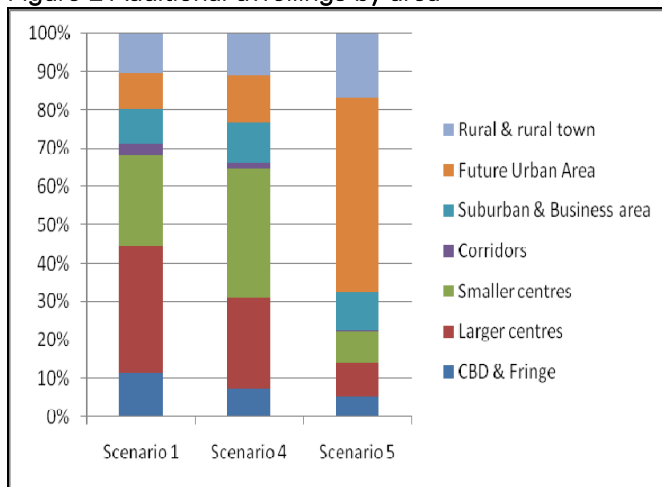
The scenarios each have a different centres classification reflecting different growth concepts.

- Centres in Scenario 1 follow the centres and corridors classification report. This includes Regional Centres (ie Newmarket and Manukau) and Principal Centres (ie Takapuna and Onehunga), in addition to Town Centres.
- Scenario 4 follows the existing centres classification contained in Schedule 1 to the RPS – this includes Sub-Regional Centres (ie Newmarket and Takapuna) and Town Centres.
- Scenario 5 focuses growth within the future urban area and not in centres; therefore all centres are identified as growth centres although they range in size considerably (ie Newmarket and Takapuna).

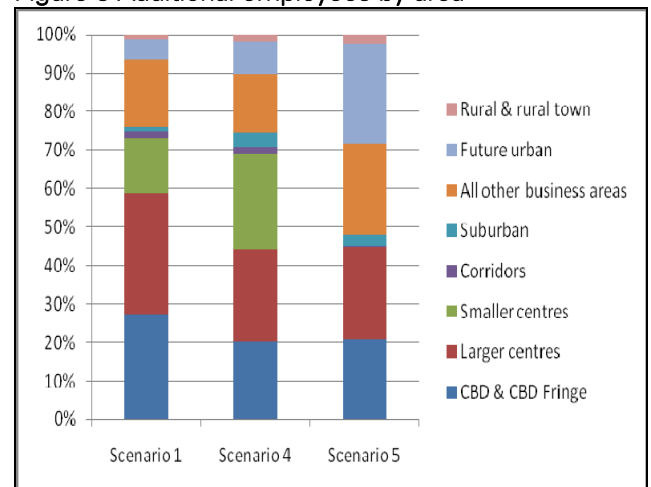
Each scenario allocates residential and employment growth capacity differently. Figure 2 and Figure 3 illustrate the different spatial allocations. Larger centres include Regional and Principal Centres (Scenario 1), Sub-Regional Centres (Scenario 4), and all growth centres (Scenario 5).



**Figure 2 Additional dwellings by area**



**Figure 3 Additional employees by area**



Both Scenarios 1 and 4 provide for compact growth, concentrating development within the existing urban footprint. The compact scenarios (1 and 4) have almost 70 per cent of additional dwellings in centres compared with Scenario 5 which has around 20 per cent. Approximately 50 per cent of additional dwellings in Scenario 5 are in future urban areas, compared with around 10 per cent of the compact scenarios. For employees, the compact scenarios provide approximately 70 per cent of employee capacity in centres (including the CBD and CBD Fringe), whereas Scenario 5 provides approximately 50 per cent of employee capacity in centres and 30 per cent in future urban areas.

Table 1 below identifies the total land area required to be urbanised to provide for population growth. Scenario 5 requires 50 per cent more land to accommodate the future population, whereas the compact scenarios rely on intensification of the existing urban area (including some future urban areas already planned for).

**Table 1 Urbanised land area by scenario**

	Scenario 1 (hectares)	Scenario 4 (hectares)	Scenario 5 (hectares)
Current MUL	56,369	56,369	56,369
Future Urban Areas (outside the current MUL)	2,165	2,165	2,165
Expansion Areas	0	0	27,210
Additional Group 1 Land	0	0	1,910
<b>Total land area urbanised</b>	<b>58,534</b>	<b>58,534</b>	<b>87,654</b>

### 3.6 Transport networks

Each of the three scenarios was based on the transport package contained in the 2009 notified version of the RLTS. Transport projects and assumptions common to all

scenarios include (projects already underway are not identified here but are included in the network modelled):

- PT packages for the region including integrated ticketing and fares, rail upgrades on existing lines, rail station improvements with rail electrification, Onehunga branch line, Manukau branch line, new ferry infrastructure, and Northern Busway extension to Silverdale.
- Strategic roading (state highway and arterial) SH20 Waterview Connection, AMETI stage 1, Mill Rd corridor, and Penlink to Whangaparaoa.
- RLTS non price TDM initiatives including increased working from home and community, education and workplace travel initiatives.
- Assumed fuel price increases (\$1.55 in 2006; \$2.38 in 2016; \$2.75 in 2026; and \$3.71 in 2041).
- Rail services were modelled at 10 minute frequencies with no constraint on the number of passengers on each train.

While the RLTS transport system forms the basis of the transport system for all scenarios some changes or refinements have been used to better integrate the transport system to the individual land use scenarios (Table 2).

**Table 2 Summary of key transport projects by scenario**

Project	Scenario 1	Scenario 4	Scenario 5
Additional Harbour Crossing	Yes <i>RTN focus</i>	No	Yes <i>Road focus</i>
CBD Rail Link	Yes	Yes	No
Airport Rail	Yes	Yes	No
Avondale to Southdown Rail	Yes	Yes	No
Rail to the Northern Busway	Yes	Yes	No
SH1 three lanes Albany to Puhoi, two lanes Puhoi to Wellsford	No	No	Yes
Bridge to Karaka	No	No	Yes
Additional Peripheral Roothing	No	No	Yes
Improvements to SH22 and SH16	No	No	Yes

In addition, the timing of the different projects varies by scenario to better integrate the timings of the transport improvements with land use capacity release (see Attachment 2).

# 4 Evaluation Process

## 4.1 Background

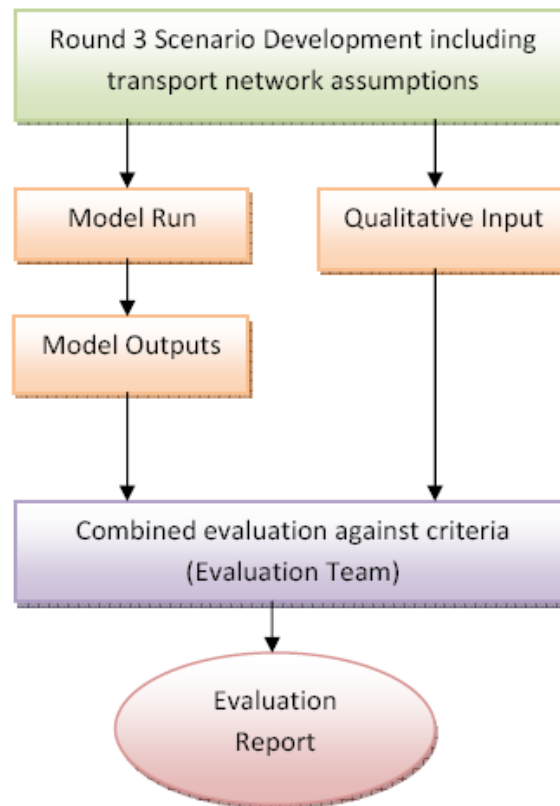
The purpose of the evaluation exercise was to identify the strengths and weaknesses of the scenarios against a range of criteria, in order to inform the further development of land use in the region. The scenarios have some important differences and some important similarities. The aim was to compare and contrast the scenarios on a regionally consistent basis, in order to identify lessons that will assist in the development of a future Spatial Plan.

A number of principles and assumptions were taken into account in both the development of the scenarios and their evaluation:

- A quality, compact urban form (apart from Scenario 5), with strong well connected, higher density, mixed-use and transit orientated, walkable centres.
- Protection of environmental values and heritage.
- The need to leverage off existing and planned infrastructure investment.
- A regional economy based on improving regional productivity.
- New or redeveloped areas would be compact, well designed, well connected and transit orientated.
- Best practice in terms of environmental design, urban design and heritage protection would be applied.
- Provision of infrastructure and services to support population and economic growth.

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 expert groups. This has enabled a comprehensive assessment of the relative merits of each scenario against the criteria. The evaluation process is shown in Figure 4 below.

Figure 4 Round 3 Evaluation process



## 4.2 Evaluation criteria

The evaluation process assesses how well the scenarios deliver against the long term outcomes of the region. The process involved identifying high level goals and outcomes, determining whether these had any spatial elements and developing criteria and measures accordingly.

The goals and objectives of the ASF, significant regional strategies and plans such as the RGS and RLTS, and relevant legislation were considered. Criteria and measures were then developed under the four wellbeings. Input was sought from a joint workshop of territorial authority and central government officers and the criteria were finalised with input from experts in each area. The approach has also drawn from existing processes and previous evaluation exercises (for RLTS and ASF) and from other jurisdictions.

No attempt was made to weight the criteria in terms of relative importance. This was deemed to be a political decision and more relevant to a process aimed at delivering a preferred scenario, rather than an assessment of three separate scenarios.

For many of the criteria, outputs from the integrated land use and transport model were able to provide guidance. However, for some criteria the model outputs were insufficient, therefore additional 'qualitative' feedback from expert groups was sought.

The evaluation criteria and measures are listed below in Table 3. Also listed, is whether each criterion was addressed through model outputs or qualitative feedback.

**Table 3 Evaluation criteria**

Section	Criterion	Measure	Source of information for evaluation
	<b>Economic wellbeing</b>		
6.2	Improved travel reliability	Extent to which travel times are reliable	Model Output
6.3	Improved accessibility to economic activity	Accessibility to, between and within key economic areas	Model Output
6.4	Improved access to labour pool	Access to labour pool by business	Model Output
6.5	Increased productivity	Degree to which "Business Services" are concentrated (agglomeration benefits)	Model Output
6.6	To enable land extensive business sectors to grow in appropriate areas	Degree to which there is sufficient Group 1 land available and that any new Group 1 land is appropriately located	Scenario Input
6.7	Minimised infrastructure costs	The extent to which an option results in measurable private and public monetary costs or losses over time	Model Output and Expert Assessment
6.8	Protection of productive rural land	The degree to which urban development consumes the most fertile soils of the region	GIS Assessment
6.9	Energy resilience	Fuel use per person	Model Output and Expert Assessment
6.10	Feasibility from current market perspective	Extent to which the market is likely to respond to the proposed land use pattern	Expert Assessment
	<b>Environmental Wellbeing</b>		
7.2	Reduced greenhouse gas emissions	CO <sub>2</sub> emissions	Model Output and Expert Assessment
7.3	Protection of or enhancement of marine values	The degree to which it avoids risks to areas of high ecological value	Expert Assessment
7.4	Protection or enhancement of stream corridors	The degree to which it avoids damage to stream form and character	Expert Assessment
7.5	Identify, protect and enhance terrestrial ecosystems	The degree to which it protects ecologically significant areas including a diverse and representative range of native species and habitats	Expert Assessment
7.6	Avoidance of hazards	The degree to which an option avoids exposure to future sea level rise, storm surges, flooding and land instability	Expert Assessment
7.7	Improved air quality (impact on public health)	Extent to which population is exposed to harmful air emissions	Model Output and Expert Assessment

Section	Criterion	Measure	Source of information for evaluation
7.8	Water quality and human health	Extent to which options reduce the ability to swim safely at bathing beaches and collect shellfish, due to beach closures from water pollution	Expert Assessment
	<b>Social wellbeing</b>		
8.2	Improved accessibility	Access to a range of activities such as employment, education, health and social activities	Model Output and Expert Assessment
8.3	Improved accessibility for deprived households	Access to essential activities and services for the most deprived households (eg poorest 30 per cent)	Model Output
8.4	Housing Choice	Suitability of the housing stock to meet projected household demand	Model Output
8.5	Ageing in place	Housing stock allows for all life stages in the same area	Model Output
8.6	Greater housing affordability	Extent to which housing costs are affordable to households	Model Output
8.7	Improved levels of physical activity	Opportunities to replace car trips with active modes (walking and cycling)	Model Output
8.8	Improved access to local employment opportunities	The degree to which the location of residents/jobs are balanced	Model Output
	<b>Cultural wellbeing</b>		
9.2	Protection of cultural heritage, cultural landscapes and waahi tapu	Extent to which options impact on cultural heritage, cultural landscapes and waahi tapu	Expert Assessment
9.3	Economic opportunities for tangata whenua	Extent to which economic opportunities are provided for tangata whenua	Expert Assessment
9.4	Preserving the mauri	Extent to which kaitiakitanga is able to be exercised	Expert Assessment

Procedures for evaluating the scenarios were developed in order to standardise the scoring of the scenarios. 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

Consideration was given at the outset to what a strong positive or negative result might be and where appropriate, comparison was made to 2006 levels and past trends. Additional factors such as national targets (for example for CO<sub>2</sub> emissions) were considered. Non quantifiable criteria were considered with reference to qualitative information (discussed below in Section 4.4), including in some cases, proposed scoring, from experts.

Following the allocation of scores as described above, any issues and items of note were recorded and have contributed to the commentary in this report.

### 4.3 Integrated land use and transport models

Important tools used in the evaluation were the ARC'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 uses model software called Delta and is referred to as ASP3 (Auckland Strategic Planning model version 3). The transport model ART3 (Auckland Regional Transport model version 3) 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 is calibrated to 2006 data and forecasts a number of inputs other than population and employment capacities and transport networks that vary over time (car ownership levels, fuel price, the effects of non-pricing TDM). The model takes six days to run each of the scenarios plus additional time needed to output, analyse and illustrate results.

The model process has three main components:

- a regional economic and demographic forecast,
- land use scenarios that describe the amount and location of permitted development (capacity),
- a transport system, which includes a roading network, passenger transport services, walk access, travel costs and fares and numerous transport and area parameters that describe the regional transport system.

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 and evaluation teams have 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 evaluation process. Further information about the model is provided in separate documents.



#### 4.4 Qualitative assessment

It has been recognised since the outset of the project that 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 to the Evaluation Team:

- Climate Change and Energy Resilience
- Environmental Policy
- Hazards Analysis
- Heritage Policy
- Maori Perspectives
- Market Feasibility
- Physical Infrastructure
- Social Perspectives.

#### 4.5 Evaluation team

The Evaluation Team was a group of independent planning professionals. Membership was chosen in order to maintain independence from the scenario building and modelling processes. The team represented both regional and local interests, and had expertise in both land use and transport planning. The Evaluation Team members were as follows:

- Barry Mein (Consultant), Chairman
- Brenna Waghorn (Auckland Regional Council)
- Brian Waddell (Consultant, representing Auckland Regional Transport Authority)
- Catherine Harland (Consultant)
- David Hookway (North Shore City Council)
- David Young (Consultant)
- John Williamson (Consultant)
- Kyle Balderston (Waitakere City Council)

- Steve Wrenn (Manukau City Council)
- Terry Conner (Auckland City Council).

Members of the Evaluation Team in previous rounds of the Futures Project, but who were unable to take part in this round were:

- Aimee Barwick (Auckland Regional Transport Authority)
- Cassandra Smith (Auckland Regional Council).

The team was supported by Michael Tucker, Dawne Mackay, Chloe Trenouth and Elfyn Henderson of the ARC's Regional Development Team. In addition to being a member of the Evaluation Team, David Young also provided in-depth analysis of model outputs. Russell Jones, consultant, provided in-depth analysis of model outputs in prior rounds of the project.

## 5 Overview of Model Outputs

This section provides an overview of the modelling results for a number of core model outputs around land use and transport. These model outputs are useful in providing broad contextual information that can be further drawn upon in the subsequent sections where the specific criteria are evaluated. The model outputs help illustrate how the scenarios generally perform over time for land use outputs such as housing and employment uptake, and transport related activities, such as travel time, mode share and passenger transport supply and demand.

In summary the main findings are:

- There is strong growth in housing in the CBD and CBD Fringe irrespective of the scenario. However household growth in centres is significantly stronger in the compact scenarios. In Scenario 5 where greenfield areas are provided for future housing, the model outputs indicate that future housing will locate in these areas first, before locating in centres.
- Employment uptake tends to reflect the different locations of employment capacity provided in each scenario. The CBD provides for strong growth in employment irrespective of the scenario. Employment growth is stronger in centres (particularly secondary centres) in the compact scenarios, whereas it is less strong in Scenario 5, reflecting a preference for employment growth in business areas outside centres and greenfield areas.
- Land use and transport integration is more successful in the compact scenarios than Scenario 5, which shows a mismatch between the location of household and employment uptake resulting in longer travel distances to work.
- For all scenarios, most future trips will continue to be by car but at a decreasing proportion of mode share. Conversely the proportion of mode share by PT and active modes increases, with active modes noticeably higher in the compact scenarios.
- For all scenarios, there is a significant increase in traffic volumes and a concomitant 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.
- It is likely that people will take more, longer trips by passenger transport, especially in Scenario 5 where there is significant urban expansion outside the existing urban area because of increasing congestion.

## 5.1 Land use outputs

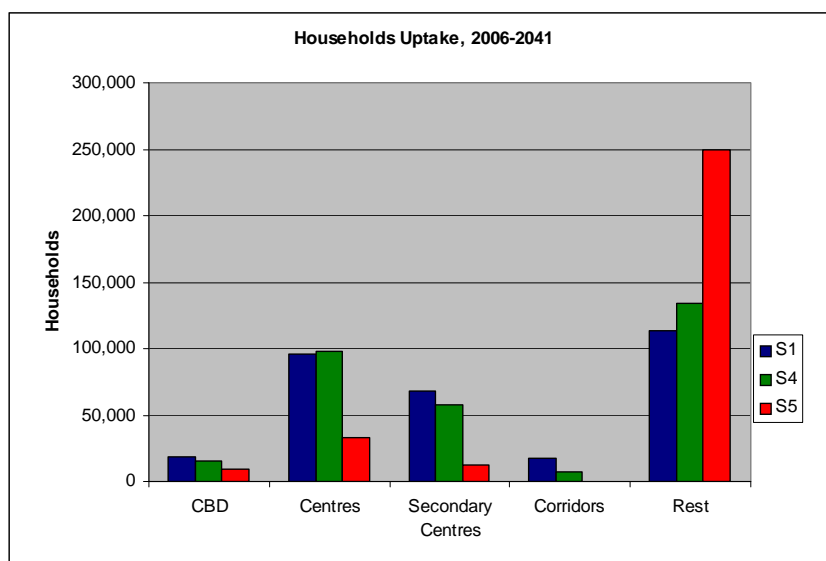
This section looks at how the scenarios performed in terms of land use outputs and how population growth may be distributed in the CBD, centres, corridors, and through infill. In particular where household and employment uptake occurred and the resulting capacities and spatial pattern of growth achieved.

Through the scenario development, household and employment capacities are inputted into the model, as discussed in section three. 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. A range of model outputs were considered, the key graphs are discussed below, the other graphs are provided in Appendix 2.

### 5.1.1 Growth in households

The model outputs suggest that uptake of household capacities varies across the scenarios. Figure 5 below illustrates household uptake by categories CBD, Centres, Secondary Centres, Corridors and the rest of the region.

**Figure 5 Households uptake in key areas**



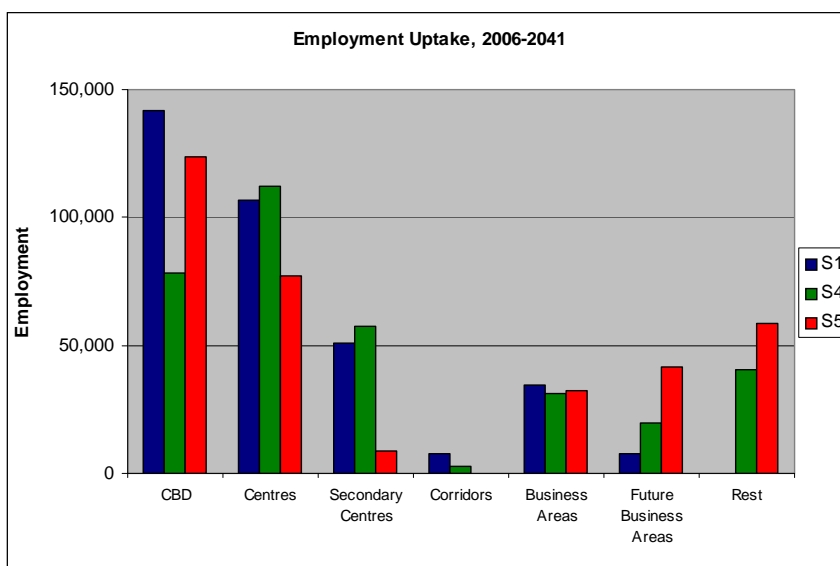
Importantly, household uptake in the CBD is strong and ranges from 18,000 (Scenario 5) to 41,000 (Scenario 1). However it does not meet the total capacities provided in any of the scenarios. This may be because of the strong uptake of employment in the CBD affecting household location (see Figure 6 below).

There is significantly higher uptake of households in centres in the compact scenarios. In part this reflects the greater capacity provided in these scenarios, but it also illustrates that where capacity is provided in new greenfield growth areas (Scenario 5) it is taken up by the model before existing centres.

### 5.1.2 Growth in employment

Employment uptake (see Figure 6 below) tends to reflect the different locations of employment capacity provided in each scenario. Employment uptake is very strong in the CBD, particularly for Scenarios 1 and 5, exceeding the capacities provided. In contrast, employment in Scenario 4 is strongest in large centres. This probably reflects that this scenario provides proportionally more of its employment capacity in larger centres.

**Figure 6 Employment uptake in key areas**



Uptake in existing business areas is much the same across the scenarios. There is a large amount of uptake of capacity in future business areas in Scenario 5 because the other scenarios do not provide much capacity in this type of business land.

There is no uptake of capacity in the 'rest' category in Scenario 1 because it provides employment capacity in existing centres and business areas only.

Secondary centres have strong employment growth in the compact scenarios, but very little employment growth in Scenario 5 - with less than half of its available capacity taken up. This reflects a general preference for employment growth in the CBD and centres.

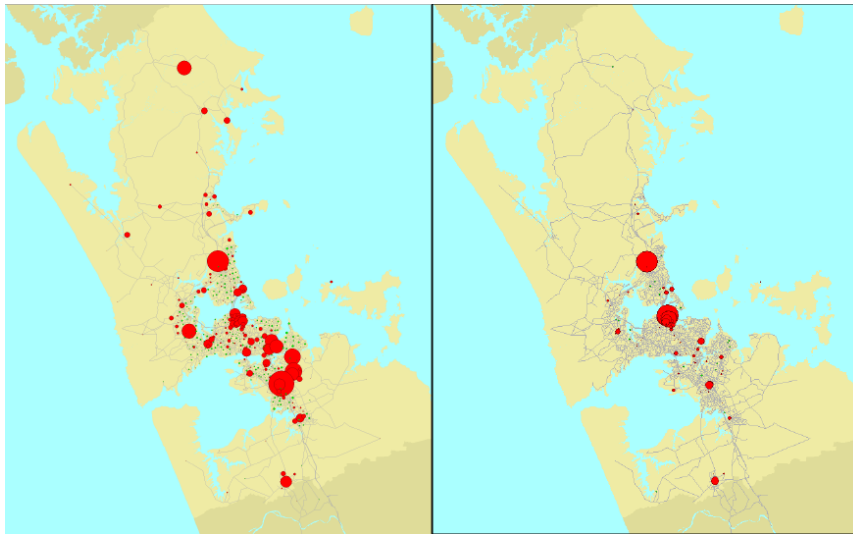
### 5.1.3 Household versus employment uptake

Development of the scenarios aimed to integrate land use and transport by providing employment capacity in areas where household capacity was also provided, thereby reducing the need for travel. Figure 7 to Figure 9 below provide comparisons of the household and employment uptake for each scenario (household uptake is on the left, and employment uptake to the right).

Most significantly the large concentration of employment in the CBD is seen in all scenarios, but particularly Scenario 1 and 5. This has been discussed previously, and means that households in Scenario 5 will have to travel further to get to work.

The model outputs indicate a lack of land use and transport integration for Scenario 5, with employment uptake focused in the CBD and existing employment areas and household uptake focused on the periphery. The compact scenarios are less of a mismatch as households tend to be concentrated in the existing urban area.

**Figure 7 Scenario 1 Household/employment uptake 2041**



**Figure 8 Scenario 4 Household/employment uptake 2041**

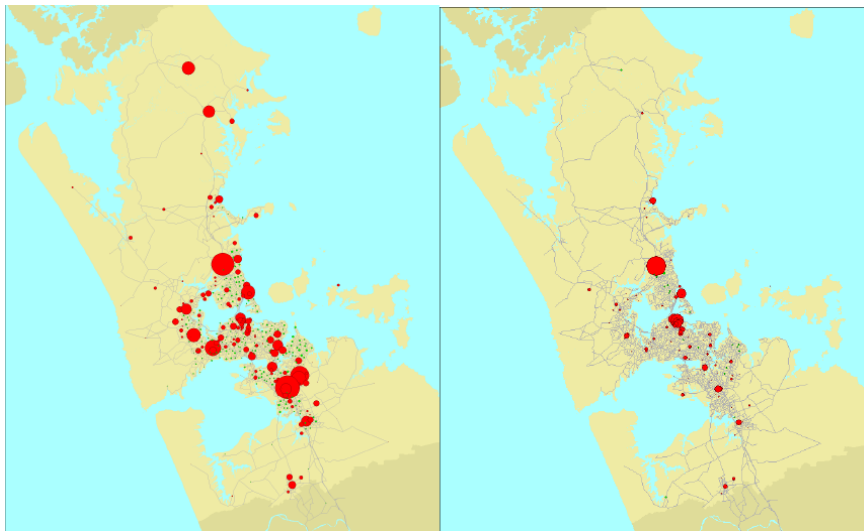
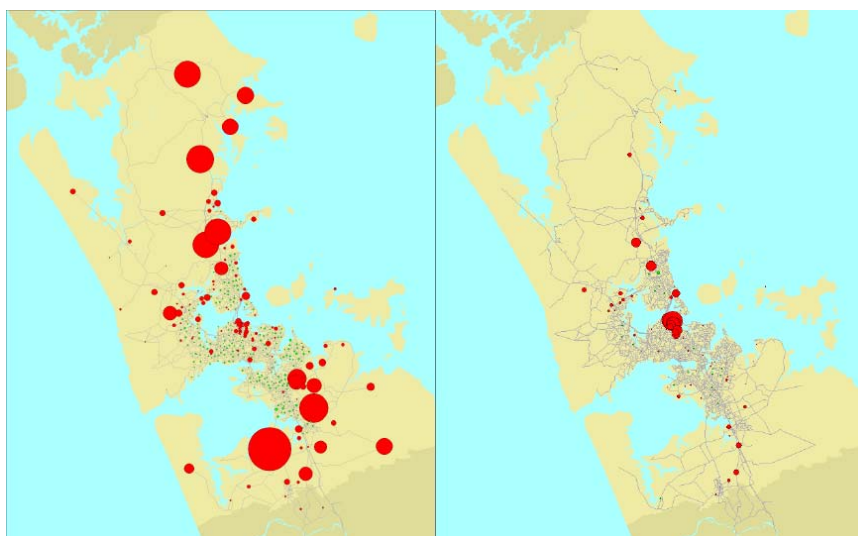


Figure 9 Scenario 5 Household/employment uptake



## 5.2 Transport outputs

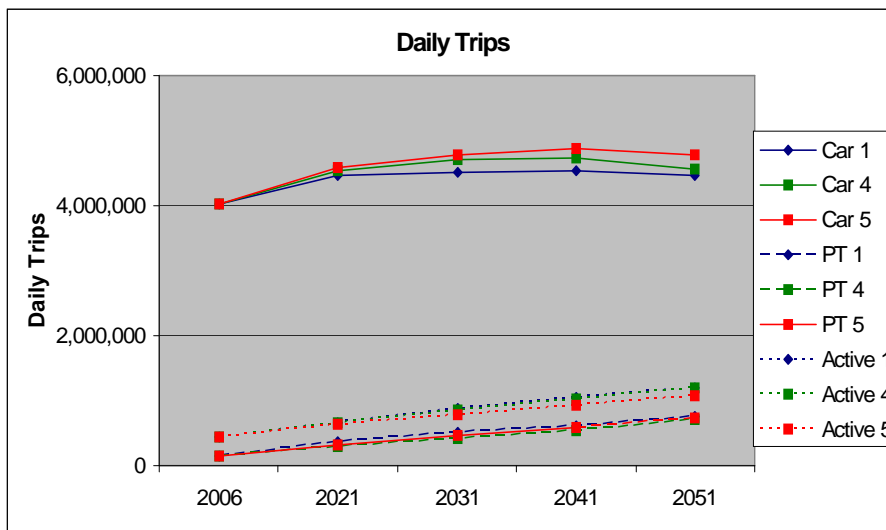
A number of the transport outputs are fundamental to evaluating the performance of the scenarios. These include an understanding of how, with an increasing population, the number of daily trips is changing over time and how preference for transport modes may also be changing over time. These outputs are presented in this section.

### 5.2.1 Daily trips and mode share

The model estimates the total number of daily person trips made by people over time, and this is then split into different modes; car, passenger transport, active mode (walking and cycling).

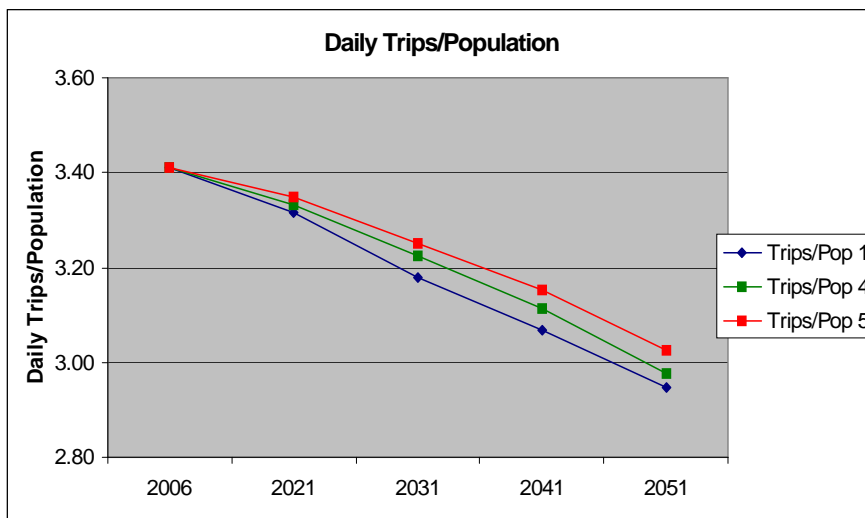
Figure 10 shows the number of daily trips by mode. The number of daily trips increases for all modes as population increases across all scenarios. The number of daily trips continues to be dominated by the car, but car trips remain fairly constant after 2021 for all scenarios, particularly Scenario 1.

Figure 10 Daily trips



Daily trips per capita (Figure 11) illustrates that although the total number of daily trips continues to increase, the number of trips per capita decreases over time for all scenarios. This is probably due to more people being able to work from home in the future and an ageing population incorporating more retirees.

Figure 11 Daily trips per capita

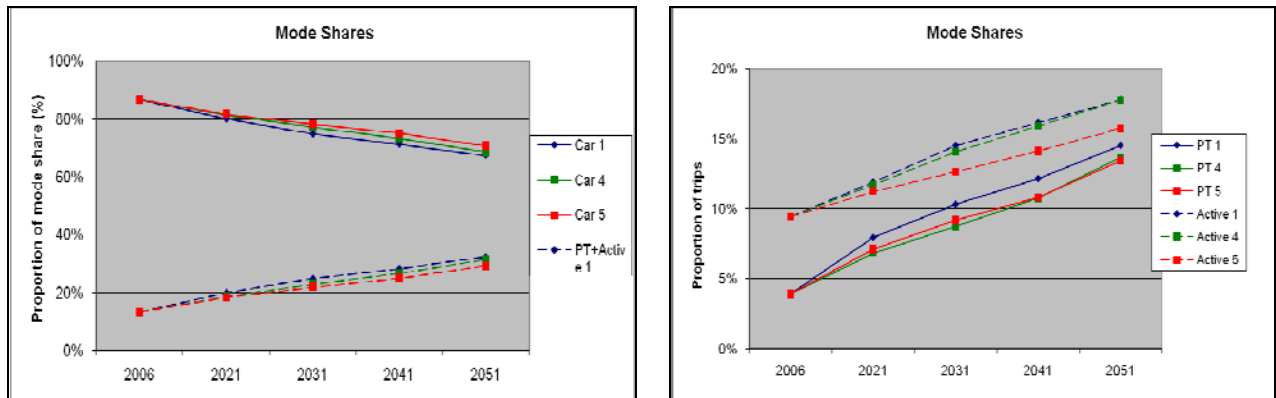


Looking at mode share demonstrates the changing profile of trips, showing a decreasing share for trips by car in all scenarios (Figure 12). Mode share by car declines significantly over time from 87 per cent (2006) down to 71-75 per cent (2041). In response, passenger transport and active mode shares increase from 13 per cent to 25-28 per cent. Scenario 1 performs slightly better than Scenarios 4 and 5.

In term of non-car based mode share, PT increases most significantly across all scenarios increasing from four per cent (2006) to 11-12 per cent (2041). Increases in active mode share are from nine per cent in 2006 to 14-16 per cent in 2041.



Figure 12 Mode shares



### 5.2.2 Vehicle statistics

Vehicle kilometres travelled (VKT) is the total network wide distance travelled by vehicles, measured for the AM peak and during the interpeak. Along with total VKT is daily VKT per capita (Figure 13). Total VKT increases over time for all scenarios, with the interpeak exceeding the AM peak by 2041. Scenario 5 has the highest VKT in both AM and interpeak.

The increase in total VKT for Scenarios 1 and 4 is less significant than Scenario 5, because the daily VKT per capita decreases from 23km per person to 21km (eight per cent). In contrast daily VKT per capita in Scenario 5 increases from 23km to 26km (13 per cent) reflecting growth on the periphery of the region increasing trip lengths.

Figure 13 Vehicle-kilometres travelled

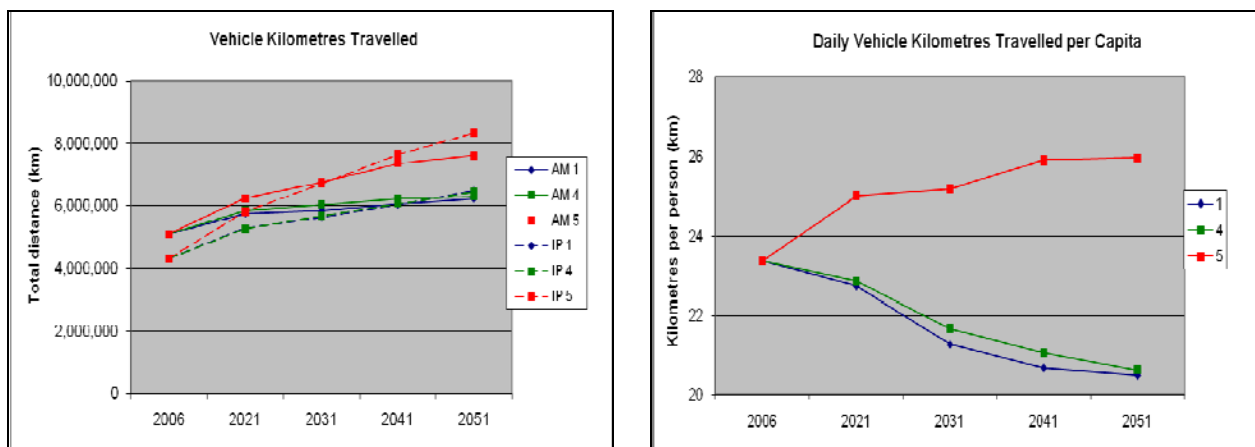


Figure 14 gives the total network vehicle travel time and the average vehicle trip time in the AM peak and interpeak. Total vehicle minutes of travel increase for all scenarios in both periods, with the compact scenarios showing lower increases. However the average trip time generally increases for all scenarios; except in the AM peak where it reduces for the compact scenarios.

Figure 14 Vehicle travel time

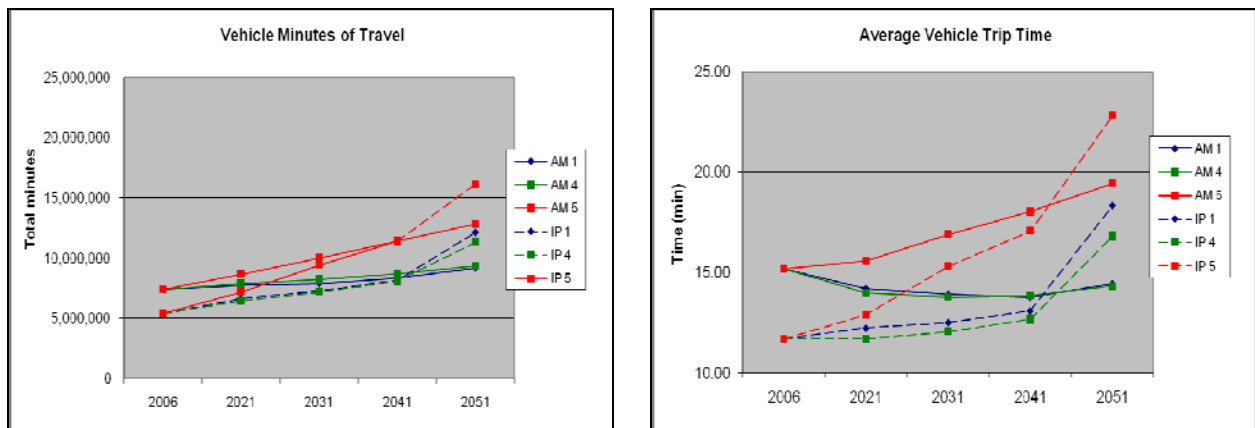
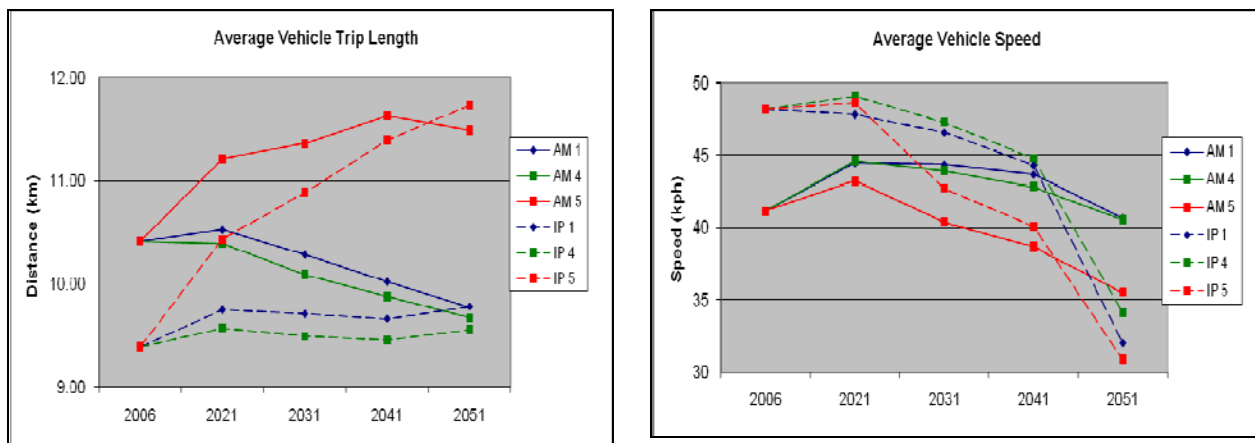


Figure 15 looks at vehicle trips in terms of average length and speed. Average trip length increases for Scenario 5 in both AM peak and more significantly the interpeak. Scenario 4 performs best with distances reducing during the AM peak and staying similar to 2006 during the interpeak. Scenario 1 follows a similar trend, but the interpeak would be slightly worse than 2006.

Average vehicle speed increases for all scenarios to 2021, and then starts to decline over time in both AM peak and interpeak. Average speeds will generally be worse than 2006, but will actually improve during the AM peak for the compact scenarios for 2041

Figure 15 Vehicle graphs (length and speed)

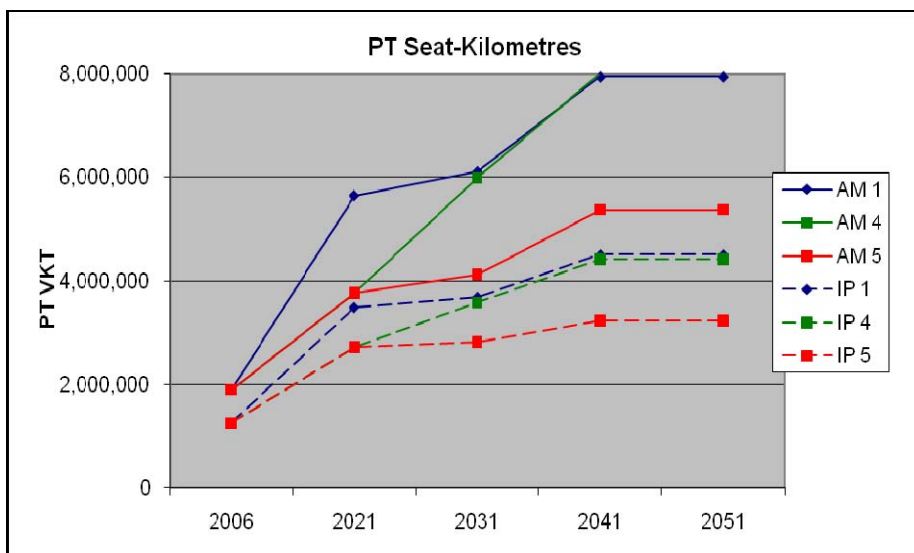


### 5.3 Passenger transport (PT) statistics

Given anticipated growth in the region, accessibility by PT will be an increasingly important consideration. PT capacity is demonstrated in Figure 16 below by PT seat-kilometres, reflecting the capacity of different PT modes (rail, ferry and bus). Total seat-kilometres increase across all scenarios. The compact scenarios have four times the PT capacity of 2006 by 2041 for the AM peak, compared with about two and a half for Scenario 5. PT capacity has a similar trend but lower capacity for the interpeak

period. This is a reflection of the investment in the PT network and services, and the different inputs for each scenario (refer Section 3).

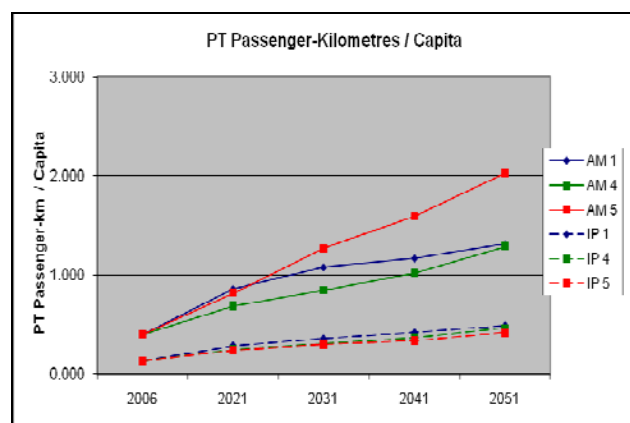
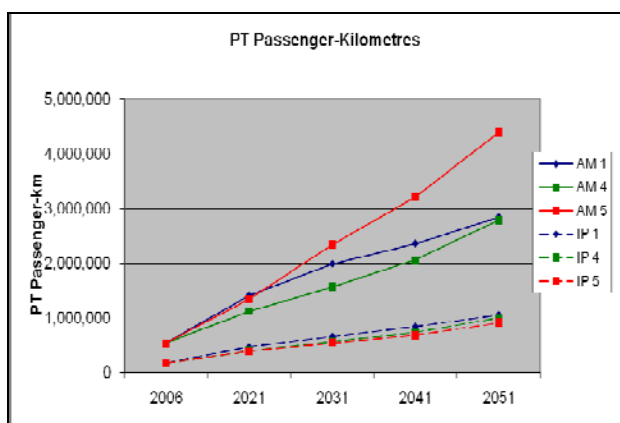
Figure 16 PT capacity (supply)



Demand for PT and the distances travelled by PT are shown below in combination with PT passenger kilometres (Figure 17). Passenger kilometres increase over time for all scenarios, with very large increases in Scenario 5 in the AM peak. This is due to the large trip numbers generated by population growth in the north (busway) and south (rail and bus).

Per capita passenger kilometres increase over time in all scenarios. Scenario 5 shows significantly greater increase in per capita PT kilometres – again this is likely to be due to the large trip numbers generated by population growth in the north and south.

Figure 17 PT demand



## 6 Economic Wellbeing

Economic wellbeing is defined by the economic outcomes a community wishes to achieve. It can be measured by material standard of living, quality of life, or the long term sustainable prosperity of the community. The ARC's LTCCP (2009-2019) identifies the following outcomes to support economic wellbeing:

- A thriving regional economy that supports a good standard of living.
- The ARC, the community, local and central government, and business work together to achieve results.
- Aucklanders are educated and skilled and have access to appropriate learning and training opportunities.
- Maori are succeeding socially and economically, and contribute to decision-making<sup>3</sup>.

The RGS identifies regional outcomes relating to economic values in terms of managing growth. It aims to promote employment choice and business opportunity through business growth, development opportunities, providing affordable and suitable land and infrastructure, and improved matching of employment and population in different parts of the region. A range of principles are identified for evaluating regional growth alternatives:

- 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.
- Provide adequate and high-quality infrastructure to support business, residential and other opportunities in a timely manner<sup>4</sup>.

These principles aid in the delivery of the Auckland Regional Economic Development Strategy outcomes of more economic opportunities, more participation in the economy and high quality economic activity<sup>5</sup>. Policy relating to economic development is set out in the ARC's statutory plans.

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 qualitative expert analysis.

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<sup>3</sup> Auckland Regional Council, 2009, Long-Term Council Community Plan 2009-19.

<sup>4</sup> Auckland Regional Council, 1999, Auckland Regional Growth Strategy.

<sup>5</sup> Auckland Regional Council, 2002, Auckland Regional Economic Development Strategy.

## 6.1 Summary

Economic wellbeing has been measured by the following criteria:

Criteria	Scenario 1	Scenario 4	Scenario 5
Improved travel reliability	✓	0	x
Improved accessibility to economic activity	xx	x	xx
Improved access to labour pool	✓✓	✓✓	✓
Increased productivity	✓✓✓	✓	✓✓
To enable land extensive business sectors to grow in appropriate areas	x	x	✓
Minimised infrastructure costs	x	x	xx
Protection of productive rural land	0	0	xx
Energy Resilience	x	x	xx
Feasibility from current market perspective	xxx	xx	✓✓

### *Conclusion*

Regional accessibility, travel reliability and accessibility to strategic economic areas (including ports and the airport), 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, although the Compact Scenarios generally remain better at 2041 than they were at 2006. 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.

Agglomeration of business services in centres, supported by improved accessibility can increase regional productivity. All scenarios drive growth in business services in the CBD and CBD Fringe. The Compact Scenarios also improve access for firms to the labour pool.

The Expansive Scenario provides additional land for Group 1 business activity in strategically identified areas. The strong take-up of this land indicates the importance of new Group 1 land provision and confirms previous work by the Business Land and Economy Group in identifying the region's need for additional Group 1 business land. Some intensification of existing Group 1 business areas is also anticipated (which may lead to a change in activities), although where this transition might occur was not assessed. In terms of location, access to ports and the airport, the motorway network and the national domestic market are all important.

With respect to energy resilience, all scenarios showed an increase in fuel use and fuel use per capita above the 2006 levels. The Compact Scenarios show increases in fuel usage over time with similar trends, while the Expansive Scenario has a significantly higher increase over the time period until 2051 indicating a greater reliance on fuel usage and accordingly less energy resilience.

A number of areas were identified as potentially contributing to a decrease in domestic energy usage including city form, embodied energy in infrastructure design, dwelling typologies and construction. These are areas 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.

In terms of infrastructure costs (bulk water supply, waste water treatment, storm water management, transport networks and energy distribution), compact growth could lead to greater optimisation of existing infrastructure and possible cost savings, while dispersal of growth appears to lead to greater costs.

From a market perspective there would be a clear preference for the Expansive Scenario because it is the closest to a business as usual approach most familiar to both developers and the market. However, in contrast, the Expansive Scenario urbanises over 18,000 hectares (some 15 per cent) of the region's productive rural land whereas the Compact Scenarios urbanise a minimal amount.

## 6.2 Improved travel reliability

This criterion measures the extent to which travel times across the region are reliable.

Travel time reliability is important for economic development because it directly affects the efficiency of movement of people, goods and services. Increased travel time 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*

This criterion was measured using proxies for travel reliability from the model. For road reliability these were the average ratio of speed to free-flow speed and the percentage of congested vehicle kilometres travelled (VKT) in the road network. 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 (see Appendix 2: Figure 89 - Figure 91).

Two sub-scores were given, for road and PT, but due to the importance of motorway and urban arterial access to economic development and the considerably higher car mode share, the final score is taken from the data for private vehicle trips only.

Figure 18 Average speed as proportion of free flow speed

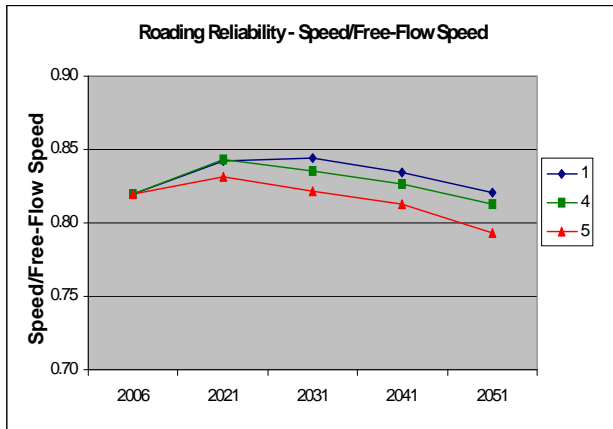


Figure 19 Percentage congested VKT, all road

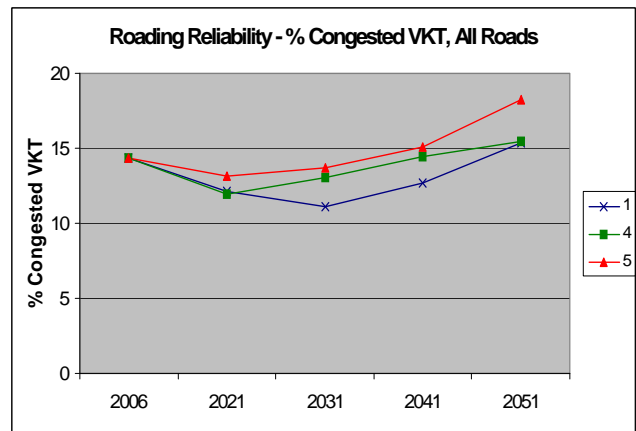


Figure 18 shows the average ratio of speed to free-flow speed; the higher this ratio the better the travel reliability. The Compact Scenarios are slightly better at 2041 than at 2006, whereas the Expansive Scenario is slightly worse.

Figure 19 shows the percentage of congested VKT in the road network; the lower the percentage the better the travel reliability. Scenario 1 is better at 2041 than at 2006, Scenario 4 is the same and Scenario 5 is only slightly worse. This ranking is the same as Figure 33 and the same trend is evident in the VKT data in Section 5.2.2.

Generally speaking, in all scenarios travel reliability initially improves but then declines from 2021 onwards as shown by the reducing ratio of speed to free-flow speed and increasing percentage of congested VKT. This suggests that the improvements in the transport network and other initiatives are not keeping pace growth in vehicle travel.

Further graphs (see Appendix 2) show congested VKT by road types (motorways, urban arterials and rural roads) and geographical sectors. The noticeable difference with the road type data is with rural roads where the Compact Scenarios are fairly constant over time whereas congestion increases greatly for the Expansive Scenario. The percentage of congested VKT by sector shows some variation between the scenarios which reflects the location of growth in each; the Expansive Scenario has the highest percentage of congested VKT in the north and south, while all scenarios are similar in the central sector.

At the regional level there is little difference between the scenarios however when localised effects are considered, as discussed above, there is a clear ranking between them: Scenario 1 (small positive), Scenario 4 (neutral) then Scenario 5 (small negative).

For PT reliability all scenarios improve to 2031 then generally remain at this level to 2041 (see Appendix 2). The differences between the scenarios are generally small, which reflects the similar PT improvements in each (eg bus lanes). The most notable sectoral difference is in the west where the Expansive Scenario has lower reliability than the Compact Scenarios. However, overall, the scenarios score positively and equally for PT reliability because the difference between them is marginal.

	Scenario 1	Scenario 4	Scenario 5
<b>Improved travel reliability</b>	✓	0	x
<i>Road</i>	✓	0	x
<i>PT (bus)</i>	✓✓	✓✓	✓✓

*Conclusion*

Travel reliability is generally better in the Compact Scenarios in 2041 than in 2006, but for the Expansive Scenario it is worse. However, in all scenarios after an initial improvement to 2021, reliability generally declines. This is a reflection of both the absence of transport infrastructure investment in later years and the large scale of projected population growth and subsequent growth in vehicle travel. The clear message is that planned improvements in the transport network and TDM initiatives do not keep pace with the projected population growth.

In the long term this 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 traffic.

Efficient transport links to and between the region’s most important business locations are fundamental to the effective movement of goods and services; unnecessary delays can lead to reduced economic performance. 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 Evaluation Team considered model outputs showing average vehicle speeds to and between strategic economic locations namely the CBD, the Port, the Airport, Wiri Inland Port, Penrose, Albany, East Tamaki and Rosebank. The average vehicle speeds were to these specified economic locations in the AM peak and interpeak and between the locations in the interpeak, weighted by the numbers of trips made. The average speeds were for all locations combined and individually in the AM peak; the latter can be seen in Appendix 2. The scoring for this criterion is based on all data.



Figure 20 Speed to economic sites in AM peak, and network speed in AM peak

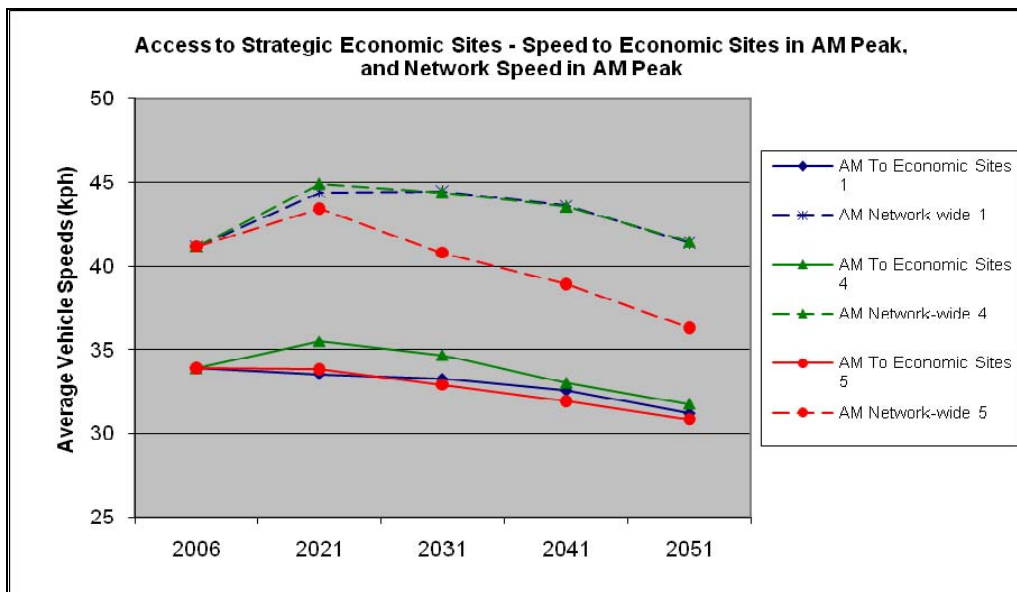


Figure 20 shows the average vehicle speed to all specified economic locations in the AM peak along with the network-wide average speed in the AM peak (for context). This is aimed at access to these locations for commuters in the AM peak. For all scenarios at 2041 the average speed to the economic locations in the AM peak is lower than 2006. The overall network speed is higher in 2041 for the Compact Scenarios, but lower for the Expansive Scenario.

Figure 21 Speed to Economic Sites in Interpeak, and Network Speed in Interpeak

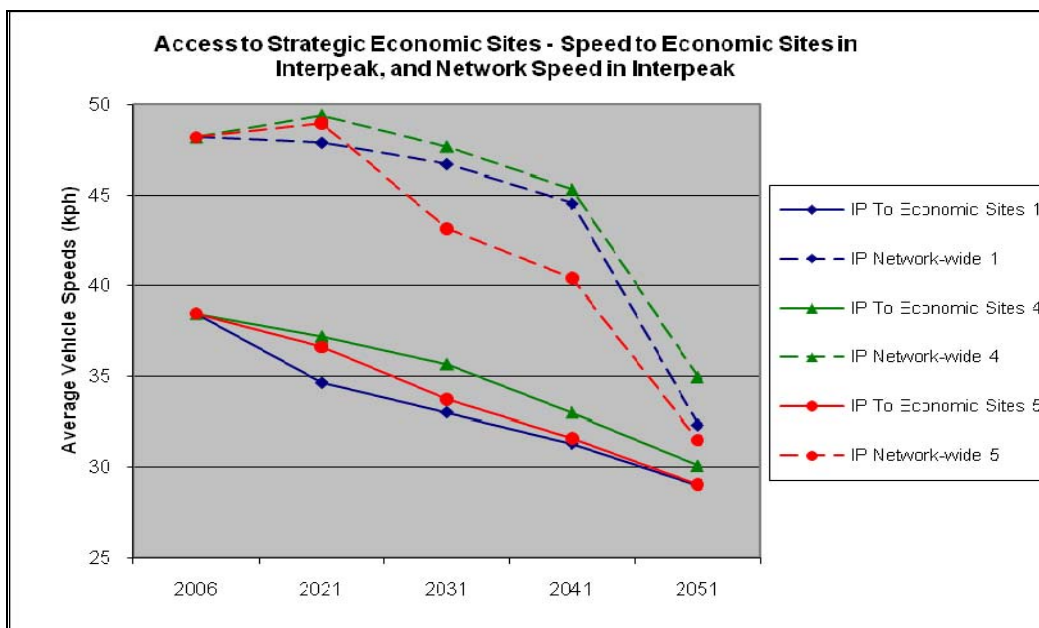


Figure 21 shows the average vehicle speed to all specified economic locations in the interpeak along with the network-wide average speed in the interpeak (for context). This is aimed at the movement of goods to the locations in the interpeak period. For all scenarios at 2041 the average speed to the economic locations in the interpeak peak is

significantly lower than 2006, with Scenario 4 performing better than the other two scenarios. The decrease in speed to the economic locations over time is more gradual than for the network as a whole.

Figure 22 Speed between economic sites in interpeak

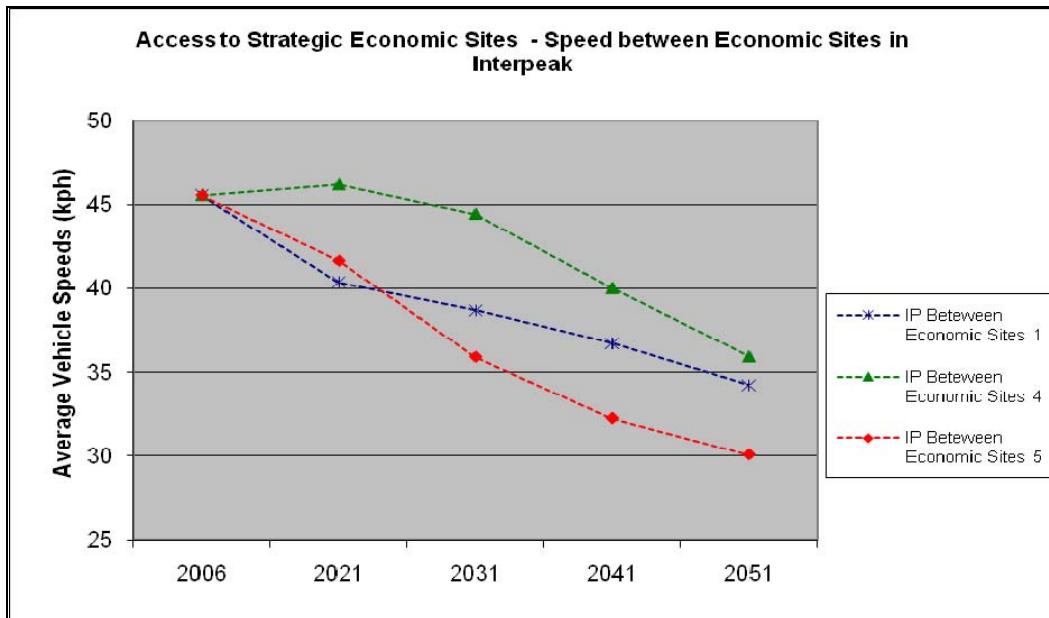


Figure 22 shows the average vehicle speed between all specified economic locations in the interpeak. This is aimed at the movement of goods between the locations in the interpeak period. Again, for all scenarios at 2041 the average speed between economic locations is significantly lower than 2006; it declines from 45kph in 2006 to between 40kph and 33kph in 2041. This is more gradual than for the network as a whole which declines from 48kph to between 34kph and 31kph (see Figure 15 in Section 5.2 – Transport Outputs)

The average speed to locations of economic activity declines over time and there is little difference between the scenarios for both the AM peak and interpeak periods, particularly by 2041. There is some difference in the interpeak speeds between the economic locations with Scenario 4 performing the best followed by Scenario 1 and then Scenario 5.

There are some differences for individual locations (see Appendix 2):

- The airport has good access (high average speed) in 2006 compared with other locations, which improves further by 2021, but then declines to be lower than 2006 in 2041.
- Access to the CBD and the port remains at similar levels to that in 2006.
- Albany has good access in 2006, but this declines rapidly by 2021.

Accessibility to most areas of economic activity declines across all scenarios, the exceptions to this being:

- The CBD and the port where average speeds in the AM peak are generally similar in 2041 to 2006.
- Penrose where they are slightly higher.
- Rosebank where they are considerably higher (reflecting roading improvements).

The network-wide average speeds are higher than the averages to locations of economic activity in 2006 in both the AM peak and the interpeak, but the network-wide averages decline at a greater rate than those to the economic centres, particularly for the Expansive Scenario. There is little discernable difference between the scenarios however during the interpeak, when most economic benefits are achieved. Scenario 4 performs less poorly than the other two and therefore scores better.

	Scenario 1	Scenario 4	Scenario 5
Improved accessibility to economic activity	xx	x	xx

#### *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. Average vehicle speeds to locations of economic activity remain higher than those for the transport network as a whole, although in all cases, after an initial improvement, there is a downward trend from about 2021. As with Section 6.2 Improved Travel Reliability, this is a reflection of the front loading of transport infrastructure investment and the scale of population growth and vehicle growth. The clear message is 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. This investment would need to be more significant in an expansive urban form.

## 6.4 Improved access to labour pool

This criterion measures the extent to which an employer has accessibility 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 in a number of ways: as the percentage and number of working-aged adults within 30 and 45 minutes of employment by car and 30 and 45 minutes by PT. This was considered at the regional level and for each geographic sector.

All data were considered by the Evaluation Team but the focus of the scoring was on the 30 minute data for car and 45 minute data for PT (Figure 23), by region and sector. These were chosen because commuters are generally willing to allow more time when using PT than when using private cars. These two graphs are included below; refer to Appendix 2 for the other graphs. Two sub-scores were given, for car and PT, but due to the high car mode share the final score is taken from the car data.

**Figure 23 Access to labour pool - car (30 min)**

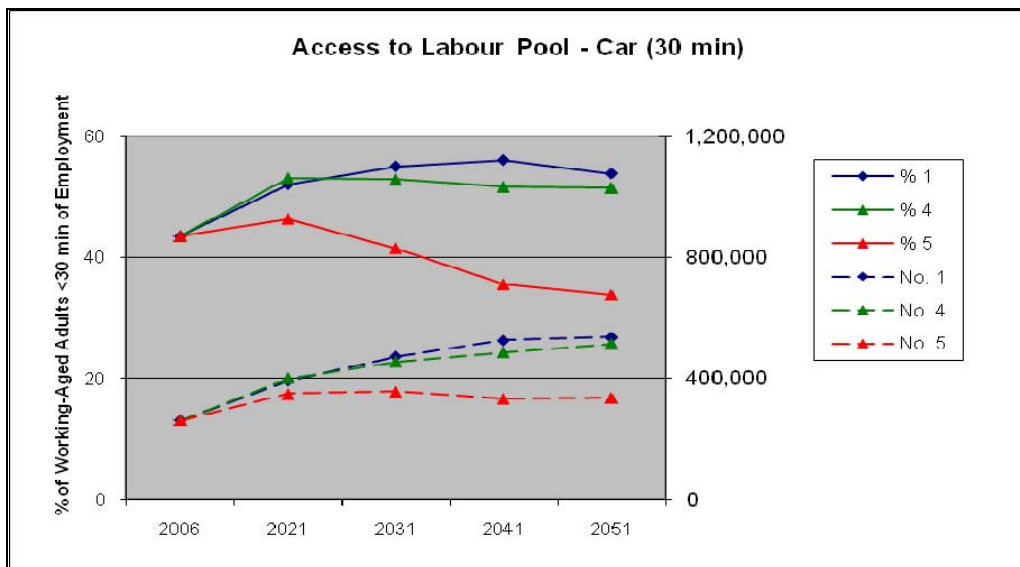


Figure 23 Access to labour pool - car (30 min) shows accessibility to the labour pool, which in percentage terms, increases for the Compact Scenarios over time then levels out, while for the Expansive Scenario it declines to below the 2006 level. In number terms, access to the labour pool increases over time in all scenarios, though the Expansive Scenario levels out from 2021, whereas the other two scenarios continue to increase.

For car therefore, the scenarios show a definite order; Scenario 1 is best, followed by Scenario 4 and then Scenario 5, with Scenario 4 closer to Scenario 1 than to Scenario 5.

Figure 24 Access to labour pool - PT (45 min)

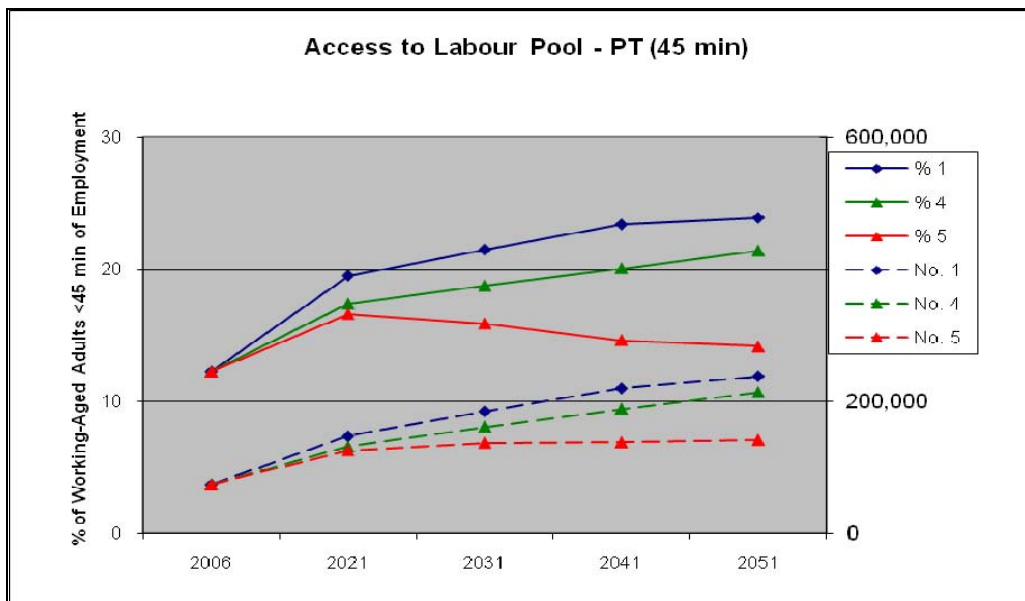


Figure 24 Access to labour pool - PT (45 min) shows accessibility to the labour pool in terms of the percentage of working-aged adults within 45 minutes of employment by PT, increases for the Compact Scenarios over time, while for the Expansive Scenario it increases initially then declines to a level above the 2006 percentage. For the number of working aged adults within 45 minutes of employment by PT, accessibility increases for the Compact Scenarios over time, while for the Expansive Scenario it increases initially then levels out.

The ranking of the scenarios is therefore the same as for car, but with Scenario 4 closer to mid-way between the other two scenarios. However the difference between the two Compact Scenarios is not sufficient to warrant a difference in scoring.

	Scenario 1	Scenario 4	Scenario 5
<b>Improved access to labour pool</b>	✓✓	✓✓	✓
<i>Car</i>	✓✓	✓✓	✓
<i>PT</i>	✓✓✓	✓✓	✓

### Conclusion

The Compact Scenarios provide firms with better access to the labour pool than the Expansive Scenario, for both car and PT. Generally, the Compact Scenarios show an upward trend from 2006 whereas the Expansive Scenario either levels out or declines after an initial improvement. Again, as with the previous two criteria, this is a reflection of the absence of transport infrastructure investment in later years and the large scale of the population growth. However in this scenario it is less pronounced and affects the Expansive Scenario significantly more than the others.

A compact urban form will therefore 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 under investment in the transport network.

## 6.5 Increased productivity

This criterion centres 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.

Auckland is home to a third of New Zealand's people and generates a third of the country's income, the Auckland 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>6</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>7</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. The uptake in the CBD takes precedence in the scoring as they are three to four times greater than those for the CBD Fringe.

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<sup>6</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>7</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 25 Total group 2 employment by area<sup>8</sup>

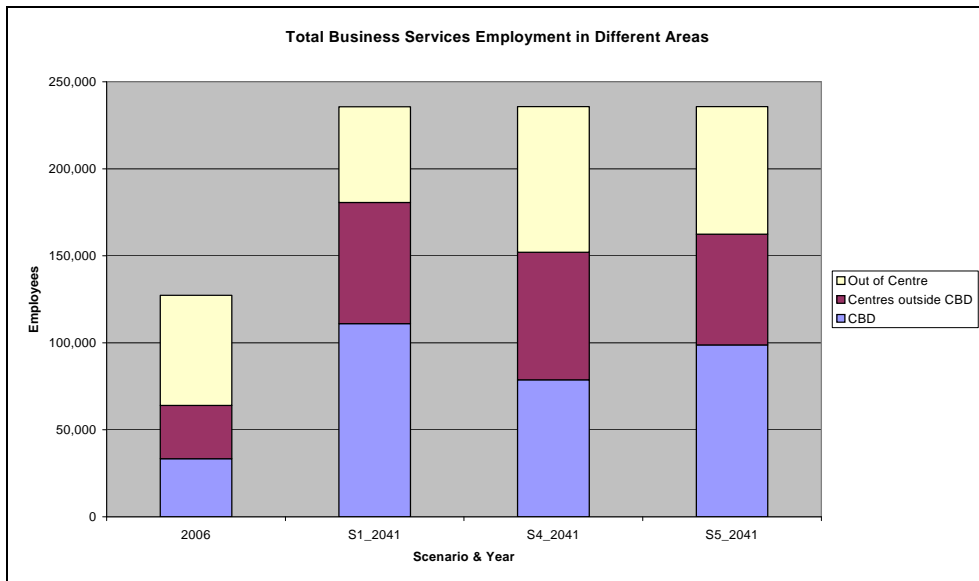


Figure 25 Total group 2 employment by area shows that all scenarios are better for agglomeration than 2006 in that they have a greater number of business services employees in the CBD and other centres (including the CBD Fringe). There is a clear ranking between the scenarios; Scenario 1 is best followed by Scenario 5 and then Scenario 4. The same ranking is evident for the percentage of business services employees, see graph in Appendix 2.

Figure 26 Total group 2 employment in CBD

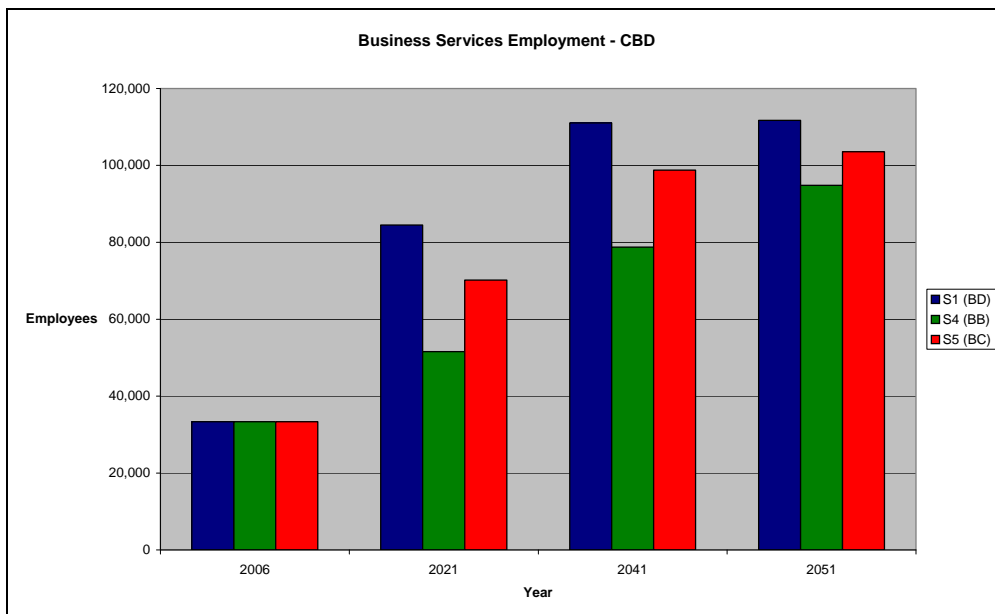


Figure 26 Total group 2 employment in CBD shows the number of business services employees in the CBD by scenario. In 2041, Scenario 1 supplies the greatest number

<sup>8</sup> The same model zones were compared across the scenarios therefore "Out of Centre" in Scenario 5 includes a number of greenfield employment centres which were not included in the other scenarios.

of business services employees in the CBD, with over three times the current number. Scenario 5 is next followed by Scenario 4. Once again the same ranking is evident. For the CBD Fringe there is a different ranking (see Appendix 2); this time Scenario 5 has the greatest number of business services, followed by Scenario 1 and then Scenario 4. However, as previously discussed, the figures for the CBD take precedence as they are three to four times greater than those for the CBD Fringe.

Overall there is therefore a clear order to the scenarios; Scenario 1 has the greatest agglomeration, followed by Scenario 5 and then Scenario 4.

Other centres studied were Newmarket, Albany, Henderson, Manukau City, Takapuna, New Lynn, Onehunga and Papakura (see Appendix 2 for these graphs). Other individual centres deviate from this order and most reach their highest numbers of business services employees in Scenario 4, which is likely a result of the model inputs because this scenario has more larger centres than Scenario 1. Albany, Henderson, Takapuna, New Lynn and Papakura see most agglomeration in Scenario 4; and Manukau City and Onehunga are best in Scenario 1 (although only marginally from Scenario 4). The outlier is Newmarket which performs best in Scenario 5. This is possibly explained by Scenario 5 not having any large centres other than Newmarket and the CBD therefore the model was given fewer choices in where it could allocate business services employees.

	Scenario 1	Scenario 4	Scenario 5
Increased productivity	✓✓✓	✓	✓✓

#### *Conclusion*

This criterion does not show the same ranking as the accessibility based economic criteria. Being focused on business services agglomeration in centres, it is perhaps more affected by the centres classification (and resultant distribution of employment capacity) used in each scenario.

Significant levels of agglomeration occur in all scenarios - a strong CBD and CBD Fringe are evident in all scenarios and therefore all score positively, however Scenario 4, despite its compact urban form, has the smallest CBD. This could be as a result of it having a large number of larger second tier centres which compete more strongly with the CBD for business services than either of the other two scenarios. The policy implication for this could be that the centres classification used in Scenario 4 may not be optimal for business services agglomeration.

## 6.6 Group 1 business land

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>9</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>10</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.

Scenario 5 provides approximately 2000 hectares of additional greenfield land for Group 1 activities in five locations: Silverdale, Whenuapai, the airport, Drury and Paerata. Scenario 1 provides 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 within the current MUL, such as Hobsonville Airbase, Hobsonville Corridor (first stage), Massey North, Paerata and Takanini (first stage). Similarly in Scenario 4 additional greenfield land for Group 1 activities is provided in the structure plan 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 the Expansive Scenario clearly means it scores higher than the other scenarios. In this sense the scoring is straightforward; the Expansive Scenario provides additional greenfield land for Group 1 activities so scores positively, the Compact Scenarios do not provide additional land and therefore score negatively.

	Scenario 1	Scenario 4	Scenario 5
<b>To enable land extensive business sectors to grow in appropriate areas.</b>	<b>x</b>	<b>x</b>	<b>✓</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. In an effort to answer this question, additional work is being undertaken to assess the relative benefits of a number of identified greenfield sites in the region for Group 1 business activities. This work takes the following proposed sites identified by the Business Land and Economy Group (BLEG) and assesses their validity against Group 1 locational criteria:

- Whenuapai

<sup>9</sup> Business Land and Economy Group, Auckland Region greenfield Business Land Report, 2007, page 2.

<sup>10</sup> Auckland Regional Council, Industry Snapshot for the Auckland Region: The Manufacturing Sector, 2009, page 3.

- Silverdale
- Kumeu
- Paerata
- Glenbrook
- Drury.

The results of the assessment of the above sites were not available at the time of this evaluation.

### *Conclusion*

It has been established that the Auckland region requires additional greenfield land for Group 1 business activities<sup>11</sup>. It is clear that this aspiration is most easily provided for in an expansive urban form, as illustrated in the Expansive Scenario. The question remains, where this land should be provided. This work is further progressed in a separate Group 1 Business Land Assessment (Harrison Grierson 2010), which tests the potential Group 1 business locations using a range of economic and sustainability criteria<sup>12</sup>.

## 6.7 Minimised infrastructure costs

This criterion is concerned with the relative estimated cost of the regionally significant physical infrastructure that would be required to support each scenario. Social infrastructure is not considered here; refer to Section 8 for a discussion on social infrastructure.

The Regional Sustainable Development Forum's One Plan: Auckland Regional Infrastructure Inventory (2009) defines infrastructure as "...a system of services, networks and facilities that support people, businesses and communities..."<sup>13</sup>. This inventory contains further information on Auckland's regionally significant capital infrastructure projects.

### *Evaluation*

Information for this criterion was received from a number of sources and included the transport network, energy, three waters and broadband. The scenarios were considered by Vector, Transpower and Watercare and high level feedback was provided based on assessment against their own modelling and strategic planning work. Information on the transport network was extracted from the model. No judgements have been made on specific major infrastructure shapers such as the port and the airport.

<sup>11</sup> Business Land and Economy Group, Report on the Findings of the Business Land and Economy Group. 2007.

<sup>12</sup> Harrison Grierson, Futures Land Use and Transport Planning Project: Group 1 Business Land Assessment, 2010, page 4.

<sup>13</sup> Regional Sustainable Development Forum, One Plan: Auckland Regional Infrastructure Inventory, 2009.

Transport infrastructure costs are significantly higher than other infrastructure costs (refer to Section 3.6 for a full description of the transport networks in the scenarios) and can play a predominant role in shaping urban form. Due to inconsistencies in the analysis and presentation of information from the different infrastructure providers, the scoring is based on the transport network information only. The comments provided by the infrastructure providers are discussed below for completeness and to provide additional context.

Figure 27 Transport infrastructure and PT operating costs

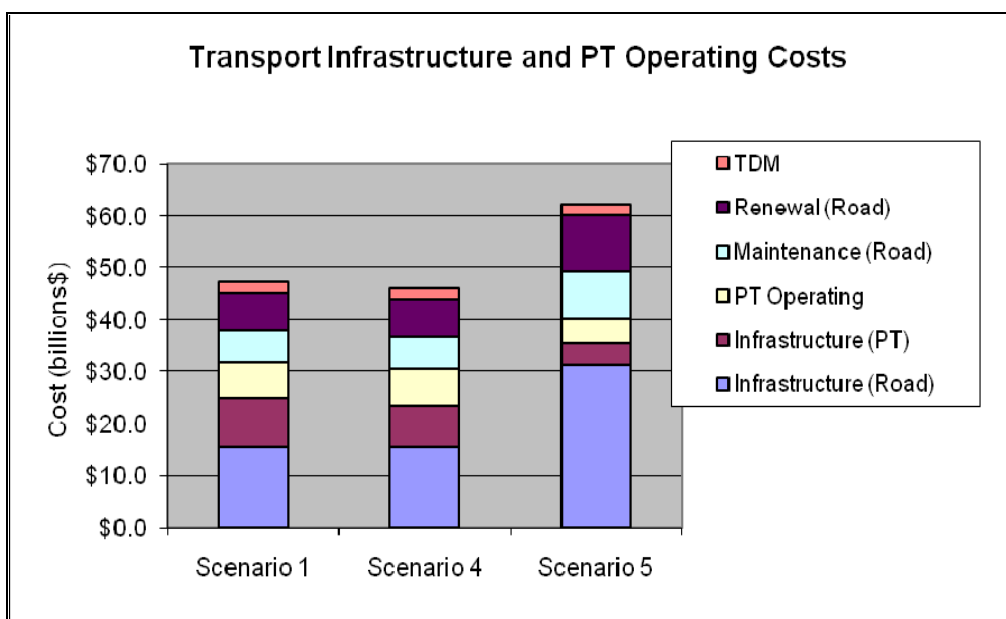


Figure 27 above shows a very high level comparison of the potential transport network costs of the three scenarios. TDM, Renewal and Maintenance costs are based on the fundability assessment carried out on the RLTS 2010 Preferred Option and contain some further assumptions (see Appendix 2: Table 6 for data table and a description of the assumptions). 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 relative coarse in nature, with many assumptions, however this data is sufficient to show the relativity between the potential costs of the transport networks.

This data shows that the Expansive Scenario is considerably more expensive than the Compact Scenarios in terms of transport infrastructure capital expenditure, PT operational expenditure and ongoing maintenance and renewal. This is most apparent in road infrastructure where Scenario 5 (\$31.4 billion) is twice as expensive as the Compact Scenarios (both \$15.5 billion). The historical underinvestment in Auckland’s transport network means that all scenarios would require significant additional investment. For this reason all scenarios must score negatively, with the Expansive Scenario scoring more negatively than the other two.

	Scenario 1	Scenario 4	Scenario 5
Minimised infrastructure costs	x	x	xx

### *Conclusion*

In general, it was found that the Expansive Scenario is likely to be more expensive and need more new infrastructure whilst the more Compact Scenarios could utilise the current infrastructure more efficiently. Indeed, Australian research by Curtin University concluded that there are substantial cost savings associated with urban redevelopment as opposed to fringe development and that the largest costs are associated with the provision of infrastructure and transportation<sup>14</sup>.

All scenarios score negatively due to historical underinvestment, and would therefore need increased investment in order to keep pace with population growth. This is shown in the accessibility related economic criteria (Sections 6.2, 6.3 and 6.4) which show a general trend of declining accessibility from 2021 as the impact of new transport projects becomes overtaken by population growth.

Further detailed work is required in this area to fully understand the infrastructure cost implications of different spatial forms.

#### 6.7.1 Feedback from infrastructure providers

##### *Three waters*

An assessment of the water, wastewater and stormwater infrastructure implications of the scenarios was provided by Watercare (water and wastewater) and the ARC Stormwater Management Team (stormwater). Watercare's assessment was based upon its ability to provide infrastructure within the next 20 years only. The three waters are discussed in turn below.

##### *Water supply*

Watercare planning for the next 20 years is based on a growth scenario similar to the Compact Scenarios. No major supply problems are anticipated provided that currently planned upgrades are completed. The Expansive Scenario however is not reflected in current Watercare strategic planning and would be difficult and expensive to service. Urban expansion to the north is likely to require the development of a northern water source. Additional supply to the southern expansion areas will require a faster upgrade of the Waikato River water supply.

##### *Wastewater*

As with water supply, Watercare's wastewater planning for the next 20 years is based on a growth scenario very similar to the Compact Scenarios. The Expansive Scenario would require a significant increase in infrastructure costs if it were to be properly serviced. Watercare is planning to install wastewater infrastructure in the North Western expansion area (NORSGA) within the next three years which would be well below capacity for this area if fully developed as per the Expansive Scenario. Watercare is also planning to install infrastructure in the Takanini area in the next two years that could be unable to cope with any additional changes in the growth

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<sup>14</sup> Parsons Brinckerhoff, 2009, Assessing the Costs of Alternative Development Paths in Australian Cities, by Roman Trubka, Peter Newman and Darren Bilsborough, Curtin University Sustainability Policy Institute Fremantle.

projections for this area. No planning currently exists for the other expansion areas identified in the Expansive Scenario<sup>15</sup>.

### *Stormwater*

The ARC Stormwater Management Team reviewed and ranked the scenarios in terms of cost implications for stormwater infrastructure provision. Consideration was given to the costs associated with three stormwater issues - stormwater infrastructure (eg pipe networks); flood protection; and stormwater quality control (eg treatment devices). Scenario 1 was considered the least expensive option as development is contained within distinct main centres. Scenario 4 has a greater number of larger centres therefore a greater number of targeted upgrades within the main centres and corridors might be required, balanced by fewer upgrades required in smaller centres. Scenario 5 was considered the most expensive as it allows widespread expansive growth, which could result in very high overall stormwater costs across all fields.

### *Energy*

It was not possible to obtain detailed scenario based feedback from energy infrastructure providers.

High level analysis provided by Vector suggested that the provision of electricity infrastructure in a more intensive scenario may incur greater costs than a more expansive scenario. However this situation is reversed for the provision of gas infrastructure which may be more expensive in an expansive scenario.

Transpower noted that it does not have an evaluated preference for any one future scenario. Its priority is the protection of existing transmission corridors to ensure security of supply to the region and this would remain the case irrespective of any particular growth scenario.

### *Broadband*

Central government has committed \$1.5 billion over the next ten years to the roll-out of fibre to 75 per cent of homes and businesses in New Zealand and has signalled it expects the private sector to at least match this figure. It is not known whether there is a strong relationship between land use and broadband, however the high likelihood that almost all of metropolitan Auckland will become fibre-connected within the next ten years lessens the importance of broadband as a significant factor of influence on Auckland's urban form.

### *Conclusion*

Generally speaking it was found that the Expansive Scenario is likely to be more expensive and need more new infrastructure while the more Compact Scenarios could utilise the current infrastructure more efficiently. Indeed Australian research by Curtin University concluded that there are substantial cost savings associated with urban

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<sup>15</sup> It should be noted that trunk wastewater capacity to service the projected population must be provided from "Day 1", ie before this growth has occurred, hence the majority of costs will fall due before the development proceeds. The minimum time period for planning such infrastructure is 10 years.

redevelopment as opposed to fringe development and that the largest figures are associated with infrastructure and transportation<sup>16</sup>.

All scenarios score negatively due to historical underinvestment, and would therefore need increased investment in order to keep pace with population growth. This is shown in the accessibility related economic criteria (Sections 6.2, 6.3 and 6.4) which show a general trend of declining accessibility from 2021 as the impact of new transport projects becomes overtaken by population growth.

Further detailed work is required in this area to fully understand the infrastructure cost implications of different spatial forms.

## 6.8 Protection of productive rural land

This criterion compares the total amount of additional land developed in each scenario against the total amount of productive agricultural land that could be lost.

The New Zealand Land Resource Inventory includes 25 per cent of the area of the Auckland region in Land Use Capability Classes (LUC) 1, 2 and 3<sup>17</sup> (*“land of moderate to high value for primary production”*)<sup>18</sup>. This is a higher percentage than for New Zealand as a whole but about a quarter of this prime rural land in Auckland has already been urbanised and lost to production. In spite of this the Auckland region currently produces around a quarter of the nation’s vegetables. It is therefore important to protect these fertile soils not just for economic reasons, but also to maintain a resilient and secure food supply for Auckland and the rest of New Zealand.

### *Evaluation*

The Evaluation Team considered the following information (Table 4, Table 5 and Figure 28), which show a comparison of greenfield development in the scenarios and Class 1, 2 and 3 land.

**Table 4 Hectares of productive rural land lost**

LUC Class	Scenario 1 (ha)	Scenario 4 (ha)	Scenario 5 (ha)	Total in region (ha)
LUC 1	9	9	32	3,588
LUC 2	1,130	1,130	11,914	53,524
LUC 3	322	322	6,185	64,650
Total	1,461	1,461	18,131	121,762

<sup>16</sup> Parsons Brinckerhoff, 2009, ASSESSING THE Costs of Alternative Development Paths in Australian Cities, by Roman, Trubka, Peter Newman and Darren Bilsborough, Curtin University Sustainability Policy Institute Fremantle.

<sup>17</sup> Auckland Regional Council, Auckland Regional Policy Statement, 1999, Chapter 12, page 1.

<sup>18</sup> Auckland Regional Council, Auckland Regional Policy Statement, 1999, Appendix D, page 39.



The information considered clearly shows that the Expansive Scenario results in the greatest loss of productive rural land; almost 15 per cent of the regional total is lost. Of the three LUC classes, Class 2 is worst affected, followed by Class 3. Class 1 land is marginally affected losing less than one per cent. The Compact Scenarios result in the loss of only around one per cent of productive land and therefore score neutrally. The Expansive Scenario therefore scores as a moderate negative.

	Scenario 1	Scenario 4	Scenario 5
Protection of productive rural land	0	0	xx

### *Conclusion*

The Compact Scenarios urbanise a minimal amount of productive rural land. In contrast the Expansive Scenario has a significant impact, affecting over 18,000 hectares, some 15 per cent of the region's productive land.

All scenarios have considerable growth in or around Pukekohe and this could affect Class 1 land to the west of the town (although much of Pukekohe's growth is currently planned for the east). Avoiding Class 1 soils should be ensured which means managing the direction and extent of growth in Pukekohe. It was noted that there is actually little land of Class 1, 2 or 3 around in the Dairy Flat area which is urbanised in the Expansive Scenario.

In some parts of the region much fertile land has already been taken out of agricultural production and is used for countryside living, although where good soils exist the future opportunity for productive use remains.

## 6.9 Energy resilience

This criterion provides a response to concerns about Auckland's reliance on fossil fuels particularly in relation to transport and the energy resilience issues that this raises; namely how easily will the region be able to respond if there is a threat or disruption to the city's energy supplies.

Auckland relies on energy from outside the region to power the city, 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 were considered in this assessment:

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

The issues relating to reducing greenhouse gas emissions have been 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 was noted that transport accounts



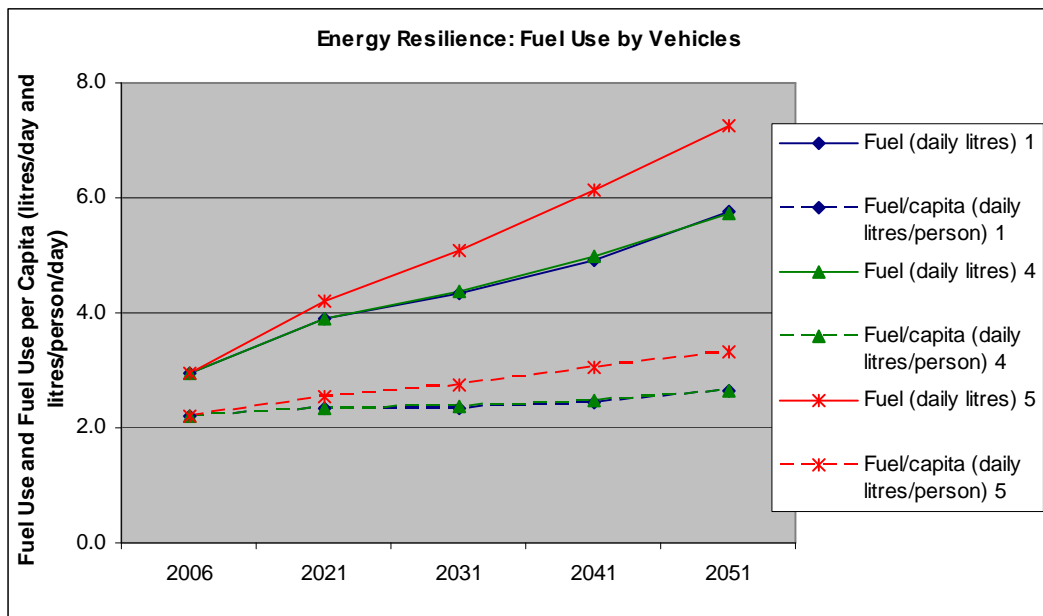
for 56 per cent of energy usage in the Auckland region<sup>19</sup>. Potentially, Auckland's reliance on imported oil makes us vulnerable to price volatility and security of supply. Given this significance, this aspect of the criterion was used as the basis for the overall scoring.

The other aspect of this criterion that is noteworthy is consideration of domestic energy (electricity) usage and how the scenarios perform in terms of minimising consumption (or reliance) on energy sources. Commentary on this is provided as part of the analysis.

### Evaluation

Looking at the transport component, fuel use by vehicles has been estimated from model outputs and fuel use rates for each of the scenarios from 2006 to 2051. This provides an indication of the relative dependence each of the scenarios has on fuel usage for transport.

Figure 29 Energy resilience fuel use by vehicles 2006- 2051



All scenarios show an increase in fuel use and fuel use per capita above the 2006 levels. In the case the Compact Scenarios, the increase is approximately following the same trend of increasing fuel usage, while the Expansive Scenario has a significantly higher increase over the time period until 2051. This would indicate that the Expansive Scenario has greater reliance on fuel usage and accordingly less energy resilience, Figure 29, above, illustrates this for fuel use and fuel use per capita. This assumes that new technology does not replace the dominance of fossil fuels during this timeframe.

Considering domestic energy usage, there are a number of areas identified as contributing to this including: urban form, embodied energy in infrastructure design,

<sup>19</sup> Regional Energy Database, ARC, 2008.

dwelling typologies and construction. No modelling outputs were able to provide a guide for the assessment of this aspect of energy resilience; however qualitative comment was received from the Regional Climate Change Working Group (Attachment 4 Section 4.1). This group indicated that the more intensive scenarios, with a compact urban form, provided greater energy efficiency opportunities through co-location and intensification of services. They also indicated that there were energy efficiencies in the building typologies that are associated with the more intensive scenario, including less embodied energy and heating costs because of design and construction.

The evaluation considered 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 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.

However, the Evaluation Team commented that some 50 per cent of the future housing stock already exists. They considered that the greatest opportunities for energy efficiency gains would be in the redevelopment opportunities that this existing housing stock presents (ie replacement of existing housing stock with more efficient design and construction models). From this perspective Scenario 1 would involve significant redevelopment within centres requiring the replacement of much of the existing stock within these areas, whereas the suburban areas would remain largely unchanged. In the same way, Scenario 2 would result in additional infill and some redevelopment within centres with replacement to a lesser extent than in Scenario 1, whereas Scenario 5 would see little redevelopment of existing stock with new growth occurring beyond the current urban area.

The scores, below, reflect that while all the scenarios had higher fuel usage than is currently the case, Scenario 5 was significantly worse in the outcomes it produced.

	Scenario 1	Scenario 4	Scenario 5
<b>Energy Resilience</b>	<b>x</b>	<b>x</b>	<b>xx</b>

### *Conclusion*

All scenarios showed an increase in fuel use and fuel use per capita above the 2006 levels. The Compact Scenarios increase similarly. The Expansive Scenario shows much greater increase over time, indicating a greater reliance on fuel usage and accordingly less energy resilience.

A number of areas 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.

## 6.10 Feasibility from current market perspective

This criterion considers the feasibility of the scenarios from a current 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 workshops and discussions with a group of independent market commentators from private sector property firms, the development industry and real estate (refer to Attachment 4 Section 4.20 for the full discussion). The market commentators were as follows:

- Ascari Partners
- Bayleys Real Estate
- CB Richard Ellis
- Jones Lang LaSalle
- McCormick Rankin
- Property Economics.

It is important to note that the consultation exercise with the market commentators occurred at the early stages of the global economic slowdown in 2008/9. The information gained is therefore predominately based on a pre 2009 market outlook.

A separate piece of work was commissioned for the Futures Project in order to provide a high level analysis of the likely impact of the global economic recession on the Auckland region. This report concluded that, amongst other things, one of the main drivers of New Zealand's recovery from the downturn will be a modest increase in both residential and non-residential construction activity<sup>20</sup>. In Auckland *"this will be on the back of the improvement in residential construction to meet an increase in housing demand and a shortfall in housing supply in the region"*<sup>21</sup>.

Given the relatively short lived impact of the economic downturn compared with the 2051 horizon of the Futures Project, the pre 2009 market opinions are still deemed valid.

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<sup>20</sup> Infometrics Ltd, May 2009, The Impact of the Global and National Economic Recession on the Auckland Region (for Auckland Regional Council), page 5.

<sup>21</sup> Infometrics Ltd, May 2009, The Impact of the Global and National Economic Recession on the Auckland Region (for Auckland Regional Council), page 6.

### *Evaluation*

The Evaluation Team considered the market feedback and provided a number of sub-scores for the elements that might be required in any successful future urban form. The overall score for this criterion was drawn from the discussion of the sub-scores.

The main points raised by the market commentators are as follows:

- The dwellings and employment capacities contained in the more intensive scenarios are unlikely to be achieved, except for in a few main centres such as the CBD.
- Concern was raised about the proportion of multi-unit dwellings required in the intensive scenarios. There was a strong view that total housing choice in the region needs to contain significant standalone housing as well as apartments.
- There are difficulties in acquiring and agglomerating land into parcels large enough to achieve the economies of scale required for intensification.
- The attractiveness, in terms of accessibility and amenity, of a centre is a significant driver for its intensification.
- Growth in multi-unit apartments is unlikely to occur unless there is a strong price differential between these and stand alone dwellings.
- The current shortage of land for Group 1 business activities needs to be addressed. Future Group 1 greenfield sites need to be protected from alternative development.
- There is strong demand for industrial growth in the south of the region from businesses with a national or international focus. To the north, future industrial growth is likely to be more focused on meeting local demand.

An analysis of centres was also provided looking at factors such as development momentum, local amenity, provision of supporting infrastructure; land ownership patterns and proximity to transport routes (see Attachment 4 Section 4.20 for the full ranking). From this it is suggested that business intensification potential is more selective than residential and that the CBD, CBD Fringe and Newmarket probably have the most potential for dwelling intensification.

Most, although not all, high potential areas are on the isthmus. Sequencing of development will generally follow concentric rings from the central area along main corridors and in other centres where there is good amenity and accessibility. For example, in the west, New Lynn is likely to develop before Henderson simply because it is closer and more accessible to the CBD. Centres are more likely to appeal to property developers than corridors as a residential intensification option. Lower socioeconomic areas are less economically feasible for intensification (generally due to poorer amenity and accessibility).

Large format retail shopping areas can undermine intensification potential in nearby centres, for example Sylvia Park has undermined Manukau City Centre's attractiveness

as a retail centre. Individual developers have a significant impact on how Auckland develops - if one developer invests in a particular area others tend to follow.

From the market commentators' perspective, important elements for a successful future urban form were identified as:

- Strong growth of business and residential in the CBD and CBD Fringe areas.
- Residential growth in those corridors that originate in the CBD and/or exhibit good amenity and accessibility.
- A good balance of regional supply between stand alone dwellings and multi unit dwellings.
- Residential and business growth focused in centres that are able to be supported by good transport and other infrastructure.
- Growth capacities below those contained in the more intensive scenarios.
- Good amenity in and around centres.
- Additional greenfield land for future growth of Group 1 business sectors.
- Identification of additional Group 1 business land predominantly in the south of the region.
- Sequencing of growth in centres is undertaken in a way that reflects a propensity for the market to develop in concentric rings from the CBD.

The sub-scoring for the elements that might be required in any successful future urban form is as follows:

Market Feasibility Criteria	Scenario 1	Scenario 4	Scenario 5
Strong CBD and Fringe	✓✓	✓✓	✓✓
Residential corridors and amenity	✓✓✓	✓	0
Balance of standalone dwellings	xx	xx	✓✓
Centres supported by transport and infrastructure	✓✓	✓	✓
Growth thresholds below S1.1	xxx	xx	✓
Additional greenfields	0	0	✓✓
Group 1 land in south	0	0	✓✓✓
Feasibility from current market perspective	xx	xx	✓✓

*Overall score:*

	Scenario 1	Scenario 4	Scenario 5
<b>Feasibility from current market perspective</b>	<b>xxx</b>	<b>xx</b>	<b>✓✓</b>

*Conclusion*

The market commentators expressed a clear preference for Scenario 5 because this provides the closest to a business as usual approach and is most familiar to both developers and the market. However they also provided valuable insight into some of

the critical success factors that could facilitate intensification. The challenge for the future Spatial Plan will be harnessing the market to deliver the desired urban form.

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 would all be required.

## 7 Environmental Wellbeing

Environmental wellbeing is defined by the environmental outcomes the community wants to achieve. The ARC's Long Term Council Community Plan 2009-2019 (LTCCP) identifies these as a desire to respect and conserve the region's special places, and to protect and restore the diversity of native species and habitats.

The RGS identifies regional outcomes relating to environmental values in terms of implementing growth. It aims to promote the protection and maintenance of the character of the region's natural environment including water quality, coastal environment, air quality and habitat. A range of principles are identified for evaluating regional growth alternatives:

- maintain or improve water quality in all catchments,
- maintain and enhance high-quality indigenous habitats, especially those in proximity to Significant Natural Areas and Values<sup>22</sup>, during (re)development,
- recognise and maintain qualities of identified highly valued coastal environments (the sea, islands, marine reserves, shoreline, harbours and estuaries) during (re)development,
- integration of land use and transportation reducing the need to travel by car, ie locating housing and community facilities near passenger transport.

In addition, urbanisation should be avoided in the most highly valued and sensitive areas in respect of water quality and coastal environments such as estuaries, harbours and wetlands.

Land use has a direct impact on the region's receiving environments through discharges to air (transport, industry, domestic fires) and through stormwater runoff carrying contaminants and sediment. The construction stage creates the most significant impact from sediment runoff, but ongoing effects occur as a result of impervious surfaces.

The models were not set up to provide specific information on environmental impacts. Therefore assessment of the environment is based on qualitative analysis is 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 (for example air quality monitoring results) where this is available (see Attachment 4 for qualitative assessments).

### 7.1 Summary

The environmental assessment of scenarios is based on sensitivity or risk from development on receiving environments (air, streams, harbours, estuaries and

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<sup>22</sup> Significant Natural Areas and Values are described in Appendix B of the Regional Policy Statement, July 1999.

terrestrial). 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.

Environmental wellbeing has been measured using the following criteria:

Criteria	Scenario 1	Scenario 4	Scenario 5
Reduced greenhouse gas emissions	x x	x x	x x x
Protection of or enhancement of marine values	x	x	x x x
Protection or enhancement of stream corridors	x	x	x x x
Identify, protect and enhance terrestrial ecosystems	x	x	x x x
Avoidance of hazards	x	x	x x
Improved air quality (impact on public health)	x x	x x	x
Improved water quality (impact on public health)	x x	x x	x x x

### *Conclusion*

The scenarios were developed taking into account the region's environmental values and constraints, with highly valued areas and sensitive catchments avoided. The environmental evaluation assumes good quality urban design, and best practice approaches in regard to mitigation for all scenarios. However, the impact on environmental criteria worsens for all criteria compared with 2006 because of the scale of growth and assumptions that current policy and practice would continue.

All scenarios score negatively with the Expansive Scenario performing worst in all but the improved air quality criterion. Performance of Scenarios 1 and 4 are scored the same as they have the same urban footprint and similar population concentration.

The scores suggest that where possible it is best to avoid development in catchments and areas that are not currently developed and are in relatively good shape. 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.

Best practice would require greater investment in infrastructure to manage effects of stormwater runoff into receiving environments, and would need to include policy responses around Low Impact Urban Design. However, this would not avoid the adverse effects from land disturbance that would be considerable under the Expansive Scenario and less so in an already impacted urban environment under the Compact Scenarios.

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 sprawl.

## 7.2 Reduced greenhouse gas emissions

Reduced greenhouse gas (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 the ASF, RPS, Regional Plan: Air, Land and Water Plan, RLTS, and the Civil Defence Emergency Group Plan. 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> (Figure 30). Total emissions increase most significantly reflecting the scale of population growth and the increases in vehicular travel and levels of congestion. Per capita emissions increase to a much lesser extent.

The Expansive Scenario performs worst, with emissions significantly higher than the Compact Scenarios. Total CO<sub>2</sub> emissions double between 2006 and 2041 and per capita emissions increase by about 40 per cent. This increase in emissions is a

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<sup>23</sup> ARC, State of the Environment Report 2010.

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

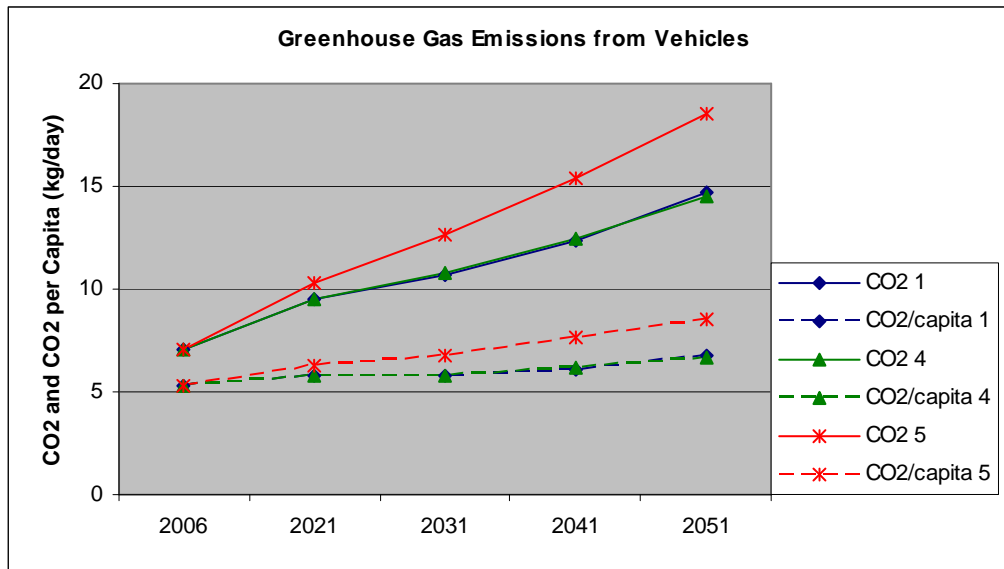
<sup>25</sup> ARC, 2009, Issues and Options: Climate Change, page 12.

<sup>26</sup> CO<sub>2</sub> emission rates are from the ARC's Vehicle Emissions Projections Model (VEPM v2.3). The rates vary by speed and vehicle type (car, categories of heavy commercial vehicle) and fuel type (diesel, petrol), and decline over time to year 2030 to reflect improving technology, and are constant thereafter.

reflection of both increased vehicle kilometres travelled and higher congestion as illustrated in Section 5.2.2, with greater investment in roads than in PT.

The Compact Scenarios perform better than the Expansive Scenario, increasing to a lesser extent. Total CO<sub>2</sub> and per capita emissions under the Compact Scenarios increase by 75 per cent and 20 per cent respectively, starting to level out more after 2021. This is reflective of the lower amount of vehicle travel occurring.

Figure 30 CO<sub>2</sub> emissions from vehicles



In addition to consideration of the model output, feedback was sought from the Regional Climate Change Working Group on how scenarios performed in terms of reducing GHG emissions (see Attachment 4 Section 4.1). It was a concern of the group that the model assumptions on increasing vehicle ownership and vehicle use made it difficult for the scenarios to reduce GHG emissions from transport. A quality, compact urban form supported by the provision of a multi-modal transport system including active modes would reduce reliance on using private vehicles for transportation and therefore see a reduction in car ownership. It was expected that these changes would positively affect the emission of GHGs.

Importantly, none of the scenarios, including the transport networks that support them, will come close to achieving the central government’s targets of reducing CO<sub>2</sub> emissions. However, the Compact Scenarios perform less poorly.

Based on the model outputs and the comments from the Regional Climate Change Working Group, the Evaluation Team scored all scenarios negatively because emissions are supposed to be reducing from 2006 not increasing. While all scenarios are bad, the Expansive Scenario is identified as the worst. Scoring reflects the model outputs of transport related CO<sub>2</sub> (Figure 30).

	Scenario 1	Scenario 4	Scenario 5
Reduced greenhouse gas emissions	xx	xx	xxx

### *Conclusion*

Transport related CO<sub>2</sub> emissions will continue to increase for all scenarios above 2006 levels, even accounting for the advent of more efficient fuels and improved vehicle technologies. Land use policy alone will not deliver a reduction in GHG emissions.

Travel demand by private vehicles will increase in response to a growing population; the consequences of this growth will depend on the development of effective and robust transport policy at national, regional and local levels. The Climate Change Group indicated that policy interventions will be required to play a significant role in moving away from carbon-intensive travel patterns; such as infrastructure and service delivery, good urban design, road/parking pricing mechanisms, travel demand management and update of new technologies. The ability to deliver these interventions will be severely undermined through expansive land use approaches that favour greater urban sprawl.

## 7.3 Protection 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, and include harbours, estuaries and terrestrial habitat adjacent to the coast.

Assessment of this criterion is based on sensitivity or risk from development proposed to the marine receiving environment – harbours, estuaries and terrestrial. The emphasis of the evaluation is on the effects of urbanisation, recognising that the most significant effects occur during development particularly in areas that are currently undeveloped.

### *Evaluation*

A qualitative assessment was carried out by the ARC's Environmental Policy Team with consideration of the following information:

- Regionally Significant Marine Receiving Environment Project.
- Auckland Regional Plan: Coastal maps series defining coastal protection areas.
- Auckland Regional Policy Statement maps showing environmentally significant marine areas sensitive to water quality degradation and other impacts.

Overall the level of threat to marine receiving environments is assumed to increase as urban development increases regardless of mitigation measures. The basic issue considered was the degree to which the scenarios might compromise the value of the marine receiving environments or expose them to risk of significant damage or adverse effects. A "High risk" would generally mean that a marine receiving environment contains features of ecological value that are vulnerable to the threats they are exposed to from the land use scenario (see Attachment 4 Section 4.2 for the full assessment).

Marine ecological features of value are identified in the qualitative assessment on marine values and include habitat, vegetation, linkages between marine and landward ecosystems. All marine ecosystems contain elements that are vulnerable to the threats from urban development. Impacts are from sediment release during development, contaminants post development (via stormwater runoff), and changed hydrology.

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 scenarios are all scored negatively.

The Compact Scenarios would increase risks to those environments already degraded inside the MUL through intensification. However, the 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 some areas exhibiting particularly high marine ecological values (eg Whangateau harbour near Omaha).

The Expansive Scenario would impact on the following regionally significant areas that are outside the MUL and therefore currently avoided:

- Lower Okura estuary
- Whangateau harbour
- Manukau harbour area to north of Karaka.

	Scenario 1	Scenario 4	Scenario 5
<b>Protection of or enhancement of marine values</b>	<b>x</b>	<b>x</b>	<b>xxx</b>

*Conclusion*

All scenarios result in development that would increase risks to highly valued marine environments. Therefore the scenarios are all scored negatively. The Compact Scenarios have the least impact on marine values by avoiding urbanisation within areas not currently affected by development.

The Expansive Scenario focuses new growth around coastal locations and in low energy and vulnerable environments (eg Manukau Harbour north of Karaka and Whangateau Harbour). Even with best practice and mitigation of effects (which increases costs of development) risks to marine receiving environments will increase.

It is possible though that greenfield development could avoid locations around the most sensitive environments to reduce adverse effects.

## 7.4 Protection 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 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 the most relevant indicators of impact on stream corridors. Therefore 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 receiving environments.

### *Evaluation*

A qualitative assessment was carried out by ARC's Environmental Policy Team and considered the relative differences in:

- Contaminant sources (stormwater runoff from roofs, roads, paved surfaces, construction).
- Infill provisions.
- Impacts in relation to stream disturbance and stream channels.

Refer to Attachment 4 Section 4.3 for the full assessment.

Currently impervious surfaces cover 42 per cent of the urban area<sup>27</sup>. All scenarios will increase the amount of impervious surface areas compared with 2006 and therefore get worse.

The Compact Scenarios minimise disturbance of non-urban land by intensifying existing urban areas. Impacts on urban streams from increased infill, which are highly modified, are considered to be minimal. While impacts on the affected urban stream corridors would continue to be degraded, those streams outside the urban areas would be protected by avoiding development within their catchments.

The Expansive Scenario is scored worst as it increases the urban footprint by 50 per cent compared with the Compact Scenarios, with impervious surface areas increasing accordingly. In this scenario there is also the greatest potential land disturbance in non-urban areas, with potential impacts on rural and urban stream form and hydrology likely to be highest. A number of streams that are of excellent or good quality (invertebrates and/or water quality) would be directly affected, ie Mahurangi, Puhoi, Waiwhiu, Hoteo, Awarere, West Hoe, and Nukumea.

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<sup>27</sup> ARC, 2010, State of the Environment report for the Auckland region.

	Scenario 1	Scenario 4	Scenario 5
Protection or enhancement of stream corridors	x	x	xxx

*Conclusion*

Growth in the Expansive Scenario will affect extensive stream corridors through a number of undeveloped catchments. If growth can be directed away from the stream corridors, adverse effects would be lessened.

The Compact Scenarios generally avoid stream corridors identified as excellent or good quality by intensifying within the existing urban area where streams are already degraded.

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 Expansive Scenario and less so in an already impacted urban environment under the Compact Scenarios.

## 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 including estuaries and wetlands.

Land use has a direct impact on terrestrial ecosystems through the encroachment of development and clearance of vegetation and habitat. Coastal forest and wetlands are identified as threatened New Zealand ecosystems and have been depleted to circa three and four per cent respectively of their original extent in the Auckland region.

The emphasis of evaluation is on the likely risk development will affect significant natural areas and whether they can be mitigated.

*Evaluation*

A qualitative assessment using available ecological data was completed by ARC's Heritage Team and considered<sup>28</sup>:

- recommended areas of protection;
- sites of high conservation value;
- sites of natural significance;
- sites of significant wildlife interest;
- significant natural areas; and

<sup>28</sup> Analysis did not consider the presence of threatened species and relied on available ecological survey information.

- LENZ threatened environments.

Refer to Attachment 4 Section 4.4 for the full assessment.

In general, urban development (intensification within existing urban and new development within rural areas) is likely to result in adverse effects including:

- 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 intensification there will be more pressure on them so even the Compact Scenarios will be worse than 2006. In the Compact Scenarios more people will be accessing remnant terrestrial ecosystems within the MUL with increased pressure resulting in negative effects.

Under the Expansive Scenario many of the areas identified for growth are in close proximity to sensitive terrestrial environments of important native and coastal bush remnants and wetlands.

Development in the Whangateau harbour catchment is of particular concern as this harbour is identified as being arguably the region's most valuable mainland estuary. This harbour is already significantly impacted and intensification would further affect the ecosystem and should be avoided.

Of particular concern under the Expansive Scenario is the requirement for a bridge at Karaka. The coastal shell bank and intertidal flats provide important wading bird habitat. Construction in this area would disrupt this habitat and birds are likely to move to the other side of the harbour next to the airport putting them at risk.

Therefore the extent of potential adverse effects on the terrestrial ecosystem under the Expansive Scenario were considered to be significant compared with 2006 and the Compact Scenarios.

	Scenario 1	Scenario 4	Scenario 5
Identify, protect and enhance terrestrial ecosystems	x	x	xxx

### *Conclusion*

Areas of high ecological value are protected in every scenario but with more intensification there will be more pressure on them. Therefore all scenarios are worse for terrestrial ecosystems.

The Compact Scenarios perform better than the Expansive Scenario because they avoid urbanisation of significant natural areas which are located outside the MUL. 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.

## 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, 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.

With the continual growth of the Auckland region, the RPS identifies that it is important that public authorities recognise the risk from natural hazards and undertake co-ordinated responses to ensure the long term reduction in risk posed to the region (risk = consequence x likelihood). The RPS aims to keep development away from hazards, rather than hazards away from people.

The evaluation focuses on people's exposure to existing hazards; where there are fewer people exposed the risk is lessened. The assumption is that development would occur in accordance with the region's current regulatory mechanisms, but any residual risk would still need to be managed. While community or infrastructure resilience was discussed, scoring was not based on these factors.

### *Evaluation*

An assessment of the scenarios was completed by ARC's Hazards Team and considered information on coastal flooding and erosion, surface and river flooding, land instability and storm surges (see Attachment 4 Section 4.5).



There is uncertainty regarding how future climate change will influence the frequency and magnitude of natural hazards in the Auckland region. It is possible that climate changes could alter environmental processes governing natural hazards identified in growth areas. For instance, future sea level rise could have significant implications on low-lying coastal areas both within and outside the existing MUL. Ministry for the Environment (MfE) guidelines suggests taking into account a half metre (0.5 metres relative to 1990 sea levels) sea level rise when developing on the coast by 2100. This will be part of the National Environmental Standards to be produced by MfE.

Climate change effects on sea level rise would exacerbate coastal erosion and flooding issues currently experienced at a number of urban centres, particularly those located along the eastern coasts of Rodney District (RDC) and North Shore City (NSC). Sea level rise will also have further implications for inland areas exposed to river or surface flooding. An increase in water levels along lower river reaches will widen the floodplain and expose more land to flooding.

When development occurs in an area of identified hazard, there is an attempt to mitigate as many of the effects as possible. However, as with any risk there is always a residual risk that will need to be managed. Therefore scoring by the hazards team reflects the ability of a community to deal with the residual risk, which is lessening the impact on the lives of residents.

Redevelopment of some business/industrial areas within all the scenarios are currently constrained by existing council restrictions on development that may preclude any further increase in capacity. An example is the Wairau Valley industrial area of NSC, much of which is sited within a 100 year event floodplain.

The Compact Scenarios increase the risk of more people being exposed to existing hazards because development is concentrated within the MUL and are therefore scored worst. However, the probability of a new or existing hazard threat is not likely to increase and scenarios are therefore scored neutrally in this regard. Increasing density and infrastructure will significantly increase the consequences of a hazard event, with smaller events causing greater consequences.

Expansion will increase exposure of residential development and infrastructure to new hazard threats outside the MUL. However, risk will be dispersed risk 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. Increased population will require measures to be undertaken to increase community resilience.

	Scenario 1	Scenario 4	Scenario 5
<b>Avoidance of hazards</b>	<b>x</b>	<b>x</b>	<b>xx</b>
<i>Avoidance of new hazards</i>	<i>0</i>	<i>0</i>	<i>xx</i>
<i>Exposure to existing hazards</i>	<i>xx</i>	<i>xx</i>	<i>x</i>

### *Conclusion*

The Compact Scenarios increase the risk of exposure to existing hazards within the metropolitan urban area. The risk of exposure to new hazards would increase in the Expansive Scenario, but the Compact Scenarios would remain the same as in 2006. Because the Expansive Scenario increases the risks of exposure to new hazards in areas not currently inhabited it performs the worst.

To facilitate intensification in the Compact Scenarios considerable infrastructure investment would be necessary within areas of existing hazards (ie Wairau Valley). However, the Expansive Scenario would need to mitigate effects on new hazards also requiring infrastructure investment.

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.

## 7.7 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.

Air quality is affected by the use of land and by discharges of contaminants into air or onto land from that use. Adverse effects on air quality can be exacerbated by land use, such as the inappropriate location of activities that are discharging contaminants into air or the inappropriate location of parties sensitive to activities that discharge contaminants into air (reverse sensitivity).

In terms of ambient air pollution in the Auckland urban areas the main sources are identified as motor vehicles and domestic fires resulting in Volatile Organic Compounds (VOC), Nitrogen Dioxide (NO<sub>2</sub>), and Fine Particulates (PM<sub>10</sub>) emissions. The RLTS's main target for protecting and promoting public health is to reduce the number of exceedences<sup>29</sup> of health standards for Nitrogen Oxide (NO<sub>x</sub>), and Particulates (PM<sub>10</sub> and PM<sub>2.5</sub>).

Poor air quality can seriously affect human health, amenity and the environment. Air pollution is identified in the ARC's State of the Environment Report as costing the region at least \$547 million per annum in health effects.

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

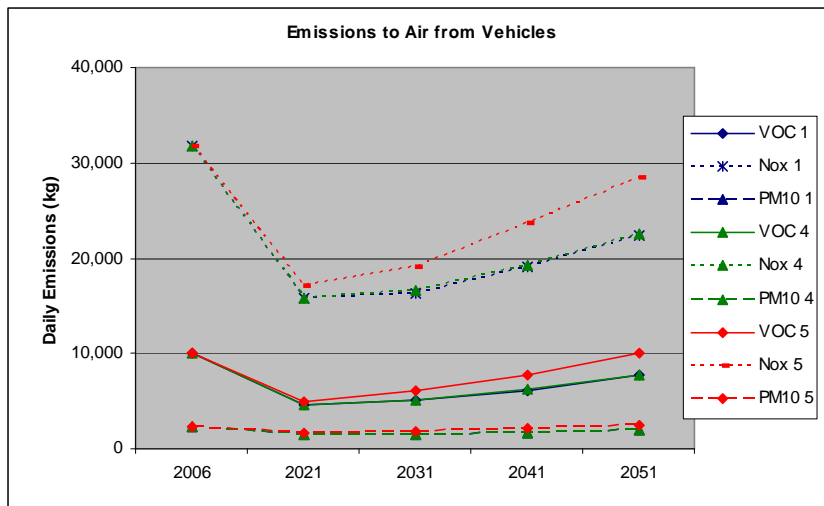
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<sup>29</sup> Refers to exceedences of the National Environmental Standards.

## Evaluation

Model outputs and emission rates<sup>30</sup> are used to estimate region-wide daily vehicle emissions of volatile organic compounds (VOC), nitrogen oxide (NO<sub>x</sub>), and particulates (PM<sub>10</sub>).

Figure 31 Emissions from vehicles



Overall the scenarios show an improvement (ie a decline) over 2006 in the quantity of emissions to air from vehicles by 2041 (Figure 31). A significant improvement occurs from 2006 to 2021, followed by a steady worsening (ie increase) over time. Initial improvements reflect investment in transport network (PT and roads), the effects of TDM non-pricing initiatives, and changes in vehicle technology. After 2021 these have lesser impact and the effects of population growth and increased vehicle travel predominate.

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.

The qualitative assessment considers the scenarios against current air quality levels within the Auckland region. Air quality levels within the MUL (Auckland Airshed<sup>31</sup>) are already degraded and the air shed exceeds the National Environmental Standards (NES) for PM<sub>10</sub> and NO<sub>2</sub> several times per year. These elevated levels cause significant health impacts within the airshed.

The qualitative assessment was based on a number of assumptions for all scenarios:

- No new solid fuelled domestic fires for new households or existing households.

<sup>30</sup> Emission rates are from the ARC's Vehicle Emissions Projections Model (VEPM v2.3). The rates vary by speed and vehicle type (car, categories of heavy commercial vehicle) and fuel type (diesel, petrol), and decline over time to year 2030 to reflect improving technology, and are constant thereafter.

<sup>31</sup> An airshed is 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.

- Only clean, low polluting passenger transport available and a significant increase in passenger transport patronage.
- Separate freight routes are utilised, with clean, low polluting heavy duty transport vehicles, with freight movements diverted as much as possible to rail and sea.

Under current policy it is not possible to meet the NES because emissions from transport and domestic fires are not controlled. It is expected that there would be more exceedences of the national air quality standards in 2041 because of the significant population growth. This will result in more people being exposed to poor air quality. Even if current air quality stays the same, there would be more people exposed to it so the situation will be worse than 2006. Therefore all scenarios are scored negatively.

The Compact Scenarios perform worst due to a larger population located within the Auckland airshed increasing exposure to unacceptably high levels of air pollutants, although concentrations may stay the same. Therefore the number of health related deaths would increase. There are few options for reducing people's exposure to air pollutants or effects as there are no land buffer distances. No additional business land is identified to provide for heavy industrial activities, and because the Auckland airshed already exceeds the NES some industries may not be permitted to locate within the urban area. Furthermore, some existing industrial areas would become unsuitable due to the close proximity of increasing residential populations and associated reverse sensitivity issues.

Air quality would worsen in the Expansive Scenario because people travel greater distances, off-setting any reductions made in transport emissions from cleaner private vehicles. There would also be a decrease in air quality within new settlement areas, as ambient air quality is currently very good (Warkworth, Silverdale and Dairy Flat, Drury, Karaka). Warkworth in particular experiences poor air quality because SH1 traffic intersects at a location at the bottom of a valley. Increased vehicle numbers coupled with topographical and meteorological characteristics in the area will make these effects worse. However, population is dispersed, increasing the size and scale of airsheds and poor air quality, but limiting the number of people in any one area exposed to unacceptably high levels of air pollutants. Therefore in terms of exposure to poor air quality, this scenario performs better than the Compact Scenarios.

Nearly all airsheds would need to be amended, some airsheds may be expanded (ie Auckland airshed) and others incorporated,<sup>32</sup> which could create similar problems for industry as the Compact Scenarios. However, additional business land is identified outside the current MUL, which could provide potential areas for heavy industry to locate outside the current Auckland airshed.

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<sup>32</sup> The effect of airsheds being incorporated is that currently the airshed classification does not allow for an assessment of localised impact; rather all the levels get included in one airshed which defaults to the poorest air quality levels across the entire airshed. This is a significant problem for the Auckland airshed covering an extensive area.

	Scenario 1	Scenario 4	Scenario 5
Improved air quality (impact on public health)	xx	xx	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 policy team consider it likely that air pollution levels within the Auckland airshed will 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 very significant reductions in emissions from mobile sources (in particular motor vehicles) and domestic fires.

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 Expansive Scenario 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.

The main issue for the Compact Scenarios is that more people are exposed to the same or worsening air pollution levels and there is a greater risk of reverse sensitivity.

Improvements in industrial technology are not expected to significantly improve air quality as this sector currently only equates to around 10 per cent of pollution. Transport contributes most significantly to air pollution, with domestic fires being another key contributor. Therefore air quality improvements would need to focus on these sectors.

## 7.8 Water quality and human 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 by ARC’s Environmental Policy Team and considered the scale of stormwater effects in terms of exposure to the greatest number of people. For example, intensification of existing urban areas will generally reduce the average stormwater environmental footprint per person for all persons in the region because on average intensification will lead to lower areas of roofs, roads, and paved surfaces and fewer vehicles per person. Also considered were the relative positions of the scenarios on the scale of stormwater loads, potential for stormwater treatment, and effects on receiving environments.

The focus of 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*

Ministry for the Environment guidelines on microbiological water quality for marine and freshwater recreation areas provide the basis for determining whether areas are safe swimming or shellfish gathering. Councils monitor the water quality in accordance with these guidelines. A standard response is that there should be no swimming within 48 hours of heavy rainfall, or near stormwater outlets, as stormwater is often contaminated with wastewater overflow due to combined stormwater and sewer pipes.

Significant investment in stormwater and wastewater infrastructure is underway in Auckland and mitigation measures are expected to be put in place with future growth (eg Project Care; NSC's 20 year project being undertaken to reduce wastewater overflows into marine environments on east coast beaches and improve stormwater quality).

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.

The main shellfish collection areas are outside the MUL and will be most affected by the Expansive Scenario as most new growth is along the coast. No discernable difference is anticipated by the location of growth although there may be some localised cultural issues (eg Maraetai).

The Compact Scenarios have the smallest region-wide spatial 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 MUL, 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.

Conversely the Expansive Scenario has the greatest region-wide spatial extent of stormwater effects on water quality and the greatest level of effects on receiving environments not presently affected, but with minimum additional effects on already affected urban streams and estuaries. 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. However, this scenario is also considered to have the greatest opportunity to provide effective stormwater management. While this would address ongoing stormwater effects, there would still be substantial impacts at the construction phase of development.

A number of areas in the Northern Expansion Area were identified as being particularly vulnerable to development. The semi-pristine Whanagateau Harbour at Omaha would be negatively affected due to sedimentation caused by development, and would be in conflict with the Whanagateau Action Plan which aims to maintain the high quality of this harbour. Expansion at Mahurangi West would further degrade the already partially

degraded Mahurangi Harbour due to sedimentation caused by development process. This would be in conflict with the Mahurangi Action Plan which aims to halt, slow or reverse the adverse effects of sedimentation on the Mahurangi Harbour. Expansion Areas at Waiwera and Puhoi would lead to localised degradation in these estuaries due to sedimentation caused by development.

	Scenario 1	Scenario 4	Scenario 5
<b>Water quality and human health</b>	<b>xx</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. The Compact Scenarios have maximum additional effects on already affected urban streams and estuaries with minimum options for mitigation, but will have limited effect on receiving environments beyond the MUL. Conversely, the Expansive Scenario has 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.

The cultural implications of water quality are considered under cultural wellbeing – preserving the mauri (Section 9.4).

## 8 Social Wellbeing

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>33</sup>. 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 social infrastructure is important because 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.

At a regional level, the ASF reflects the importance of social wellbeing most clearly in its long term goal of “*a fair and connected society*”. To achieve this goal a range of strategic responses are identified including:

- healthy affordable homes,
- access to jobs and essential services in disadvantaged neighbourhoods,
- reduce and avoid geographic concentrations of deprivation,
- lifelong opportunities for people to participate in education, training and employment,
- enable everyone to be actively involved in communities.

To reflect the ASF goal, the social wellbeing criteria focus on accessibility and housing as fundamental aspects of social wellbeing, in which access to housing, employment, retail, health, and education is critical.

### *Demographic changes*

Projected demographic changes relate to age and household size. By 2051, 20 per cent of the regional population will be aged 65 years and over - compared with 10 per cent in 2006<sup>34</sup>. This equates to a trebling in the number of older people in Auckland. There will be changing needs in relation to social infrastructure in the future, particularly as population ages.

The median age will rise from 33.7 to 40.9 years. Ageing will be more pronounced in Pakeha and European groups, less so in Maori, Pacific and Asian groups due to higher fertility rates and current age structure.

While the proportion of children five to 19 years old will decrease compared with 2006, the number will increase by approximately 93,000 children between 2006 and 2051. This increase will have implications for schooling, and may require new ways of

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<sup>33</sup> Ministry of Social Development, Social Report (2008) as reported in Royal Commission on Auckland Governance, Volume 1, Part 3 Vision for Auckland.

<sup>34</sup> ARC Populations Projections Model.



delivering schools (eg multi-level schools) and access to open space and recreation facilities, particularly in central areas in the Compact Scenarios.

By 2031, the average household size is projected to decline from 2.9 to 2.6<sup>35</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.

### *Accessibility*

The vision of the RLTS is for a transport system where getting around by all modes of transport is integrated, safe and effective; people have choices which enable them to participate in society, especially those most disadvantaged. The RLTS focuses on improving the ability of people to get around easily, affordably and reliably, with travel options to get to work, places of education, shops, recreation and other destinations (Objective 3).

Improved accessibility is a fundamental criterion within the evaluation, including separate criteria relating to general accessibility, accessibility for deprived households, access to local employment opportunities and improved levels of physical activity. It is included within the social wellbeing as it provides a measure of how the population is able to participate in society by accessing 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.

### *Housing*

The RGS identifies housing choice and affordability as a very important regional outcome, seeking improved housing choice and affordability throughout the region. In evaluating growth alternatives the RGS identifies the following principles to be applied:

- Enable people and communities to meet their basic needs of shelter, safety, health, education, cultural expression, income, recreation and leisure, to facilitate the health and safety of present and future communities.
- Enable a regional growth pattern which can provide a range of housing choice by type, affordability and location.
- Intensive centres and corridors to provide a range of dwelling types and densities including mixed-use development activity where appropriate.

The model represents the housing market by assuming all housing is rented and it counts dwelling floorspace, not numbers of dwellings. The amount of floorspace per household can vary between model zones and years. It calculates rents for every zone for dwelling floorspace for every modelled year – in this case 2006 to 2051. Household incomes increase by one per cent per annum to reflect growth over time (real household income). If households cannot afford the rent then they rent less

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<sup>35</sup> Statistics New Zealand Household Projections.

floorspace, therefore more households may be located in an area than the capacity provided for.

## 8.1 Summary

Social wellbeing has been measured by the following criteria:

Criteria	Scenario 1	Scenario 4	Scenario 5
Improved accessibility	✓✓	✓	x
Improved accessibility for deprived households	✓✓	✓	0
Housing Choice	✓	✓	✓✓
Ageing in place	✓	✓	0
Greater housing affordability	x	x	xx
Improved levels of physical activity	✓✓	✓✓	✓
Improved access to local employment opportunities	0	0	xx

### *Conclusion*

In many cases proxy measures are used as an indication of how the scenarios perform against the criteria. Qualitative information from the social perspectives workshop, focus groups and discussion with individual stakeholders was also considered, along with some limited international evidence, where relevant.

The Compact Scenario concept of a strong network of centres, and in particular many smaller centres, potentially provides benefits in terms of ageing in place, opportunities for physical activity (active modes), and social cohesion, as well as supporting local and sub-regional accessibility for the general population and for deprived households. This concentration of population can increase the efficiency of community based services and provide the required thresholds for regional specialist facilities.

The Expansive Scenario has lower regional accessibility and access to local employment opportunities than the other scenarios. However, it is considered to provide greater housing choice and have less impact on worsening housing affordability. This scenario is considered neutral in terms of access for deprived households and ageing in place.

In terms of greater housing type and location, the Expansive Scenario is considered to perform best because while the range of housing types would be similar to 2006 the choice of locations is much more extensive including both the existing urban area and a range of coastal and rural locations. However, there would need to be specific additional policy responses to ensure housing supply meets demand (including affordable housing).

For a number of criteria it was concluded that 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). Non-land use policies, such as education, affordable housing, health, income support, superannuation and welfare policies play a significant role.

Different kinds of risks were apparent in the different scenarios. For example, stronger competition for limited space in the Compact Scenarios, but potential for dormitory, isolated and poorly serviced greenfield areas in the Expansive Scenario.

## 8.2 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.

The model provides information on the opportunities for travel, the outputs being the percentage and number of opportunities, for both PT and car, within 30 and 45 minutes of residential location. More specifically, the evaluation of this criterion places emphasis on:

- 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.

Information is also provided on generalised costs; the sum of time and monetary 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 information extracted from the model shows the weighted average of car and PT generalised costs of travel in the AM peak and the interpeak periods. General accessibility is measured by average generalised costs weighted by the trips made.

Overall the weighting of the evaluation was on accessibility opportunities, in particular those within 30 minute timeframes. The exception to this being opportunities to travel to employment by PT, where a 45 minute timeframe was considered on the basis that people would be willing to travel for a longer period to access greater employment opportunities.

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 32 shows that the number of employment opportunities by car increases over 2006 levels, with a clear order to the scenarios. Scenario 1 provides the most opportunities followed by Scenario 4, with Scenario 5 providing the least opportunities. The Expansive Scenario illustrates an increase in opportunities until 2021 followed by little change over the remaining period until 2051. In contrast the Compact Scenarios continue to show an increase in travel opportunities by car over the whole period to 2051.

Figure 32 Employment opportunities by car - within 30 minutes<sup>36</sup>

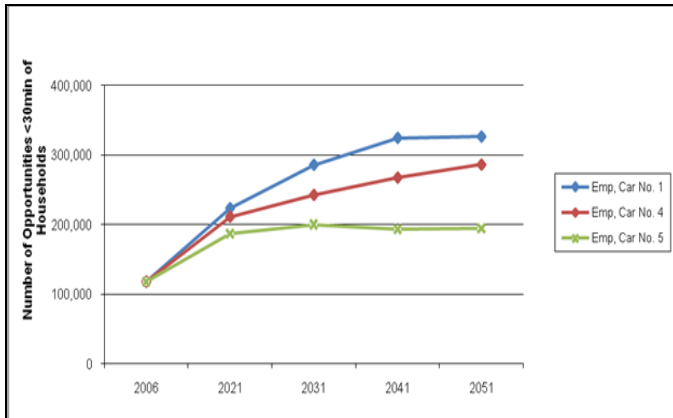
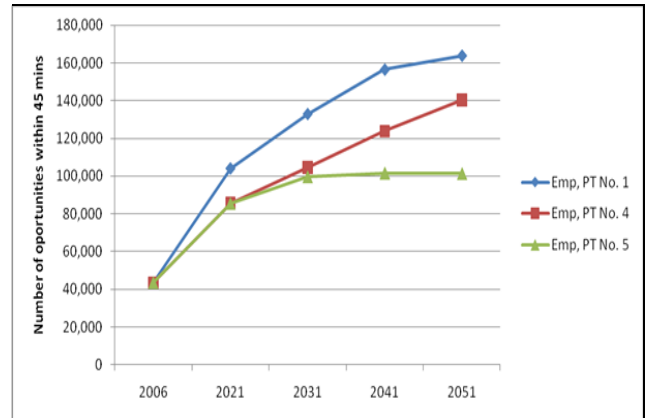


Figure 33 Employment opportunities by PT – within 45 minutes



Employment opportunities by PT, within 45 minutes (Figure 33) have similar patterns to those by car; increasing opportunities for all scenarios, with the Compact Scenarios having greater opportunities. Again for Scenario 5 the number of opportunities levels out by 2031 whereas for the other scenarios they continue to increase. The 45 minute timeframe for PT accessibility provides a significant increase in employment able to be accessed compared with a 30 minute timeframe (see Appendix 2- Figure 65).

Figure 34 Retail opportunities by car and PT – within 30 minutes

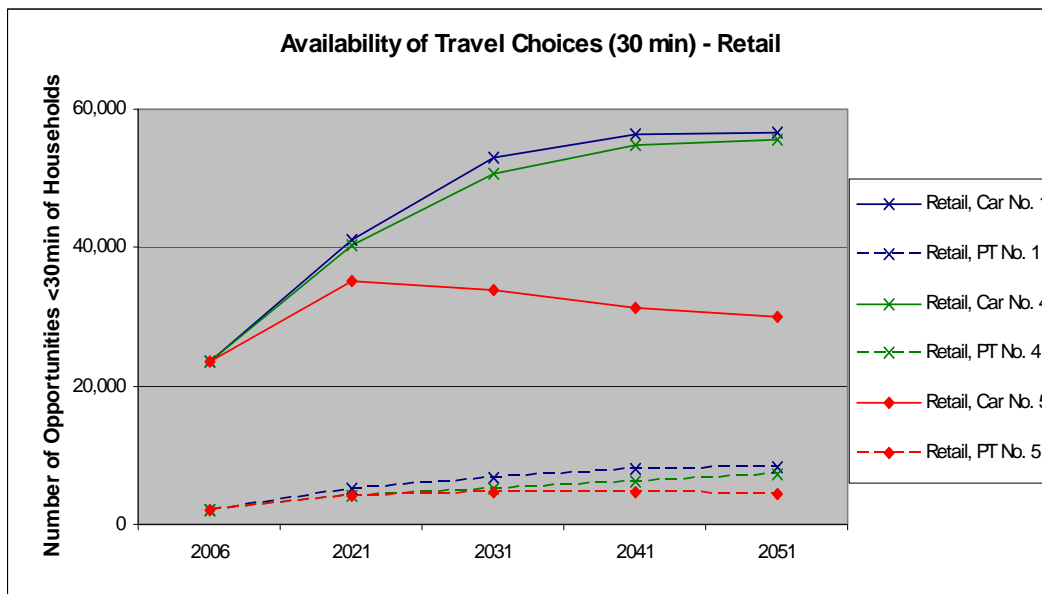


Figure 34 shows the number of retail opportunities, within 30 minutes, by car and PT. The scenarios all show an increase in the number of opportunities over 2006 levels. Scenario 1 and 4 opportunities by car are very similar and continue to increase over time. For Scenario 5 the number of opportunities by car initially increases then declines, from 2021 onwards. The Evaluation Team indicated that while the depiction

<sup>36</sup> Information on opportunities to access employment by car within 45 minutes and by PT within 30 minutes is contained in Appendix 2 Figure 65 and Figure 66.

of employment was reasonably accurate, for Scenario 5 the large modelling zones do not depict the retail centres well.

Information on accessibility to regional health and tertiary education facilities, for both 30 and 45 minute timeframes, is contained in Appendix 2. This shows that in 2041 the number of opportunities is similar to 2006 for the Compact Scenarios. Conversely, for the Expansive Scenario, the opportunities are similar for travel by PT but opportunities by car gradually decline from the 2006 levels because of increasing congestion.

Information on the opportunities, for employment (car only), retail, tertiary education and regional health facilities, by car and PT, within 45 minutes is presented in Appendix 2.

The generalised costs of travel, as weighted averages for cars and PT, are illustrated in Appendix 2 Figure 74. For cars, costs increase over time in all scenarios. Scenarios 1 and 4 have similar increases in their cost profiles. Scenario 5 has the greatest increase in average costs from the 2006 baseline. In terms of PT, for Scenarios 1 and 4 the AM peak costs remain relatively stable at the 2006 level however, for Scenario 5 these costs increase over time. Looking at the interpeak period, all scenarios have higher costs than in 2006, with those of Scenario 5 being the highest by a significant amount. The average (PT and car) general accessibility shows an accessibility pattern which is similar to that of cars alone; as cars have the much greater mode share.

	<b>Scenario 1</b>	<b>Scenario 4</b>	<b>Scenario 5</b>
<b>Improved accessibility</b>	✓✓	✓	✗
<i>Opportunities</i>	✓✓✓	✓✓	✓
<i>Generalised Cost - Car</i>	xx	xx	xxx
<i>Generalised Cost - PT</i>	0	0	xx

### *Conclusion*

Improved accessibility is a fundamental criterion within the evaluation. It is included within the social wellbeing as it provides a measure of how people are able to participate in society by accessing 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 criteria (Section 8.7) and the local employment opportunities criteria (Section 8.8), and as well as other criteria relating to the economic wellbeing. Improving accessibility could improve the performance of other aspects of city life.

The evaluation points to the better performance of the Compact Scenarios for social wellbeing. While all scenarios show an increase in opportunities to employment and retail the Compact Scenarios provide the greatest increases. This will be related to both the form of the Compact Scenarios, with population located closer to jobs, and their better accessibility, as shown by higher average vehicle speeds (see Section 5.2.2). However the Expansive Scenario, with its dispersed form clearly provides the lowest increase in accessibility. Again, when looking at accessibility to regional health

facilities and tertiary education the Compact Scenarios show increased accessibility whereas for the Expansive Scenario 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 Expansive Scenario. For PT the picture is different with the more Compact Scenarios maintaining 2006 costs in the AM peak, while having increasing costs in the interpeak period, whereas the Expansive Scenario has cost increases in both periods.

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.

### Box 1 - 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>37</sup>.

Regardless of the form of growth, additional social infrastructure will need to be provided to service the local community. No assumptions are made about new regional social infrastructure in the scenarios. Provision of social infrastructure will vary depending on the catchment size to be serviced: from regional, city/sub-regional, town and local centres down to neighbourhood level.

Discussion of social infrastructure is relevant as this improved accessibility criterion serves as a proxy for accessibility of social infrastructure. Much of the qualitative commentary related to accessibility was concerned with the provision of social infrastructure, including notes from a social infrastructure workshop and focus group, feedback from the Waitemata District Health Board, comment from the Ministry of Education and a report on tangata whenua values.

Service providers, commenting as part of a focus group, considered that education and health facilities can be drivers for development and used to support the desired urban form. The decrease in access to regional health facilities may be explained as new facilities are not introduced into the model over time, however in reality new facilities will 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. While intensive development may assist in providing efficient service delivery and provide thresholds to support specialist regional facilities it must be remembered that these facilities generally require large sites, which can be difficult to achieve in an intensified urban form.

The provision of new facilities, in locations that can be easily accessed, particularly by PT will be one of the challenges that face the service providers. Responses to the challenge may include new models that recognise the role of social infrastructure in shaping communities and places<sup>38</sup>, require less land, co-locate facilities on one site, provide a greater degree of forward planning and incorporate better integration with PT infrastructure.

Education feedback<sup>39</sup>, indicated that most commonly a “just in time” approach to delivering services is followed, although in some areas of the region a more proactive approach is taken of anticipating where new schools will be required. The implications of education provision are that particularly for scenarios based on intensification, and given the size/strength of the CBD this would mean exploring new ways of delivering schooling (eg multi-level schools and access to open space and recreation facilities).

Health feedback<sup>40</sup> indicated potential for more efficiency and accessibility for Scenario 1 because greater physical alignment between health services and concentrated populations was possible, though concerns about the cost of purchasing sites were noted. The converse was also stated; that Scenario 5 presented less efficiencies.

Access to Maori culture, through marae and educational facilities can be taken into account as part of the provision of social infrastructure. Throughout the region are marae that are based on communities, churches, educational institutes, these facilities cater for non-tangata whenua groupings.

<sup>37</sup> Social Infrastructure Planning Framework for Waitakere City, May 2007.

<sup>38</sup> Social Infrastructure can be seen as either leading and shaping development (eg community buildings, meeting space, community development coordination) or following population growth(eg some government services, early childhood, primary health care, community services) Source: Social Infrastructure Planning Framework for Waitakere City, May 2007.

<sup>39</sup> Feedback as part of the social focus group.

<sup>40</sup> Feedback from WDHB.

### 8.3 Improved accessibility for deprived households

This criterion is concerned with assessing whether the scenarios provide improved 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>41</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 an efficient passenger transport service, for these deprived households, is a key factor as it provides travel options; an alternative to reliance on vehicle ownership. For these reasons passenger transport accessibility was used as the evaluation measure for this criterion.

Figure 35 below, maps the most deprived areas (Deprivation Index 8 to 10) from the Deprivation Index in 2006. These show concentrations of deprivation particularly in western areas of Manukau, the outer isthmus and suburban Waitakere. Those zones with the lowest average household incomes are illustrated in Figure 36.

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.

Accessibility is measured in terms of generalised cost; this being the sum of time and monetary costs combined into a common unit (in this case minutes), for car this includes travel time, vehicle operating costs (petrol), parking and any tolls. 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

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<sup>41</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.



understand whether there were any differences in the way that accessibility improved or declined over the modelling period between the two groups.

Figure 35 Most deprived areas, deprivation index 2006

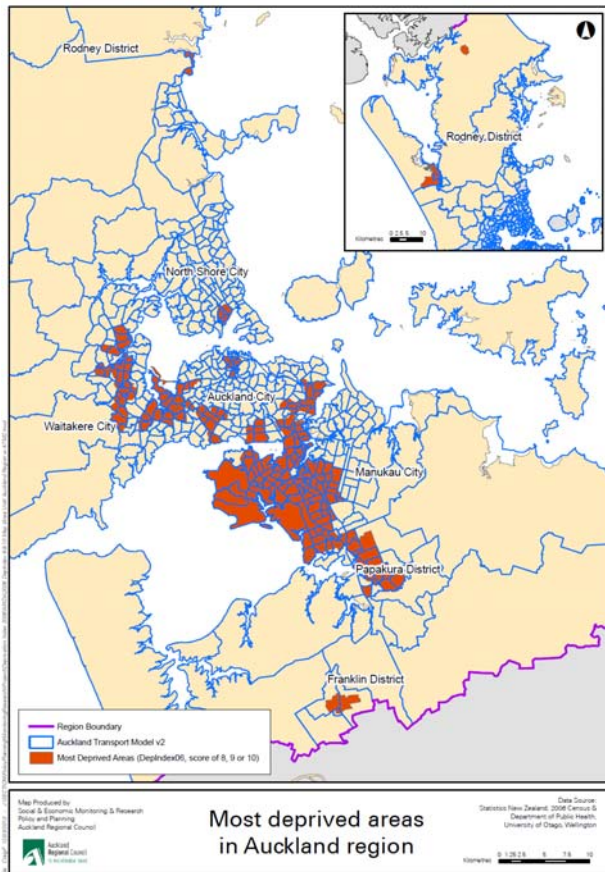
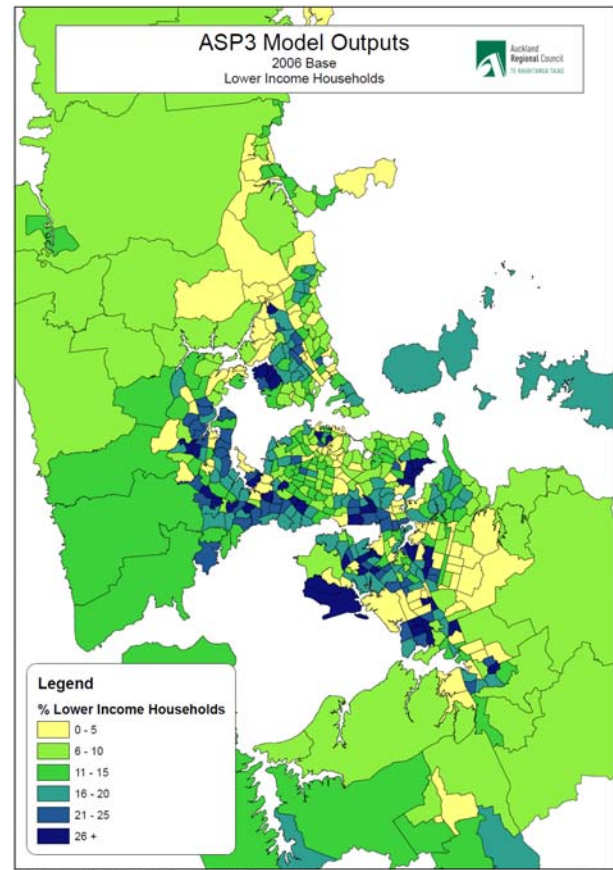


Figure 36 Lower income households 2006

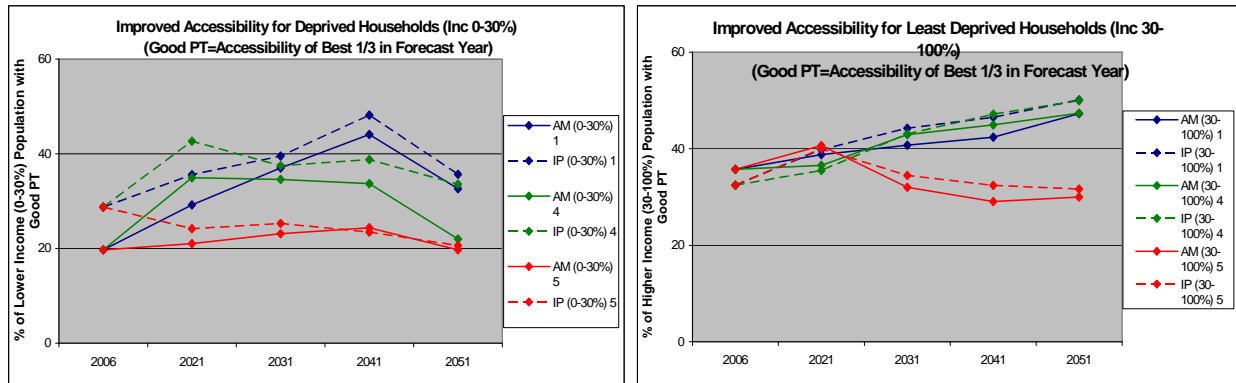


### Evaluation

Figure 37 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 Compact Scenarios in 2041 show improved accessibility over 2006, with Scenario 1 highest. Accessibility for the Expansive Scenario is similar to 2006. The evaluation centred on this approach.

Figure 37 Accessibility for deprived households (lowest income in forecast year) with comparison information for least deprived households



The modelling shows that deprived households have lower accessibility to passenger transport than non-deprived households and that over time improvements in passenger transport have benefitted non-deprived areas whereas the passenger transport services for deprived areas have stayed the same. Currently people who can afford to live close to good passenger transport services will do so; this appears to be a continuation of this trend.

Using low income as the proxy of deprivation, access to passenger transport shows the Compact Scenarios providing improved access for deprived households, while this remains a constant for the Expansive Scenario. The scores of the Evaluation Team generally reflect this pattern.

	Scenario 1	Scenario 4	Scenario 5
Improved accessibility for deprived households	✓✓	✓	0

### Conclusion

For deprived households the Compact Scenarios deliver improved accessibility while the Expansive Scenario maintains accessibility at the 2006 levels.

While the issues relating to general accessibility, discussed in Section 8.2, are relevant to deprived households, access to passenger transport 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 2051 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 however highlights that many of the areas shown as low income are those relatively distant from the CBD. The strength of the Regional 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 household’s definition. However siting of

facilities in association with growth centres and on passenger transport routes would be particularly relevant. Local employment opportunities could also improve outcomes.

Safe, convenient, accessible passenger transport also requires attention to urban design of passenger transport 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.

## 8.4 Housing choice

Greater housing choice relates to whether a scenario would provide for a greater range of housing types and locations than is currently provided (2006).

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.

This criterion was measured in terms of supply – by the mix of typologies (attached and detached dwellings) and also by location (urban area). In this way housing typology has been used as a proxy for greater housing choice. Current housing stock is dominated by detached housing (75 per cent). Therefore increased attached dwellings provides a greater range of housing types (flats, terraced housing, duplexes, low rise apartments, high rise apartments).

Whether a scenario provides greater housing choice will ultimately depend on the future demand, which is unknown. Demand is considered in terms of household type (number of adults and other aspects of housing demand, such as ethnicity and ageing). Demographic trends suggest that average household size will reduce to 2.6 by 2031, reflecting higher proportions of one-person households and couples without children in part because of an ageing population. This is likely to see increased demand for attached dwellings.

The emphasis of evaluation was on the range of housing types and locations available to choose from. It does not include affordability as this is addressed by Section 8.6, nor does it reflect that some people don't necessarily live in the type or location that they prefer. The baseline for determining greater housing choice was the type and location of housing stock in 2006.

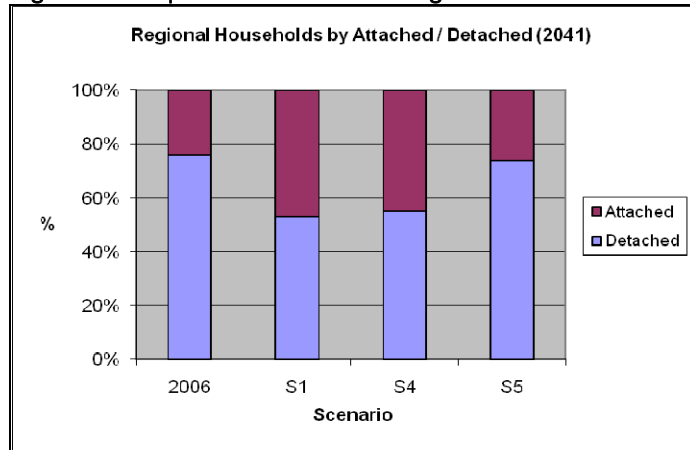
### *Evaluation*

Figure 38 and Figure 39 illustrate the supply of housing for each scenario by typology (attached/detached), as a proportion of total housing stock and in number of additional dwellings.

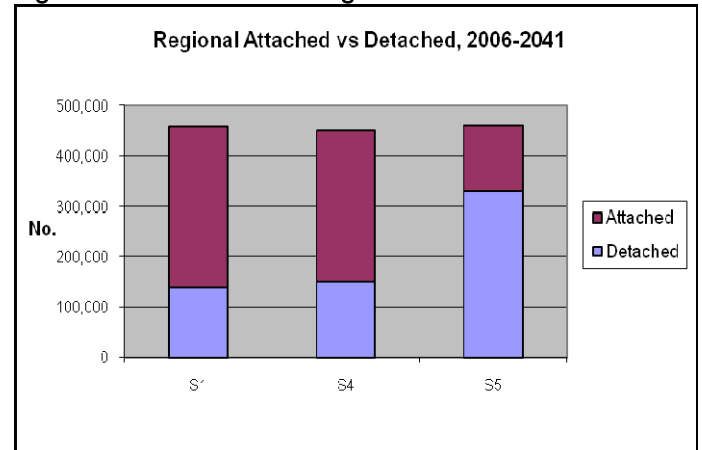
The total number of dwellings supplied by 2041 across all scenarios would be similar, but the range of housing varies between scenarios. The Compact Scenarios show a significant increase in attached dwellings built, increasing to around 45 per cent of total housing stock in 2041 compared with less than 30 per cent in 2006. The number of

detached dwellings grows in all scenarios, by around 150,000 in the Compact Scenarios and to 330,000 in the Expansive Scenario.

**Figure 38 Proportion of total housing stock**



**Figure 39 Additional dwellings**



People’s housing preferences have noticeably changed over the past 10 years, with a significant increase in demand for apartments in the CBD and numerous medium density developments throughout the region. This trend is expected to continue, and is likely to increase as a result of passenger transport network improvements, housing affordability issues, better urban design and standards for apartments.

All scenarios are scored positively because they provide the opportunity to provide a range of housing typologies (attached and detached dwellings). But only the Expansive Scenario was scored positively in terms of greater location choice. Therefore the Expansive Scenario scores most positively in terms of housing choice overall as it would provide a greater range of locations to choose from including urban and rural, compared with the Compact Scenarios that offer a greater range of housing types but focused in existing centres.

	Scenario 1	Scenario 4	Scenario 5
Housing Choice	✓	✓	✓✓
Type choice	✓	✓	0
Location choice	x	x	✓✓

*Conclusion*

In terms of greater type and location of housing, the Expansive Scenario is considered to perform best because while the range of housing types would be similar to 2006 the choice of locations is much more extensive including both the existing urban area and a range of coastal and rural 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 by 2031, especially attached housing. There will be a need for specific policy responses to ensure housing supply meets demand (including affordable housing).

It was noted that while some choice is provided by each scenario, they do not necessarily foreclose other options. For example, the Compact Scenarios can still provide expansion and the housing choices provided by that option in the future if necessary. Equally, the Expansive Scenario can intensify more within centres.

An implication of demand identified by the Evaluation Team is that if more people want to live in a location than can be catered for, the price goes up affecting affordability.

## 8.5 Ageing in place

The concept of ageing in place involves providing opportunities for people as they get older (65 years and over) to remain in their community; either in the family home, smaller homes, supported accommodation or residential care. Housing opportunities should also maintain existing social and community networks including access to local facilities such as shops, health and passenger transport.

By 2051, 20 per cent of the region's population will be aged 65 and over – three times the number of people in this age group in 2006. The ageing population is predicted to affect demand for housing, as well as labour supply, health and aged-care services. As the population ages the housing needs of elderly people is going to be an increasingly important issue.

The Centre for Housing Research, Aotearoa New Zealand (CHRANZ) recently commissioned research to better understand the implications for housing.<sup>42</sup> This research found that generally older people (over 60 years) prefer to stay in the same home or the same area.

Enabling ageing in place is measured by the number of different housing options available to older people within existing areas. As previously discussed, attached dwellings provide a variety of housing types, ie flats, terraced housing, duplexes, low rise apartments and high rise apartments. A scenario with a greater proportion of attached dwellings is considered to have a greater range of housing types, including additional detached dwellings and the housing provided by existing stock.

Wider housing choice in an area enables people, should they choose, to move through their life stages and stay in the same area close to local community networks including friends and family. Housing choice and affordability are discussed separately (Sections 8.4 and 8.6) and are closely related to ageing in place.

The focus of evaluation is on the "local area capacity" for development of different housing typologies (attached and detached). The Evaluation Team was interested in whether the market could provide for people to stay in the same area if they wished to do this, as opposed to providing opportunities in new locations. A key assumption is that where growth of attached dwellings is strong, there is a greater ability for elderly people to stay within the community as there would be a greater range of housing types within existing areas.

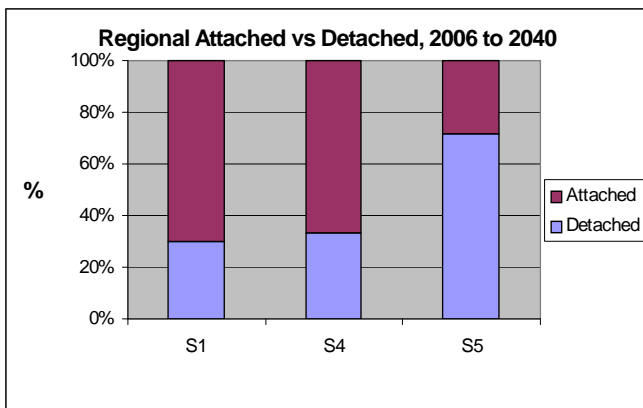
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<sup>42</sup> J Davey, V de Joux, G Nana, M Arcus. Accommodation Options for Older People in Aotearoa/New Zealand, CHRANZ (2004).

*Evaluation*

The model inputs identify different capacities for dwellings in the different areas across the region, as discussed in the comparison of scenarios in Section 3.5. These are then identified as being attached and detached housing typologies. Figure 40 illustrates that growth in the Compact Scenarios will largely be in attached dwellings, while the Expansive Scenario would be largely detached reflecting the greenfields urbanisation. The existing housing stock would remain largely the same, with redevelopment occurring largely in centres.

**Figure 40 Growth in dwellings 2006 – 2041**



**Figure 41 Uptake of housing capacity 2041**

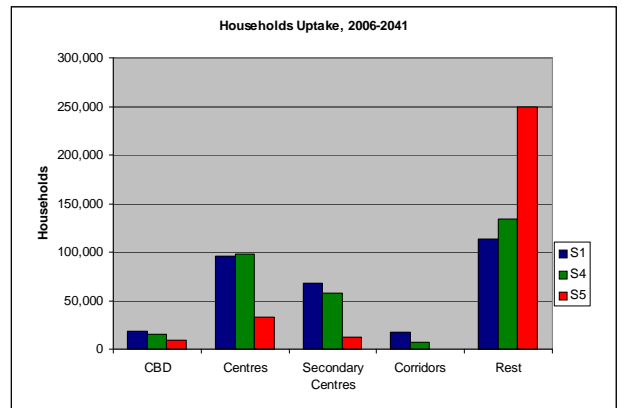


Figure 41 illustrates the model uptake of housing capacity by urban area (ie CBD, main centres); the rest identifies growth outside of these key areas, for compact cities this relates to infill development (suburbs) and for more expansive cities it relates to both infill and also greenfield development. Model uptake reflects demand as household types are allocated to dwellings.

The Compact Scenarios would experience greater growth in centres, and a greater increase in the overall range of housing types available within existing suburbs because growth is confined to existing areas resulting in intensification. Opportunities are therefore provided to downsize from the family home without having to leave the area. Scenario 1 has very concentrated growth and no infill, but will have more choice than today because of the increased proportion of attached dwellings. Scenario 4 provides for infill development which may provide some additional opportunities for housing models that are suitable for elderly, such as granny flats.

The value of providing a greater range of housing types in centres for ageing in place is highlighted by comments from the social focus group on the impacts of ageing. Impacts include loss of drivers' licences, the need for opportunities for walking and travelling only short distances to access services including healthcare.

Growth in the Scenario 5 would predominantly be detached family dwellings in greenfield areas, with a small amount of intensification occurring in centres, providing the least opportunity for choice of housing types in existing areas. Although the expansive model would provide for the elderly to move out to new growth areas where housing may be purpose built (ie retirement villages), this is likely to impact on

existing social networks and possibly reduced access to services (ie health and shops). This pattern of growth is similar to what is occurring currently and is therefore neutral.

	Scenario 1	Scenario 4	Scenario 5
Ageing in place	✓	✓	0

### *Conclusion*

The Compact Scenarios are considered to increase opportunities for elderly people to continue living in their existing communities, by providing a range of housing types. Supply of appropriate housing for elderly people would need to be supported by a range of policy responses. Vancouver provides an example of a city that specifically allows minor households (ie granny flats), attached to dwellings, providing a greater diversity than simply “attached” or “detached” dwellings.

It can be expected that ageing in place will create additional demand for attached housing typologies, providing for independent living in a mixed community. Such housing provides a sense of security and low maintenance within locations close to a range of community facilities.

## 8.6 Greater housing affordability

This criterion is designed to measure changes in housing affordability for households compared with 2006. In line with the RGS goals for affordable housing, this criterion relates to enabling all households in the region to live in housing that is affordable.

While it is generally accepted that affordable housing means a household is not required to spend more than 30 per cent of its gross income on housing costs<sup>43</sup> the model cannot provide this level of detail at the individual household level. The following model outputs relating to rent paid (where all housing is assumed to be rented) at the zonal level were used to evaluate affordability:

- total floor space available in the region,
- total rent paid per annum across the region,
- total rent per capita per annum,
- total rent per square metre (cost in 2006 dollars having removed the 1 per cent per annum household income growth),
- total per capita per annum for 20 per cent of zones with the lowest household incomes,
- total daily cost of rent and transport combined for the region.

The intention of the evaluation was to focus on the impact of housing costs on lower income households, because they tend to have less ability to absorb rental increases,

<sup>43</sup> Auckland Regional Affordable Housing Strategy (2003).

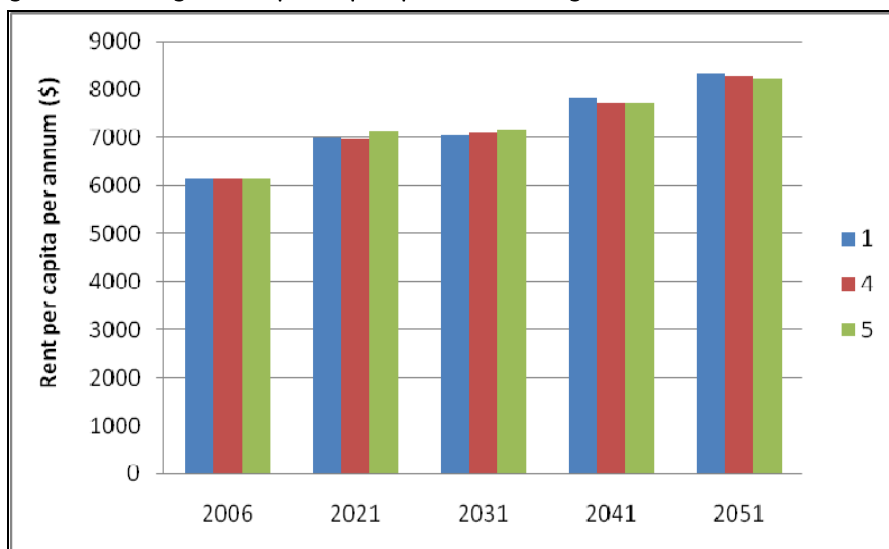
afford the cost of moving. However, the data provided by the model was unreliable. Therefore the focus is on average rents per capita across the region.

### Evaluation

The model represents dwellings in total floor space (square metres) and rent in dollars per square metre. If housing becomes unaffordable, the model reduces the amount of floor space allocated to a household until the rent it pays becomes more affordable or it has to move elsewhere.

Looking region-wide at rent per capita per annum, there is a gradual worsening of housing affordability for all scenarios over time (Figure 42). In 2041, the differences between scenarios in average rents is marginal, with Scenario 1 slightly higher (\$7,828) than scenarios 4 and 5 (approximately \$7,700).

**Figure 42 Average rents per capita per annum (region)**



Other model outputs considered also illustrate that the scenarios would all perform similarly (Appendix 2: Figure 75 to Figure 77). Using real rents (based in 2006 dollars) households in all scenarios would be spending more of their income on housing in 2041 compared with 2006, increasing from approximately \$130 per square metre to \$180 per square metre. Therefore housing affordability would deteriorate for all scenarios.

The Evaluation Team considered the impact of increasing rents on lower income households by looking at the average rent paid per annum for the 30 per cent of zones with the lowest average household income (Appendix 2 Figure 78). However, while affordability appears to be more of an issue for lower income households in the Compact Scenarios, there is significant uncertainty around this output because the rents paid are higher than the average across the region which is counterintuitive. This may be as a result of higher proportions of retirees in these zones, or the zones being in higher rent locations with high demand. Furthermore looking at those zones with the lowest incomes is not necessarily reflective of those paying more than 30 per cent of their incomes on housing.



The scoring of the scenarios is therefore based on the average rents per capita, showing that affordability deteriorates for all scenarios with no significant difference. Therefore the scenarios are all scored equally worse compared with 2006.

	Scenario 1	Scenario 4	Scenario 5
<b>Greater housing affordability</b>	<b>x</b>	<b>x</b>	<b>x</b>

To get a better idea of housing affordability, it can be instructive to look at the combined cost of housing and transport that household's face. These two factors together comprise the largest proportion of household expenditure (identified at 60 per cent in 2001 by Statistics New Zealand<sup>44</sup>). These costs are also most affected by housing location and urban form, where access to cheaper housing may result in increased transportation costs to access employment and social infrastructure. The combined costs of housing and transport are provided in Appendix 2: Figure 79, showing that when the daily transport costs are added to average rents the Expansive Scenario is slightly more costly.

#### *Conclusion*

The model outputs on rent paid indicate that affordability deteriorates for all scenarios similarly. An Expansive Scenario has little effect on housing affordability across the region despite the release of 50 per cent more land than the Compact Scenarios for urban development. This is supported by a recent review of the United Kingdom affordability model, which found that there may be limits to the extent to which affordability can be improved by further new dwelling construction. While the review found that increasing dwelling construction from 180,000 per year to 240,000 per year would improve affordability by approximately one per cent, increasing it to 290,000 per year saw even less improvement.<sup>45</sup>

It is clear from both the modelling results and international experience that housing costs will increase and housing affordability will decline as the region grows in any of the scenarios. The Compact Scenarios constrain land supply and rely more on housing intensification, and the Expansive Scenario supplies more land for housing. While it is argued that constraining land supply for new homes may push up housing prices, intensification can reduce the land costs per unit (lower rents) and provide affordable options within centres that have good access to transport (lower transport costs). The affordability of new greenfield housing in the 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 to travel to work.

The evaluation has looked at transport costs using the accessibility criteria (Sections 8.2 and 8.3) which determined that accessibility significantly improves compared with 2006 under a Compact Scenario. The lower transport costs (in terms of minutes) that would be experienced by the Compact Scenarios would start to offset housing costs

<sup>44</sup>Statistics New Zealand, Auckland Region Community Profile: <http://www2.stats.govt.nz/domino/external/web/CommProfiles.nsf/f5707c256626e5cc256d120011b32b/a90ad60ef7f3554acc256d31007ad0ab?OpenDocument>.

<sup>45</sup>Communities and Local Government UK – Recent developments in the community and local government affordability model 2008.

overall. Therefore when considering the combined costs of housing and transport a Compact Scenario would have greater affordability.

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. The model does not reflect the fact that rents may be higher in a particular area due to a lack of supply in a desirable location or because households are willing to pay more for a good location (the two are interrelated). Looking at rents across the region it is not possible to identify the subtleties of the housing market.

Housing policy in terms of both supply and demand drivers is important. The social workshop indicated that a policy response to, and provision of, affordable housing will be needed in all scenarios.

## 8.7 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. The model provides two outputs which provide an understanding of how the three scenarios perform in this regard, these are:

- Share of trips by active mode (walking and cycling) and by PT.
- Share of vehicle trips which are less than three kilometres, where three kilometres is seen as a short trip where there is 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*

There is a trend of improving share by active modes of transport (cycling and walking) combined with PT, for all scenarios; this is illustrated in Figure 43 below. This also demonstrates the clear order of improvement in active and PT mode share; with Scenario 1 having the highest mode share, and Scenario 5 having the lowest; with the profile of Scenario 4 being closer to that of Scenario 1 than Scenario 5. The share of trips by active mode (walking and cycling) and by PT combined is illustrated in Appendix 2: Figure 80. These graphs confirm the pattern of improved mode share is consistent for the individual modes for all scenarios over the modelling period.

Figure 43 Share of trips by active modes

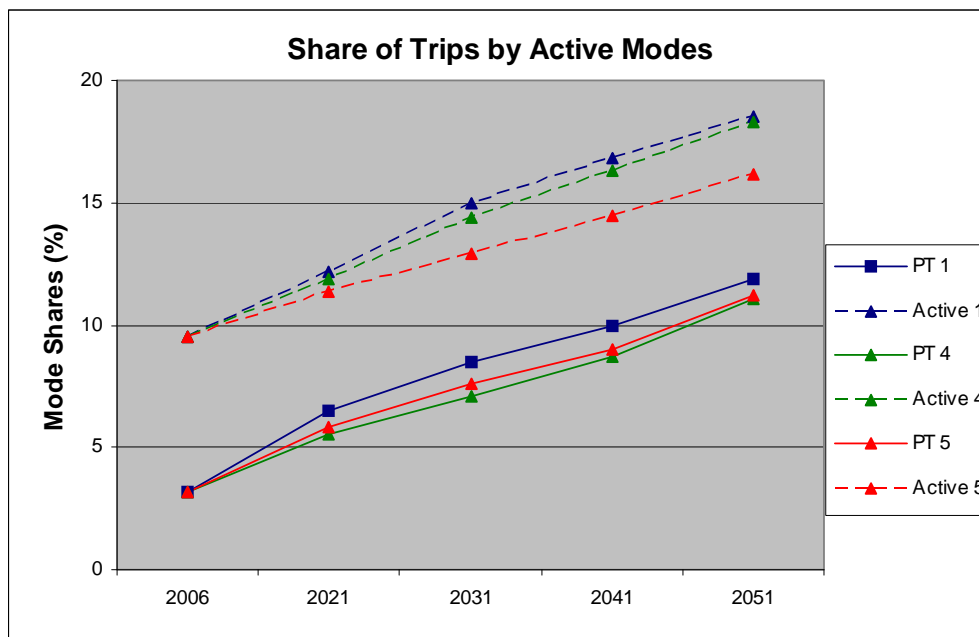


Figure 44 Improved levels of physical activity – share of trips shorter than 3 kilometres

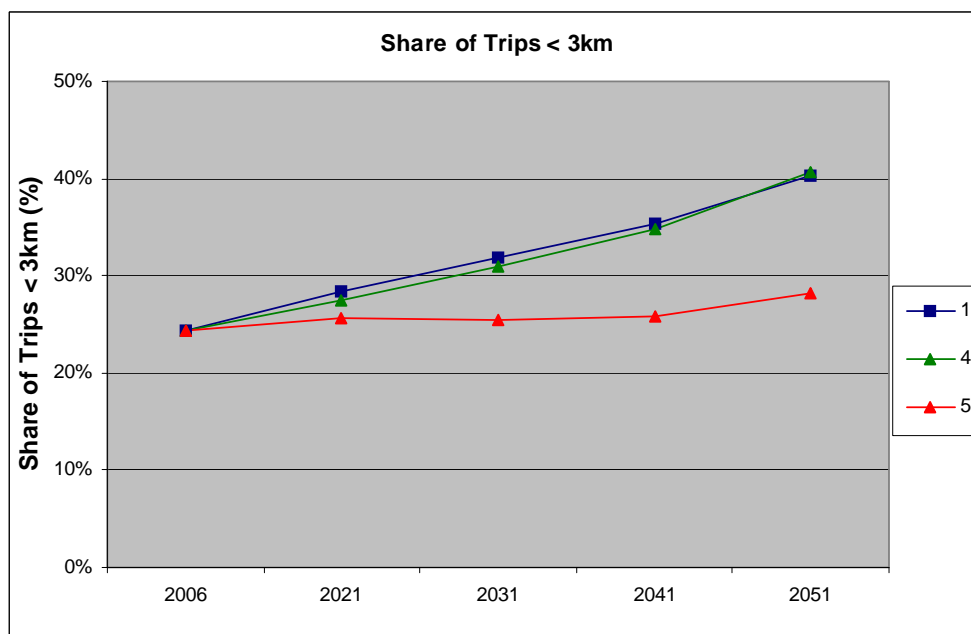


Figure 44 above, illustrates the share of short trips (less than three kilometres) by car and PT. Scenarios 1 and 4 shows similar increasing shares in these trips over time; these having a mode share of 25 per cent in 2006 increasing to 35 per cent in 2041. In contrast, Scenario 5, from the base mode share of 25 per cent in 2006, does not show any significant change in mode share over the period to 2051. This implies that for the Compact Scenarios (Scenarios 1 and 4) there is a greater potential for people to switch to active modes as part of their lifestyles. This is shown in Figure 44 above.

All scenarios provided greater opportunities to increase walking and cycling as part of daily travel routines and therefore improve levels of physical activity but overall, the differences between the scenarios are not significant.

However there are differences between the scenarios when taking into account the potential for switching short trips from vehicular transport to walking and cycling. The Compact Scenarios have more short trips because of their more intensive growth patterns; and shorter trip making on average; whereas in the Expansive Scenario it is less likely that the longer trip lengths would be substituted for more active forms of transport.

The Compact Scenarios therefore provide more potential for people to make lifestyle changes that could improve their physical activity levels and potentially their overall health.

	Scenario 1	Scenario 4	Scenario 5
Improved levels of physical activity	✓✓	✓✓	✓

#### *Conclusion*

All scenarios gave higher active and PT mode shares than in 2006, indicating increased physical activity as part of daily travel routines. However, the more Compact Scenarios (with a higher share of short trips, less than 3 km, provide a stronger basis for increasing the percentage of active trips undertaken in 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.

## 8.8 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 may vary across the region and by geographical sector. In this case the sectors have broad definitions aligning with the isthmus and the north, west and south areas of the region.

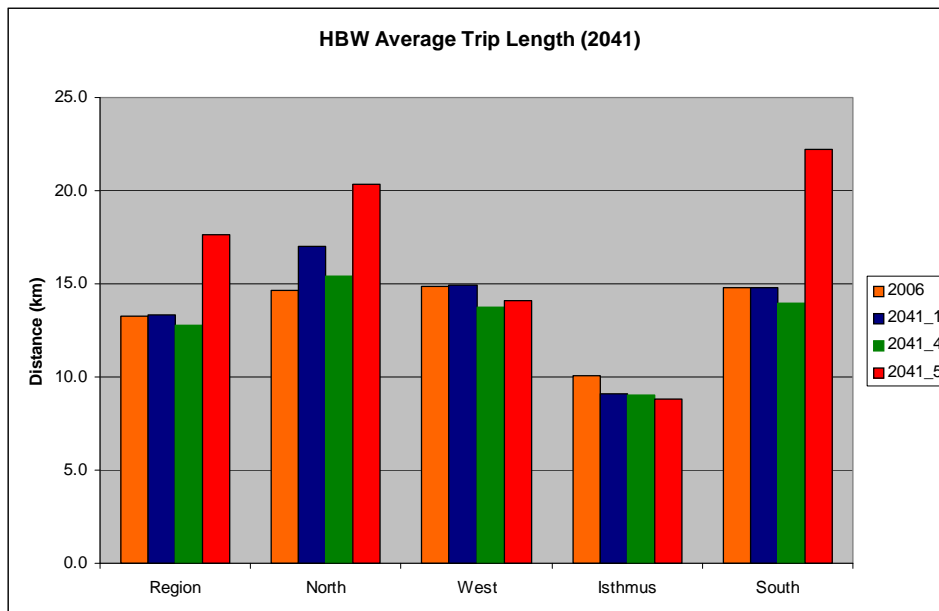
Improved access to local employment opportunities has been measured by:

- the average commuting trip length by sector; and
- commuting trip length distribution by sector.

In evaluating this criterion, weight was given to the highest average commuting lengths for the region and by sector.

## Evaluation

Figure 45 Improved access to local employment opportunities - average commuting trip length by sector



In 2041, the average commuting<sup>46</sup> trip length for the region is similar to that in 2006 for the Compact Scenarios (Figure 45). In contrast, for the Expansive Scenario it is higher by some 33 per cent. Looking at the sectors, for the isthmus and the western sector, the performance of all scenarios is slightly improved over the base 2006 figures. There are however more obvious differences in the average trip lengths from the northern and southern sectors where the average trip lengths for the Expansive Scenario are significantly longer than those of the more Compact Scenarios.

These trends are reinforced by the graphs showing the trip length distributions of commuting trips, by sector (see Appendix 2 Figure 81 to Figure 84). The graphs show clearly the increased proportions of longer commuting trips in the Expansive Scenario compared with the 2006 baseline and the Compact Scenarios. They also show the lower proportions of shorter trips for the Expansive Scenario. These trends are evident for the region as a whole and especially for trips originating in the north and south.

The social workshop indicated concerns about providing good accessibility to new business areas located on the fringe of the city, particularly for lower-skilled workers.

During the evaluation, consideration was given to the tension between providing for local employment opportunities and the desire to achieve increased regional productivity. In particular, this was seen as occurring in those employment sectors where concentrating activity leads to increased productivity through the benefits of agglomeration, notably business service sectors. A focus on creating or providing for local employment opportunities in dispersed locations was seen as mitigating against this.

<sup>46</sup> These commuting trips from home to work and back are referred to as home based work trips (HBW) within the model.

The evaluation concluded that the Expansive Scenario should be scored the lowest, giving weight to the fact that it has the highest average commuting lengths for the region and by sector. This is particularly the case in north and the south due to development in greenfield areas. Only for the isthmus and the west were the commuting trip lengths in the Expansive Scenario of a similar length to those of the Compact Scenarios. Additionally, the regional trip lengths show increased proportions of longer commuting distances for the Expansive Scenario. In contrast the average commuting trip lengths of the Compact Scenarios (except for Scenario 1 northern sector) are of similar lengths to the 2006 baseline.

	Scenario 1	Scenario 4	Scenario 5
Improved access to local employment opportunities	0	0	xx

#### *Conclusion*

The Compact Scenarios essentially maintain the same access to local employment opportunities as the 2006 baseline. However, the Expansive Scenario 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 in the case of Scenario 1 concentrating along the RTN which provides good linkages to the CBD and other significant employment centres.

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.

In common with other accessibility related criteria effective integration of land use and transport planning, particularly the provision of passenger transport, will be crucial to improving access to local employment opportunities. The RLTS provides policy and methods that would complement a land use based approach to improved accessibility.

## 9 Cultural Wellbeing

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>47</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 three criteria have been used to evaluate this wellbeing, these are:

- protection of cultural heritage, cultural landscapes and waahi tapu;
- economic opportunities for tangata whenua; and
- preservation of mauri.

These criteria take into account heritage which may have associations with a range of different cultures including European and Maori.

The specific criteria developed in relation to tangata whenua values acknowledge the ASF goal: Te puawaitanga o te tangata – self sustaining maori communities, and identifies as one of the shifts, in the way we think and act, to achieve our long term vision as being to:

- Acknowledge Mana whenua as the indigenous people of Tamaki Makaurau Auckland and recognise the significant role they play in sustaining the region. Accord value and celebrate Te ao Maori (the Maori world view, culture and values) as a core element of the region's identity.

In order to provide a basis for evaluating the specific tangata whenua criteria, a report from the ARC's Maori Relation's Team looking at tangata whenua values, was commissioned, this is attached as Attachment 4 Section 4.19. Those values with particular relevance to the spatial aspects being evaluated as part of this project include:

- Maori land holdings;
- Tangata whenua marae;
- Sites of significance; and
- Treaty settlement aspirations.

It is noted that the focus for this report was tangata whenua – those who have ancestral connections to the Auckland region, recognising that issues concerning the

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<sup>47</sup> Cultural Heritage Wellbeing What is it? Te Manatu Taonga Ministry for Culture and Heritage.

wider Maori population are to a large degree encapsulated in consideration of the other wellbeings; economic, environmental, and particularly social.

This report is prefaced by the understanding that while this project is looking at growth at the regional scale, from the Maori perspective the implications for particular hapu or iwi may vary at a local level; this points to the importance of involving tangata whenua in all stages of planning. There is also acknowledgement that the report does not set out to provide conclusions; rather it identifies key current and potential considerations that will enable Maori values to be considered in land use planning and decision making.

## 9.1 Summary

	Scenario 1	Scenario 4	Scenario 5
Protection of cultural heritage, cultural landscapes and waahi tapu	0	0	x
Economic opportunities for tangata whenua	✓	✓	✓✓
Preserving the mauri	x	x	xx

### *Conclusion*

The evaluation of the cultural heritage wellbeing highlighted that all growth scenarios present risks to heritage resources and that these risks will have to be managed by best practice, avoidance and mitigation. Mitigation of adverse effects on heritage has the potential to lower densities that are able to be achieved. This is the case in the intensification of town centres, in the more Compact Scenarios and in the Expansive Scenario, particularly, with its expansion into greenfield areas where there may be heritage sites. For these reasons the Compact Scenarios were scored neutrally while the Expansive Scenario scored negatively.

The impacts on tangata whenua values are difficult to quantify. All scenarios offer potential economic opportunities whether by way of strategic purchases of land for commercial purposes in the Compact Scenarios or taking advantage of the city, and its infrastructure, coming closer to a marae by consolidating land holdings. Realising these will need an understanding of the strategic implications of the development opportunities presented.

Evaluation also emphasised that any decisions on economic opportunities need to be considered in conjunction with how the urban form will affect the ability of tangata whenua to preserve and protect the mauri of resources. The Expansive Scenario presented the most risks for preserving mauri because of the scenario's expansion into greenfields areas. This was reflected in the scoring by the Evaluation Team.

The conclusions point to the importance of having a continuing dialogue with tangata whenua to ensure that strategic planning issues are communicated fully. For tangata whenua the impact of growth is local, accordingly the effects of scenarios may vary between different tangata whenua groups. For this reason engagement is needed



with the relevant tangata whenua group as to the immediate impacts of land development.

## 9.2 Protection of cultural heritage, cultural landscapes and waahi tapu

The Regional Policy Statement lists cultural heritage as including *“sites, places, place names, areas, waahi tapu, waahi tapu areas, taonga, buildings, objects, artefacts, natural features of cultural and historical significance, historical associations, people and institutions.”*

Cultural heritage is important as a foundation for the region’s identity and character. Preserving and protecting it enables appreciation and enjoyment by future generations. However, the city’s growth imposes pressures on its heritage resources.

For evaluation of this criterion, reliance was placed on a report by the ARC’s Heritage Team providing background information and analysis on the scenarios. No quantitative information relevant to this criterion was available from the model.

The evaluation shows each scenario may affect, or pose risks to different cultural values. In the Compact Scenarios 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 urban growth/intensification and built heritage and heritage character in some proposed growth centres/areas notably Ponsonby/the CBD fringe, Devonport, Onehunga and Helensville. For Scenario 4, as well as pressures on the centres, the allowances for infill, mean there would be additional pressure on landscape and trees in established suburbs. This contrasts with Scenario 1 where there is less development pressure on traditional, low density, suburban areas as growth is concentrated in centres with no provision for infill.

For the Expansive Scenario, with its expansion into greenfield areas, the heritage team indicated that current archaeological survey coverage is inadequate to provide a basis for assessing issues in many areas, and that where conflict can be anticipated there should be prioritisation of archaeological assessments/surveys to provide a basis for future planning. 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.

In assessing this criterion the Evaluation Team concluded that each scenario may affect different cultural values and that assuming best practice, avoidance and mitigation; all scenarios should be scored equally and neutrally except for the Expansive Scenario, which should be scored negatively.

The Expansive Scenario was seen as presenting the greatest risk to cultural heritage because it urbanises more new areas, many of which are coastal locations where there are likely to be cultural heritage features. One particular comment was made in relation to the presence of waahi tapu at Karaka, which would complicate the Weymouth to Karaka Bridge proposed as part of infrastructure for greenfield expansion in Scenario 5.

It was also noted that outcomes for cultural heritage will be influenced by factors, in addition to land use and transport, including policy development and investment decisions.

	Scenario 1	Scenario 4	Scenario 5
Protection of cultural heritage, cultural landscapes and waahi tapu	0	0	x

#### *Conclusion*

All three scenarios present risks to the protection of the region’s cultural heritage, cultural landscapes and waahi tapu with the risks for each of the scenarios focussing on different aspects of cultural heritage. The Compact Scenarios have the potential to affect built heritage as part of the intensification of the urban area, particularly growth centres. In contrast Scenario 5 poses risks to waahi tapu, archaeological sites and cultural landscapes with its 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 densities that are able to be achieved.

The expansion into greenfield areas was considered a greater risk than that presented by the Compact Scenarios. Therefore the Compact Scenarios were scored neutrally while the Expansive Scenario scored negatively.

### 9.3 Economic opportunities for tangata whenua

This criterion provides an understanding of the extent to which the growth scenarios enable tangata whenua aspirations for self sufficiency and economic development.

Maori values relevant to economic opportunities include:

- Maori land holdings;
- Marae and sites of significance; and
- Treaty settlements aspirations.

Currently, less than one per cent of land in the region is Maori owned but Treaty settlements, to be finalised within the next two years, will likely see this proportion increase. Treaty packages for commercial and cultural redress offer opportunities for tangata whenua to, amongst other reasons, consolidate land holdings around Marae and sites of significance and to buy sites for commercial development.

In considering tangata whenua marae, it is acknowledged that a number of iwi do not have land currently, the Treaty settlement process may provide an opportunity to achieve aspirations to establish marae to serve as a base for the iwi or hapu. In other cases where a marae exists, Treaty settlements may provide an opportunity to consolidate holdings or some locational proximity to Marae (without necessarily adjoining a Marae) to provide potential benefits for living and/or employment.

Building on this, the report also introduces the concept of tangata whenua growth nodes. These are described as areas that are centred on marae and would serve as a base for people to come home, learn about tikanga, and have opportunities for employment. At the moment there are limited opportunities for marae to act as focal points as they are usually located away from urban areas and are therefore unable to benefit from proximity to existing infrastructure.

Relaxation of the MUL, as part of a dispersed scenario with opportunities for greenfield development, may mean that some sites in Maori ownership are easier to develop. In these cases, with infrastructure closer to tangata whenua marae, there is the potential for better access to employment, passenger transport and education for people associated with these marae.

Some marae may still be isolated from growth and infrastructure and in these cases there may be issues of affordability, particularly for areas that cannot be developed (for cultural reasons or because they are in the rural area), yet are attracting large rates and are seen as having amenity value to an area of community significance which makes development harder. Also in these cases, these areas may not be able to be well serviced by social infrastructure, but marae may be able to provide some services themselves (eg health and housing).

Closer proximity of marae to development, in the case of Scenario 5, while bringing potential for economic opportunities also needs to be balanced against increased risk to resources (both access and quality) and the ability to continue to carry out tikanga.

The need for an understanding of the future spatial form of the city was also seen as being important during the Treaty settlement process; the example was given of Te Uri O Hau where land was purchased back as part of a Treaty settlement for commercial redress but the residential uses envisaged were challenged as the proposal was inconsistent with the MUL concept and in an area with high coastal values. One future challenge will be to understand the opportunities that settlement presents in buying of Crown owned land to take advantage of the future spatial form of the city.

Balanced against the benefits of greater proximity to infrastructure and viability of tangata whenua growth centres for a dispersed scenario are the issues related to the protection of mauri of resources.

	Scenario 1	Scenario 4	Scenario 5
<b>Economic opportunities for tangata whenua</b>	✓	✓	✓✓

### *Conclusion*

All the scenarios provided some opportunities for tangata whenua. The more Expansive Scenarios could bring infrastructure closer to tangata whenua marae whereas even in the compact form there would be business opportunities capitalising on an increased population and Treaty settlements. There was however an information gap as to the location of land in Crown ownership and how this might be used to provide economic opportunities. In light of the information that was presented, all scenarios were scored positively; in part this was because of the

increased population base in the future and acknowledgement of the Treaty settlements that would be negotiated providing a greater asset base.

## 9.4 Preserving the mauri

For Maori, mauri is the life force; it is the spiritual component of all living things. It imposes responsibilities on tangata whenua as kaitiaki (guardians). The role of the kaitiaki is to ensure that the mauri is well, in order for resources to be healthy and functioning properly.

This criterion was included within the cultural wellbeing to ensure that these spiritual and guardianship considerations were afforded weight in the overall assessment. While there is an overlap with values assessed under the environmental wellbeing<sup>48</sup>, mauri cannot be equated with the evaluation of these physical factors as the concept of mauri embodies spiritual and guardianship aspects which are not covered elsewhere, by other criteria. For example: a polluted stream represents an unwell mauri. Aesthetically it is unwell and the quality of food extracted from the stream is not fit for eating so the stream is not functioning either. This means that the use of that stream as a food source for the tangata whenua is extinguished and consequently the associated practices of gathering food from that stream (the kaitiaki practices) are lost with it.

A report from the ARC's Maori Relations Team looking at tangata whenua values, served as the basis for evaluating this criterion. This report was accompanied by a presentation from a member of the team who provided additional explanations and commentary on a range of mapped information<sup>49</sup> focusing on areas that are of significance to tangata whenua, including tangata whenua marae and Maori land ownership.

This assessment has been undertaken on a qualitative basis in reference to two measures, these being:

- The health of areas of significance to tangata whenua, and
- Access to areas of significance to tangata whenua to carry out associated practices and protocols (tikanga).

The evaluation acknowledges that sites of significance, where known, may be included for protection in district plans, and that the Treaty settlement process is identifying further sites. Where development has impacts on sites of significance there needs to be mitigation of these effects (eg Puketutu Island). A balance between economic opportunities and protecting resources and significant sites needs to be found. There may be particular protocols or prohibitions that are relevant to areas because of the history of the place, for instance rahui (prohibitions) imposed on beaches.

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<sup>48</sup> This is directly related to the concept of kaitiakitanga as reflected in s7(a) of the RMA and therefore impacts on environmental wellbeing.

<sup>49</sup> Many areas are significant to tangata whenua – the mapping exercise identifies those areas that have particular priority to Tangata whenua taken from iwi management plans, submissions and treaty settlement processes. It is not an exhaustive list of areas of significance to Tangata whenua.

Overall there was seen to be the potential for a negative impact on mauri for all scenarios assessed.

Looking at the more specific impacts for each scenario; in Scenario 1 it was considered that the mauri of resources may be vulnerable to increased intensity of population, and that this may produce a localised, but potentially significant, effect on a small area or a particular iwi. Similarly, with Scenario 4 the mauri of resources was seen as being potentially vulnerable to increased intensity of population, and that this may produce a localised, but potentially significant, effect on a small area or a particular iwi.

In contrast, for Scenario 5 the mauri of resources was seen as potentially being vulnerable to development particularly in the coastal regions and near sites of significance. Again, as discussed in Section 9.2 in relation to protection of cultural heritage, the presence of waahi tapu (Urupa) at Karaka are located in an area where there will be implications for the route of the proposed bridge between Weymouth and Karaka to link new development areas.

However, as previously stated, Scenario 5 also presents the possibility of benefits to some iwi, as extending the urban area brings opportunities closer to rural marae and areas of interest to Tangata whenua. While developments may mean that there are more opportunities to create jobs closer to marae and housing and infrastructure will be closer, there will be the need to identify areas of significance and exclude from these from areas to be developed. The evaluation concluded that the Expansive Scenario has the potential to have effects on a greater area than the more intensive footprints of the Compact Scenarios.

	Scenario 1	Scenario 4	Scenario 5
Preserving the mauri	x	x	xx

### *Conclusion*

Evaluation emphasised that any decisions on economic opportunities need to be considered in conjunction with how the urban form will affect the ability of tangata whenua to preserve and protect the mauri of resources. The Expansive Scenario presented the most risks for preserving mauri because of the scenario's expansion into greenfields areas. This was reflected in the scoring.

The evaluation highlights the importance of having a continuing dialogue with tangata whenua to ensure that strategic planning issues are communicated fully, as the effects of scenarios may vary between different tangata whenua groups.

# 10 Findings and Conclusions

This evaluation is an assessment of how well the three land use and transport scenarios deliver on long term outcomes that the Auckland region. In the face of considerable future growth in Auckland, it is not surprising that all of the scenarios show some deterioration in the criteria measures compared with the baseline year 2006. Not only does this reflect the quantum of population growth anticipated for the Auckland region by 2051, 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 have an important role in achieving the desired outcomes. However, it is important to note that in many cases urban form will be a necessary precondition in reinforcing other policy initiatives.

## 10.1 Evaluation results

The following table summarises the scores afforded to each of the scenarios through evaluation process:

Criteria	Scenario 1	Scenario 4	Scenario 5
<b>Economic wellbeing</b>			
Improved travel reliability	✓	0	x
Improved accessibility to economic activity	xx	x	xx
Improved access to labour pool	✓✓	✓✓	✓
Increased productivity	✓✓✓	✓	✓✓
To enable land extensive business sectors (Group 1) to grow in appropriate areas	x	x	✓
Minimised infrastructure costs	x	x	xx
Protection of productive rural land	0	0	xx
Energy resilience	x	x	xx
Feasibility from current market perspective	xxx	xx	✓✓
<b>Environmental wellbeing</b>			
Reduced greenhouse gas emissions	xx	xx	xxx
Protection or enhancement of marine values	x	x	xxx
Protection or enhancement of stream corridors	x	x	xxx
Identify, protect and enhance terrestrial ecosystems	x	x	xxx
Avoidance of hazards	x	x	xx
Improved air quality (impact on public health)	xx	xx	x
Water quality and human health	xx	xx	xxx
<b>Social wellbeing</b>			
Improved accessibility	✓✓	✓	x
Improved accessibility for deprived households	✓✓	✓	0
Housing choice	✓	✓	✓✓
Ageing in place	✓	✓	0

Criteria	Scenario 1	Scenario 4	Scenario 5
Greater housing affordability	x	x	x
Improved levels of physical activity	✓✓	✓✓	✓
Improved access to local employment opportunities	0	0	x x
<b>Cultural wellbeing</b>			
Protection of cultural heritage, cultural landscapes and waahi tapu	0	0	x
Economic opportunities for tangata whenua	✓	✓	✓✓
Preserving the mauri	x	x	x x

Most importantly, the evaluation signals that for most criteria, the Compact Scenarios perform better than the Expansive Scenario. However, notwithstanding the general preference for the Compact Scenarios in the scoring, it is important to note that there are a number of criteria where the Expansive Scenario scores better.

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 across the wellbeings.

The following table summarises the evaluation results and draws some thematic conclusions about future urban form for the region.

*Improving accessibility*

The results clearly showed the compact scenarios as providing the most enhanced accessibility. Improvements to regional and local accessibility were a feature of all the scenarios. Improvements to accessibility also provided benefits to the environment, economic and social wellbeings.

*Economic performance*

All scenarios drive agglomeration of business services in the CBD and CBD Fringe; however Scenario 1 performs the best for agglomeration because it also provides the highest levels of accessibility. 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, although the compact scenarios (particularly Scenario 1) generally remain better at 2041 than they were at 2006. There is a regional need for additional greenfield land to cater for the future growth of Group 1 business activities. This evaluation determined that this shortage is best addressed by the expansive scenario, as it provides an additional 2000 hectares of greenfield land for Group 1.

*Infrastructure costs*

The compact scenarios utilise current infrastructure more efficiently, thus reducing the need for additional infrastructure investment. Transport infrastructure costs are greatest, with the expansive scenario requiring the greatest additional investment in the transport network. The expansive scenario would require additional road infrastructure worth approximately \$31.4 billion compared with around \$15 billion for the compact scenarios. Yet despite the additional investment in transport infrastructure, the expansive scenario provided the worst accessibility compared with the compact scenarios.

### *The state of the environment*

All scenarios show deterioration against the environmental criteria, compared with the base year 2006. The significant difference between the scenarios is that the compact scenarios concentrate development within the existing urban footprint; an already degraded environment, thereby avoiding impacts on high quality environments outside the metropolitan urban area.

### *Effects on greenhouse gas emissions*

All scenarios increase greenhouse gas emissions. Therefore none of the scenarios achieve the Government's national policy reduction targets for transport related greenhouse gas emissions by 2040. Carbon dioxide emissions from transport are less under the compact scenarios than the expansive scenario.

### *Housing choice and affordability*

Greater housing choice is provided by the expansive scenario due to a greater range of housing types (attached and detached) plus the additional suburban, rural, and coastal housing locations available. Housing affordability deteriorates across all scenarios, including the expansive scenario even though it provides around 50 per cent more urban area compared with the compact scenarios.

### *Risks to heritage and cultural values*

All scenarios present risks and opportunities for heritage and cultural values, for example the compact scenarios increase risks for built heritage while the expansive scenario affects landscape values. In terms of tangata whenua it will be important 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 tangata whenua are understood.

### *Market feasibility*

Market commentators viewed the expansive scenario as most feasible because it is the closest to a business as usual approach; most familiar to both developers and the market. They also considered that the levels of intensification contained in the compact scenarios are likely to be difficult to achieve, except for in a few main centres that have high accessibility and good amenity. There is strong market demand for industrial growth in the south of the region from businesses with a national or international focus.

## 10.2 Conclusions

The evaluation findings, summarised above, provide the basis for some conclusions about which spatial form could best meet Auckland's agreed regional outcomes.

### *The impacts of growth*

The extent of growth facing Auckland will cause adverse effects in the region. 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 an optimum spatial form, which is supported by timely 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 are unable to make a difference – vehicle air emission controls to reduce worsening air quality is an obvious example.

### ***Spatial form***

The evaluation findings signal that overall a compact urban form is preferable for Auckland's future urban form. For most criteria the compact scenarios perform the best by having, for example:

- less impact on the environment, by avoiding pristine and valued environmental areas and better protecting stream corridors and marine values,
- improved regional productivity by enabling firms to better access skilled labour and key ports, and
- provision of a strong network of centres enabling better social cohesion and access to social facilities.

However for some criteria the expansive scenario performs better. For example, by expanding the urban footprint and providing additional greenfield land for business activities, it better enables the future growth of Group 1 business activities.

The results point to a spatial form that is based predominantly on compact principles, but that includes some flexibility to accommodate new greenfield areas for Group 1 business sectors.

### ***The importance of land use and transport integration***

The extent of growth anticipated in Auckland dictates the need for significant investment in infrastructure, particularly transport infrastructure. While this evaluation has shown that a compact urban form would require less additional investment in transport infrastructure, 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 for a future integrated land use and transport are:

- A need for a strong network of centres. In particular the planning for and provision of a multitude of local and neighbourhood centres, as provided in Scenario 1, indicate benefits in terms of ageing in place, opportunities for physical activity (active modes), and social cohesion, as well as supporting local and sub-regional accessibility for the general population and for deprived households. While the Compact Scenarios perform similarly for many of the criteria there are noticeable differences in scoring against the accessibility related criteria. The differences observed between the Compact Scenarios, in terms of accessibility and transport outputs, reflect that scenario 1 concentrates growth along the Rapid Transport Network (RTN).
- The base transport network used in all of the scenarios demonstrates some improvements in overall accessibility and regional productivity. However, they also demonstrate that it is possible to spend considerable money on infrastructure while not maximising accessibility improvements, or productivity gain. The Expansive Scenario requires the most expensive transport

infrastructure but it does not provide the best outcomes for accessibility and productivity when compared with the Compact Scenarios.

- The model outputs tended to signal initial improvements in many of the desired regional outcomes in the short to medium term, but these often declined subsequently, in the medium to long term. Investment in transport infrastructure, particularly passenger transport, in the scenarios is front loaded in accordance with the RLTS. 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.

### ***Land use planning is necessary but not sufficient***

Determining and planning for Auckland's future spatial form will not be sufficient, in itself, to meet agreed regional outcomes. While agreeing that compact spatial form is important, it will need to be supported by a suite of other, equally important mechanisms:

- A strong focus on implementation, setting a clear policy direction, supported by appropriate district plan controls. Additional implementation measures will also have to be considered, examples include development incentives, private-public partnerships, council-led exemplar projects, etc.
- Comprehensive investment in core infrastructure, such as passenger transport, new roads, wastewater, water supply, power supply, etc. It is important that this investment is signalled in advance and it's planning and roll-out is aligned with land use decisions.
- Central and local government policy interventions; for example those that can support local activities to achieve national guidelines of standards, such as introducing emission standards for vehicles.

While this evaluation report does not identify a final and preferred spatial form for the region, it does signal some core attributes that Auckland's spatial form should contain. This evaluation has shown that in order to achieve agreed regional outcomes, Auckland requires a compact urban which retains some flexibility to cater for future growth pressures. This needs to be reinforced through comprehensive planning, investment and roll-out of core infrastructure, as well as a suite of supporting national and local policy interventions.

## 10.3 The future

The establishment of the Auckland Council signals a sea-change in planning for Auckland. The development of a Spatial Plan for Auckland, plus an Infrastructure Plan, provides a unique opportunity to implement the findings of this evaluation report.

It is intended that the outcomes from this project, along with a range of other work, will provide the basis for technical advice on the future spatial form of Auckland to the incoming Auckland Council from November 2010.

# 11 Acknowledgements

Parties involved in the Futures Project:

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ARC Land and Water Policy Team	Ministry of Health
ARC Maori Relations Team	Ministry of Justice
ARC Regional Development Team	Ministry of Social Development
ARC Social and Economic Research and Monitoring Team	New Zealand Police
ARC Stormwater Action Team	New Zealand Transport Agency
ARC Strategy and Development Team	North Shore City Council
ARC Transport Analysis Team	Papakura District Council
Ascari Partners	Property Economics
Auckland City Council	Regional Climate Change Working Group
Auckland District Health Board	Regional Growth Strategy Working Group
Auckland Regional Public Health Service	Rodney District Council
Auckland Regional Transport Agency	Te Puni Kokiri
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## 12 Glossary and Abbreviations

### 12.1 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), waahi 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.

**Waahi Tapu** - A place sacred to Maori in the traditional, spiritual, religious, ritual or mythological sense.

**Whanau** - An extended Maori family including the nuclear family.

## 12.2 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
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
GHG	Greenhouse Gasses
HBW	Home based work trips
LENZ	Land Environments of New Zealand
LTCCP	Long Term Council Community Plan
LUC	Land Use Capability
MfE	Ministry for the Environment
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
NSC	North Shore City
PM <sub>10</sub>	Fine Particulates
PM <sub>2.5</sub>	Fine Particulates
PT	Passenger Transport
QTN	Quality Transit Network
RDC	Rodney District Council

RGS	Auckland Regional Growth Strategy
RMA	Resource Management Act
RLTS	Auckland Regional Land Transport Strategy
RPS	Auckland Regional Policy Statement
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

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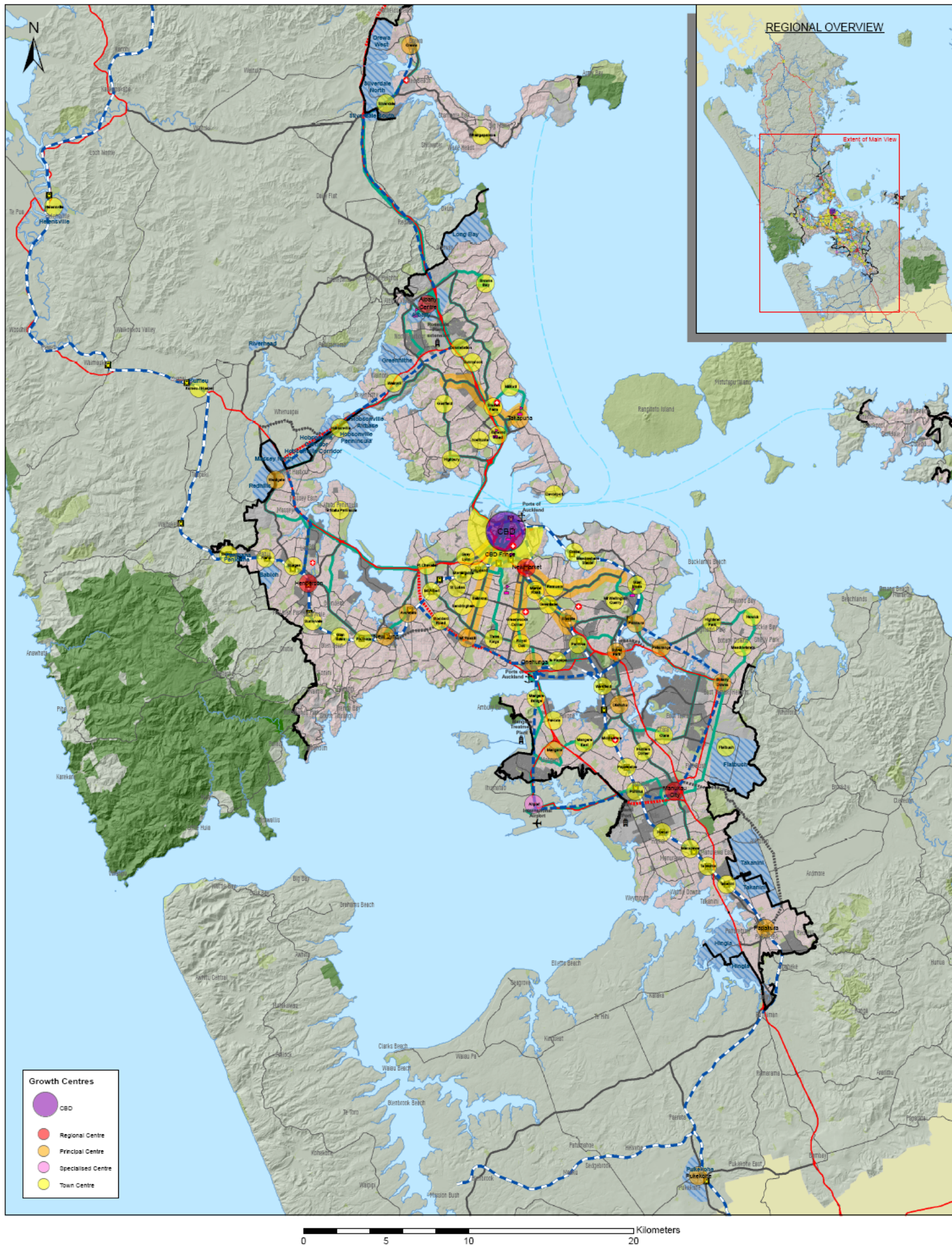
Parsons Brinckerhoff, 2009, Assessing the Costs of Alternative Development Paths in Australian Cities, by Roman Trubka, Peter Newman and Darren Billsborough, Curtin University Sustainability Policy Institute Fremantle.

Regional Sustainable Development Forum, 2009, One Plan: Auckland Regional Infrastructure Inventory.


Waitakere City Council, 2007, Social Infrastructure Planning Framework for Waitakere City.

# Appendix 1 – Scenario Maps

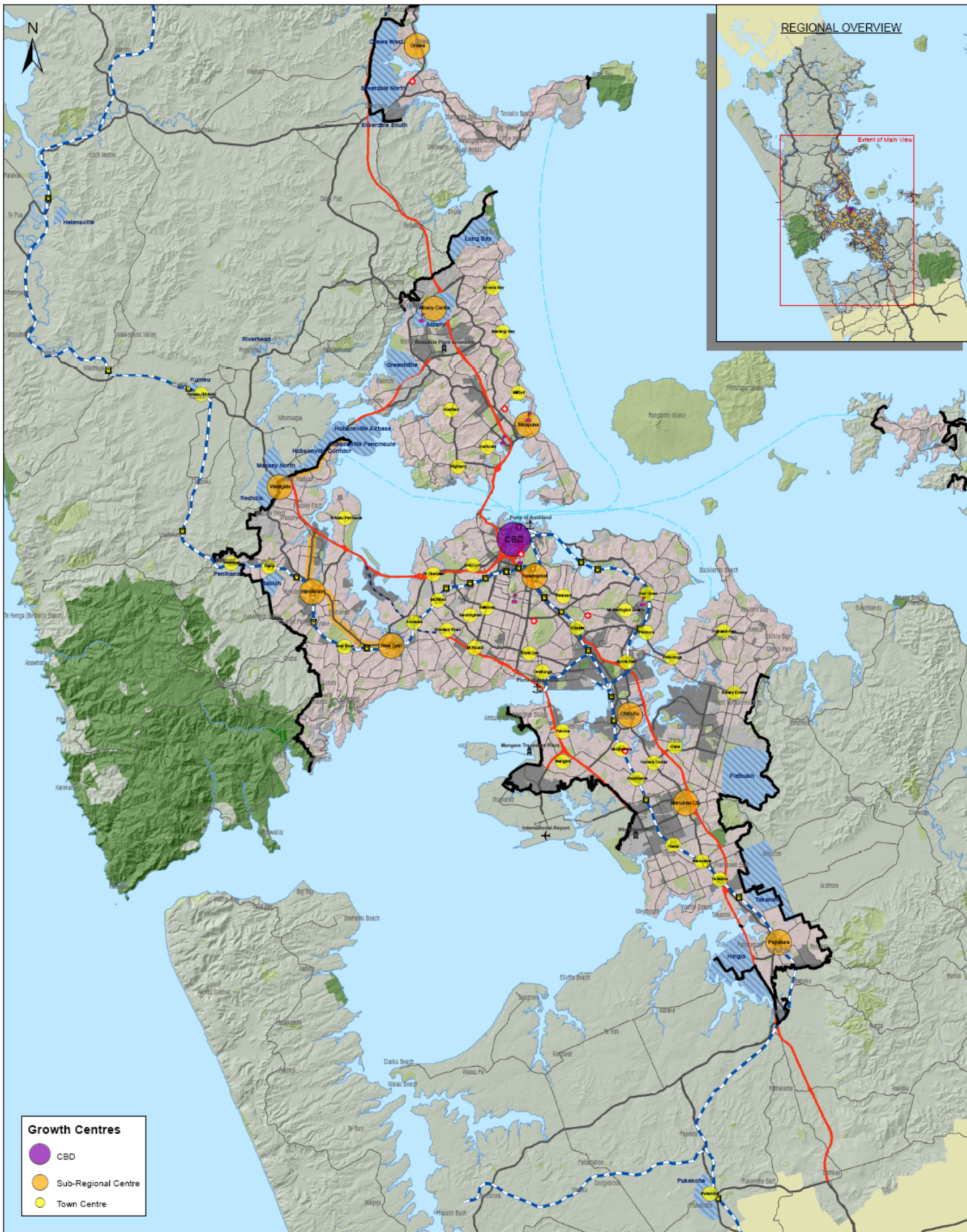
Map 1 Scenario 1 - Compact



This map is for workshop purposes only. It does not reflect any council policy. It is not intended for wider circulation.

<p><b>Legend</b></p> <ul style="list-style-type: none"> <li>✈ International Airport</li> <li>▲ Major Facility</li> <li>⚓ Ports of Auckland</li> <li>🏥 Hospitals</li> <li>🎓 Universities</li> <li>🚉 Rail Station</li> <li>— Major Roads</li> </ul>	<ul style="list-style-type: none"> <li>— Existing Rail</li> <li>— Existing Strategic Route</li> <li>— Future Strategic Route</li> <li>— Existing Regional Arterial Route</li> <li>— Possible Regional Arterial Route</li> <li>— Future Rapid Transit Route</li> <li>— Quality Transit Network</li> <li>— Ferry Route</li> <li>— Regional Growth Corridors</li> <li>— MUL</li> <li>— Commercial/Business Zoning</li> <li>— Other MUL Zoning</li> <li>— Future Urban</li> <li>— Residential Zoning</li> <li>— Regional Parks</li> <li>— Public Open-Space Zoning</li> <li>— Auckland Region Land</li> <li>— Land Outside of Region</li> <li>— Water</li> </ul>	<h2>Scenario 1.1 Compact</h2>	<p>Map Produced 4th March 2010 by GIS, Information and Communications Technology Auckland Regional Council</p>  <p>Auckland Regional Council TE RAUHIKANGA TAIAO</p>
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Map 2 Scenario 4 - Current policy



Note: Map is stylised. Not intended to be used at property level

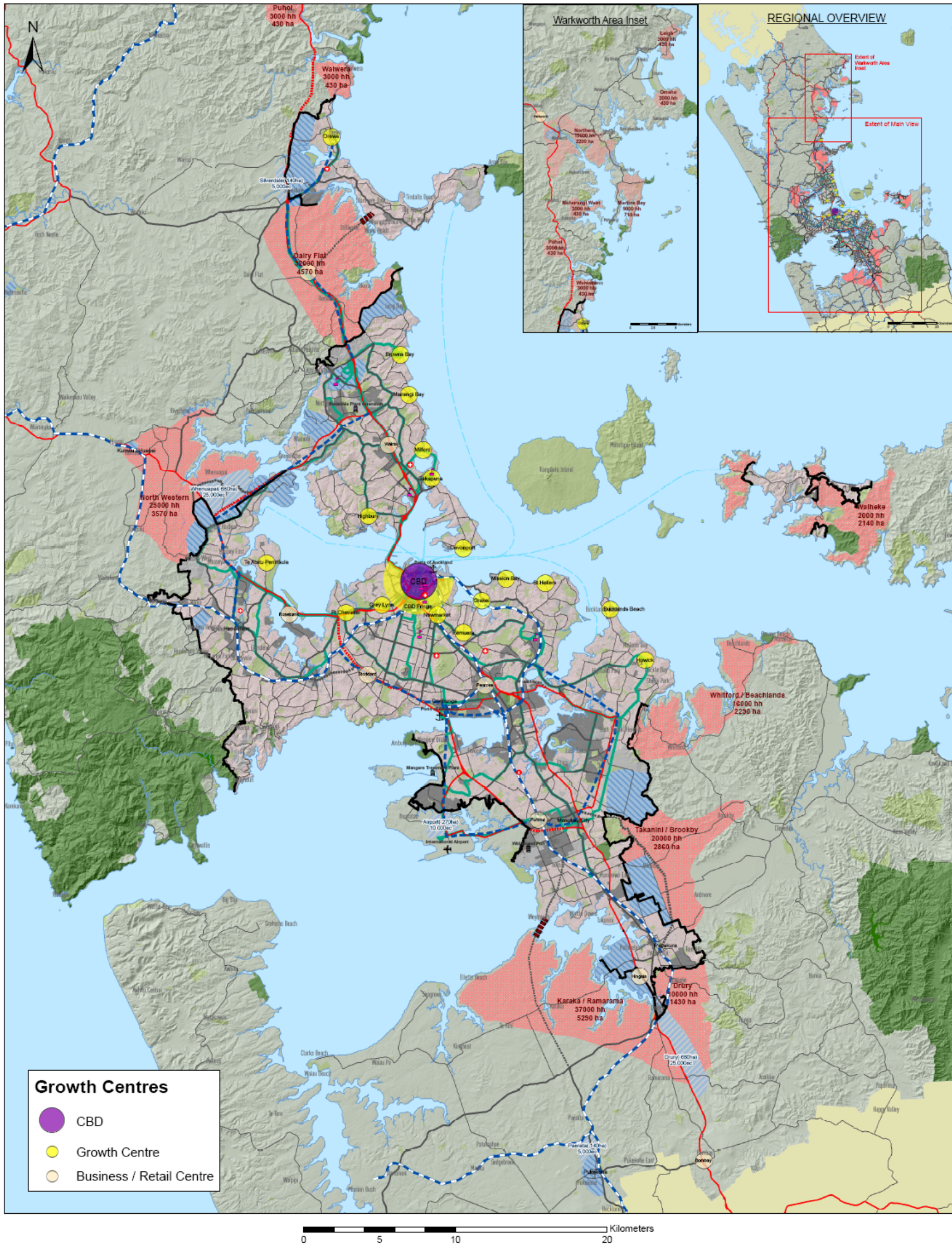
Legend		
+	International Airport	Planned Strategic Transport Links
■	Major Facility	Motorways
±	Ports of Auckland	Regional Arterial Route
○	Hospitals	Existing Rail
⌘	Universities	Ferry Route
■	Rail Station	Major Roads
■	Growth Corridor	MUL Boundary
■	Residential Zoning	Commercial/Business Zoning
■	Other MUL Zoning	Future Urban (RGS)
■	Public Open-Space Zoning	
■	Regional Parks	
■	Rural Land	
■	Land Outside of Region	
■	Water	

# Scenario 4.1 RPS Change 6

Map Produced 1st Dec 2009  
by GIS, Information and  
Communications Technology  
Auckland Regional Council



Map 3 Scenario 5 - Expansive



<p><b>Legend</b></p> <ul style="list-style-type: none"> <li>International Airport</li> <li>Major Facility</li> <li>Ports of Auckland</li> <li>Hospitals</li> <li>Universities</li> <li>Existing Rail</li> <li>Major Roads</li> <li>Potential Regional Arterial Route</li> <li>Potential Bridge</li> <li>Future Rapid Transit Route</li> <li>Existing Strategic Route</li> <li>Future Strategic Route</li> <li>Existing Regional Arterial Route</li> <li>Possible Regional Arterial Route</li> <li>Expansion Areas</li> <li>Residential Zoning</li> <li>Other MUL Zoning</li> <li>Commercial/Business Zoning</li> <li>MUL</li> <li>Future Urban</li> <li>Group One</li> <li>Regional Parks</li> <li>Public Open-Space Zoning</li> <li>Auckland Region Land</li> <li>Land Outside of Region</li> <li>Water</li> <li>Quality Transit Network</li> <li>Ferry Route</li> </ul>	<h1>Scenario 5.1</h1> <h2>Expansive</h2>	<p>Map Produced 1st Dec 2009 by GIS, Information and Communications Technology Auckland Regional Council</p> <p>Auckland Regional Council TE RAUHI TANGA TAIAO</p>
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# Appendix 2- 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.

## 13.1 Model outputs summary

### Land use outputs

Figure 46 Employment uptake vs capacity in centres 2006-2041 (retail, office, industrial, warehouse)

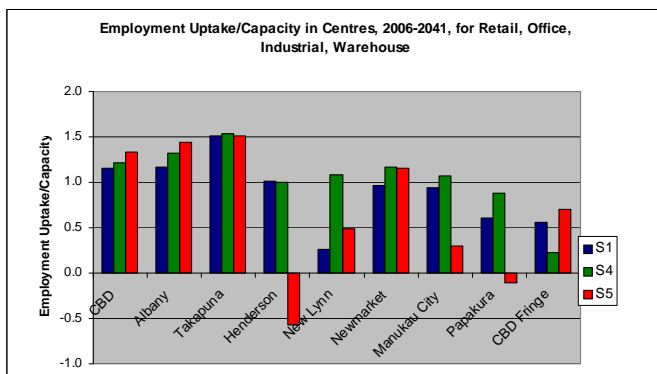


Figure 47 Household uptake in centres 2006-2041

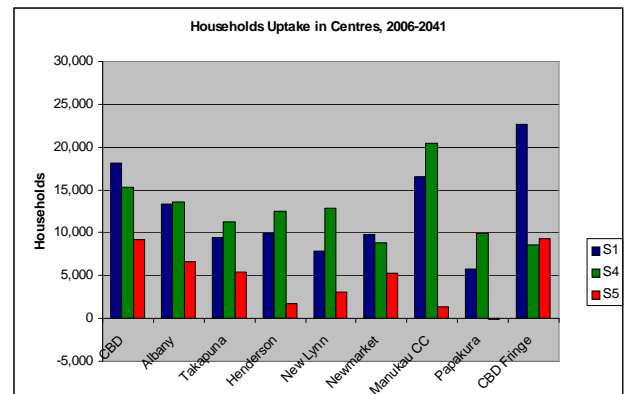


Figure 48 Household uptake vs capacity in centres 2006-2041

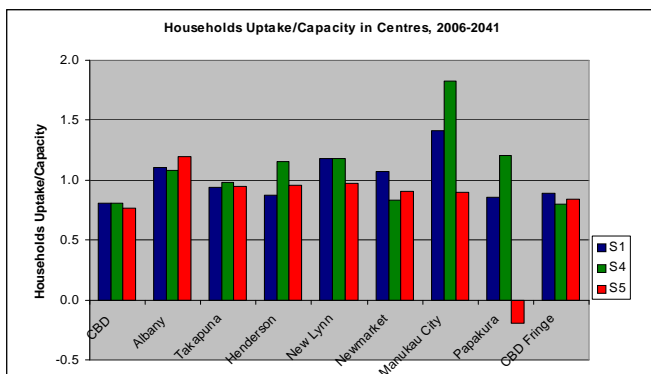


Figure 49 Average household floor areas in centres in 2041

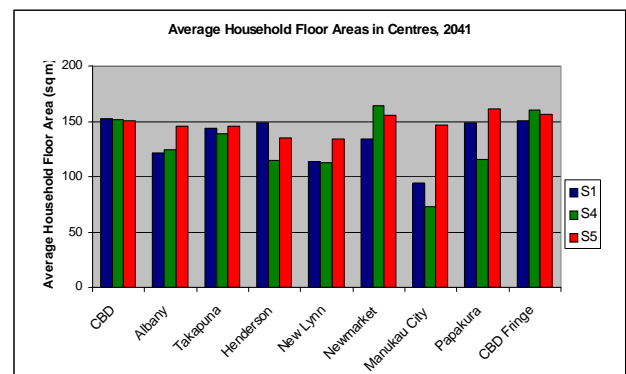


Figure 50 Employment vs household uptake in centres 2006-2041

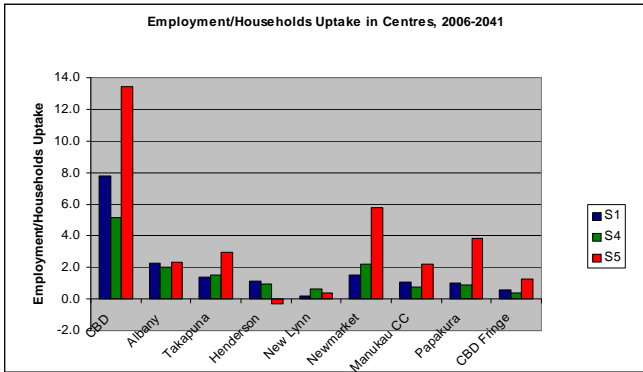


Figure 51 Employment uptake in secondary centres 2006-2041

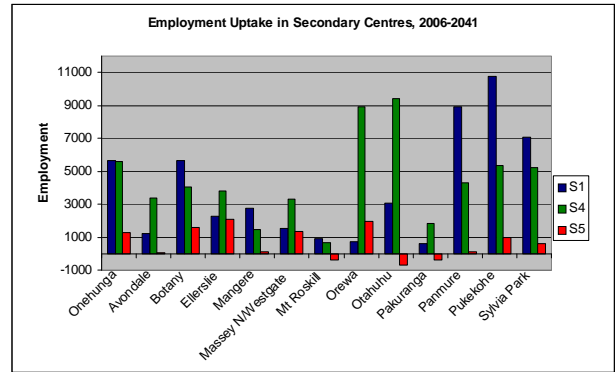


Figure 52 Employment uptake vs capacity in secondary centres 2006-2041 (retail, office, industrial, warehouse)

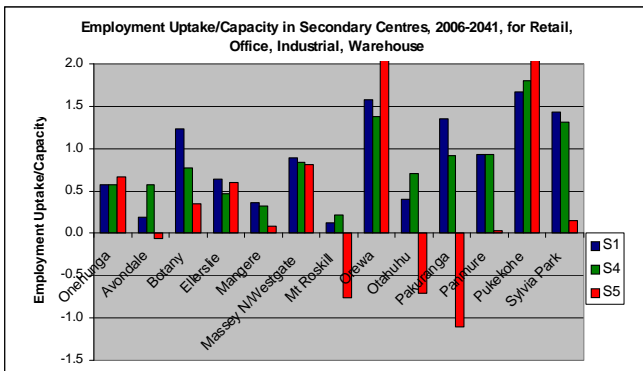


Figure 53 Household uptake in secondary centres 2006-2041

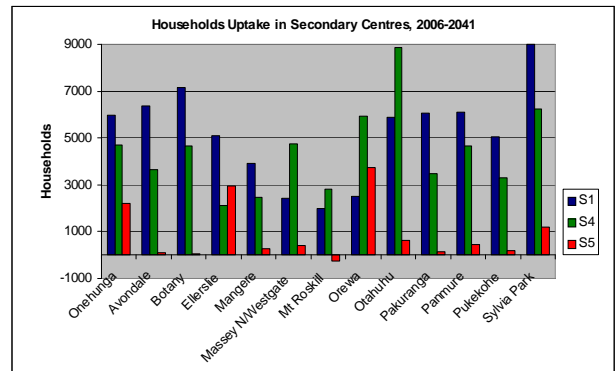


Figure 54 Household uptake vs capacity in secondary centres 2006-2041

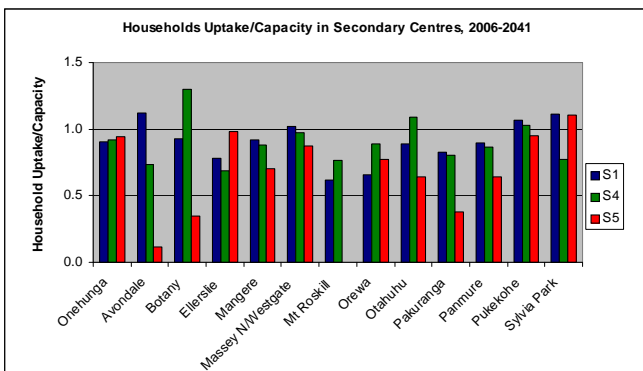


Figure 55 Average household floor areas in secondary centres 2041

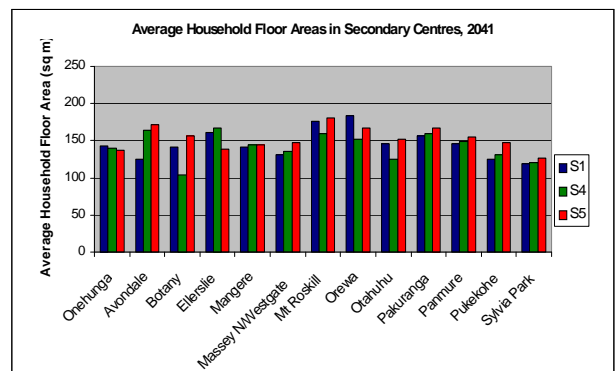


Figure 56 Employment vs household uptake in secondary centres 2006-2041

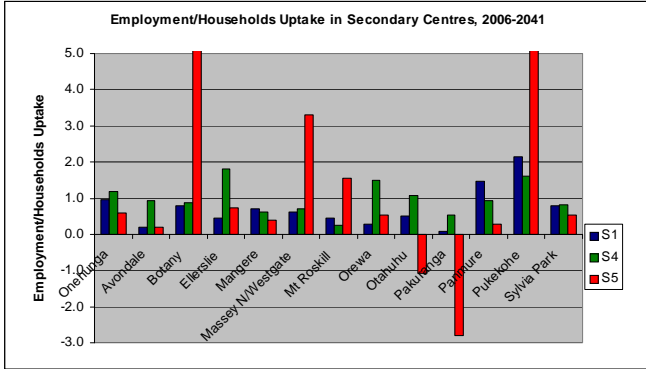


Figure 57 Employment uptake in corridors 2006-2041

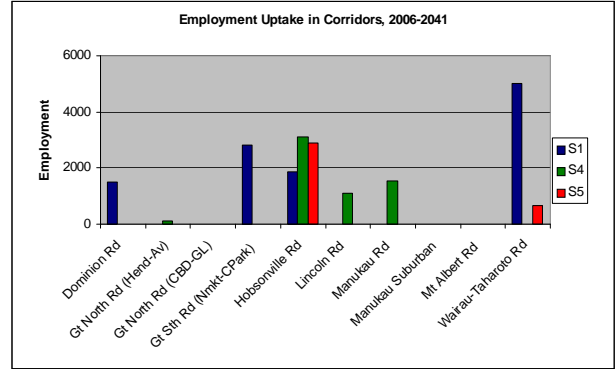


Figure 58 Employment uptake vs capacity in corridors 2006-2041

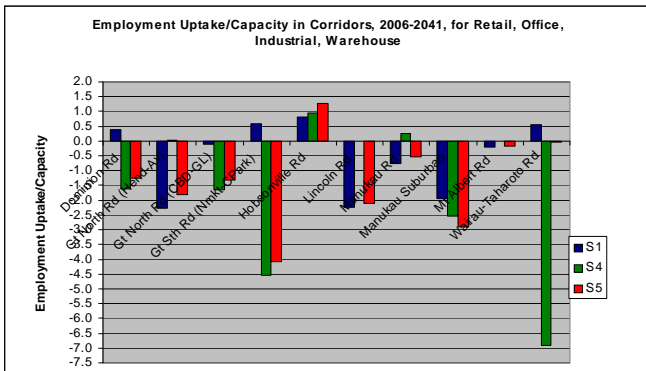


Figure 59 Household uptake in corridors 2006-2041

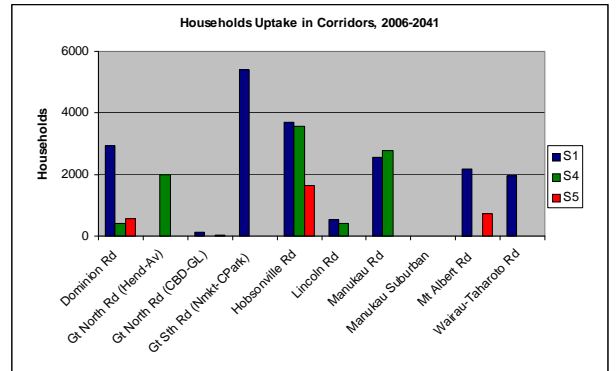


Figure 60 Household uptake vs capacity in corridors 2006-2041

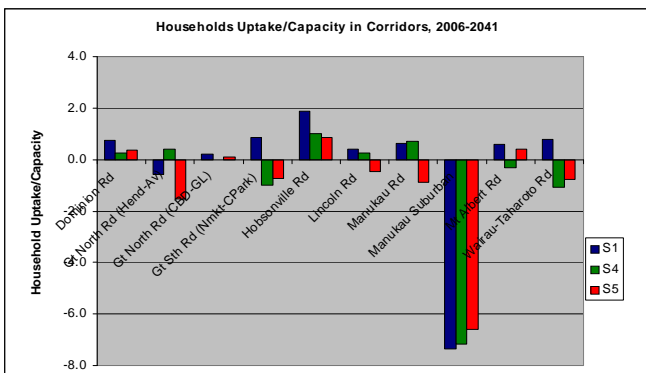


Figure 61 Employment vs household uptake in corridors 2006-2041

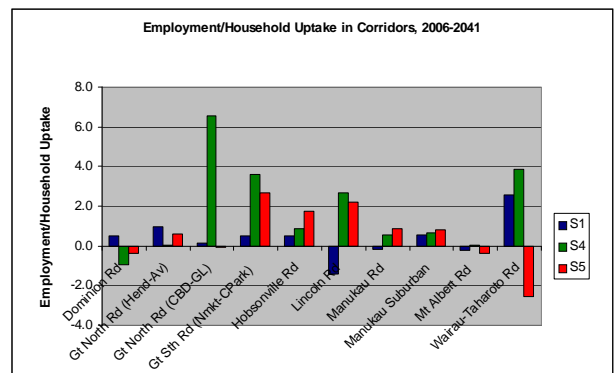


Figure 62 Employment uptake vs capacity 2006-2041 (retail, office, industrial, warehouse)

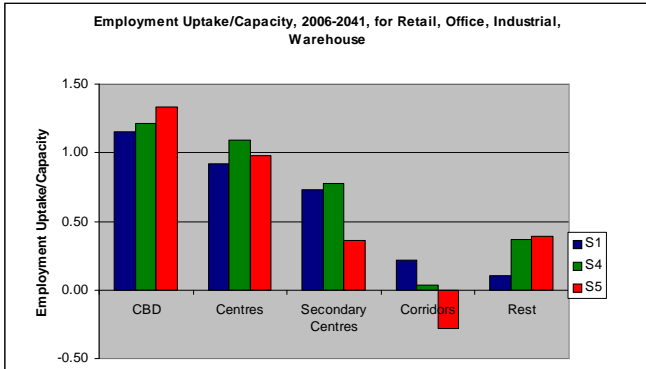
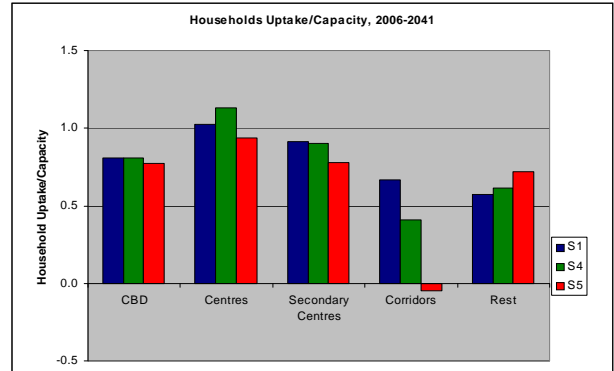


Figure 63 Household uptake vs capacity 2006-2041



*Transport outputs*

Figure 64 PT demand vs supply

AMPT Sc		2006	Scenario 1.1				Scenario 4.1				Scenario 5.1			
		2006	2021	2031	2041	2051	2021	2031	2041	2051	2021	2031	2041	2051
Hibiscus-North Shore	North	0.0	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.1	0.2	0.2	0.3
	South	0.3	0.8	1.0	0.7	0.9	0.6	0.7	0.5	0.7	0.8	1.2	0.8	1.0
Waitemata Harbour	North	0.1	0.3	0.1	0.1	0.1	0.2	0.3	0.3	0.4	0.2	0.3	0.4	0.6
	South	0.4	0.6	0.6	0.6	0.6	0.5	0.5	0.4	0.6	0.7	1.0	0.8	1.0
West Isthmus	East	0.5	0.4	0.4	0.4	0.4	0.5	0.3	0.3	0.4	0.6	0.6	0.5	0.7
	West	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Central Isthmus	North	0.5	0.6	0.8	0.7	0.8	0.6	0.6	0.6	0.7	0.7	1.0	1.0	1.3
	South	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2
CBD	in	0.4	0.6	0.7	0.6	0.7	0.5	0.5	0.4	0.6	0.6	0.8	0.7	0.8
	out	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.4
South Isthmus	North	0.6	0.4	0.5	0.5	0.6	0.4	0.4	0.4	0.6	0.6	1.2	1.5	2.2
	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	0.5	0.7	0.6	0.8	0.5	0.5	0.6	0.9	0.8	2.0	2.8	4.4
	South	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Manurewa-Takanini	North	0.3	0.3	0.5	0.4	0.5	0.3	0.3	0.4	0.6	0.6	1.7	2.4	3.9
	South	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0



## 13.2 Social wellbeing graphs

### Improved accessibility

Figure 65 Employment opportunities by car and PT within 30 minutes

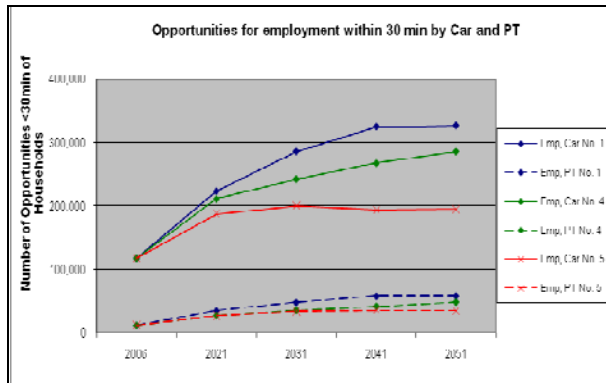


Figure 66 Employment opportunities within 45 minutes

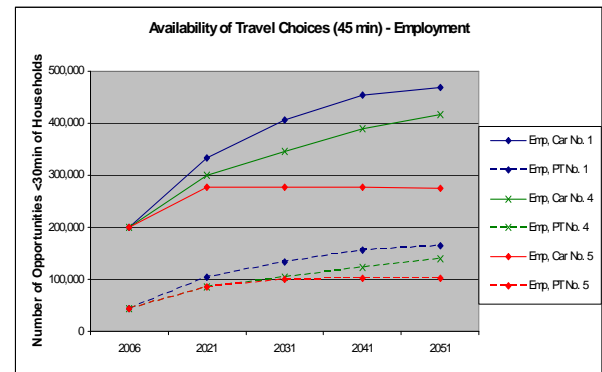


Figure 67 Tertiary education facilities opportunities by car and PT – within (30 minutes)



Figure 68 Regional health facilities opportunities - within 30 minutes

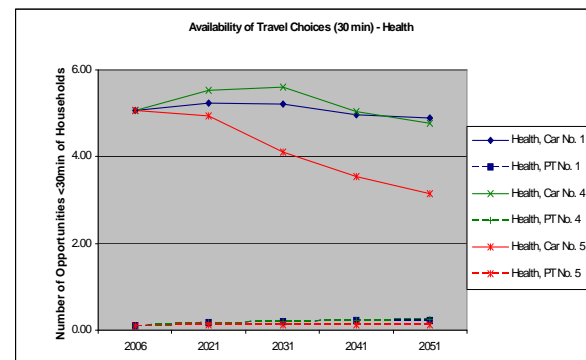


Figure 69 Tertiary education facilities opportunities within 45 minutes

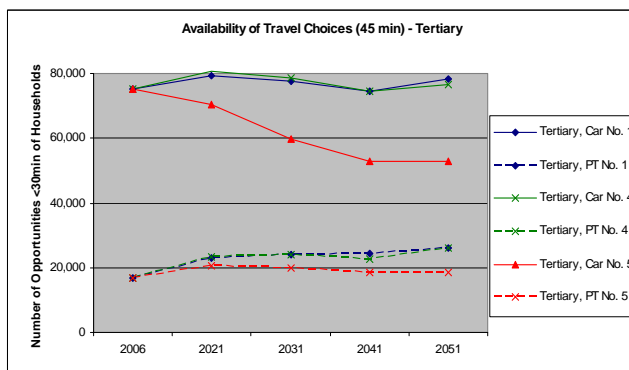


Figure 70 Retail opportunities within 45 minutes

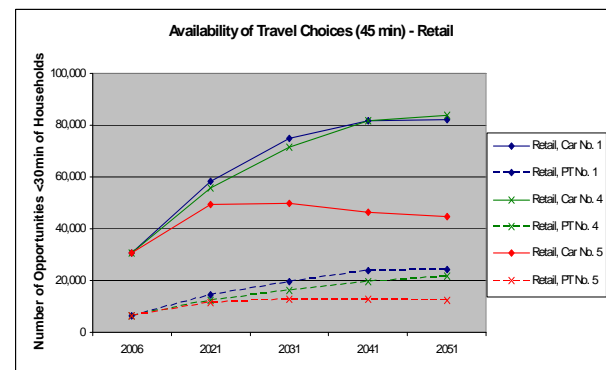


Figure 71 Regional health facilities opportunities within 45 minutes

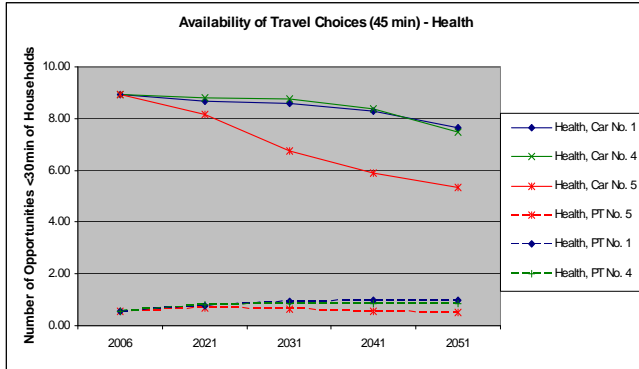


Figure 72 General accessibility 2006- 2051 – car

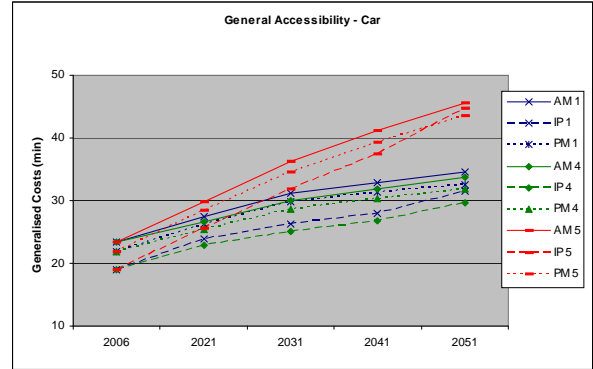


Figure 73 General accessibility 2006- 2051 – PT

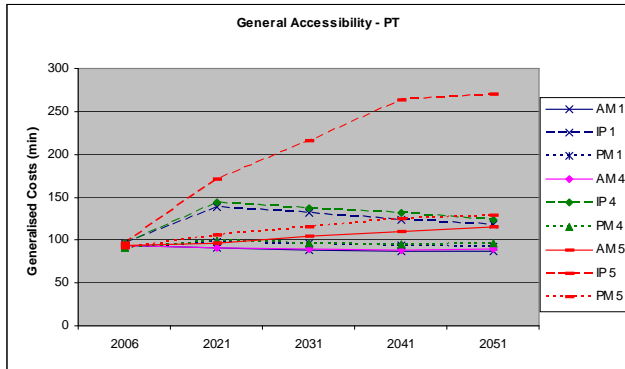
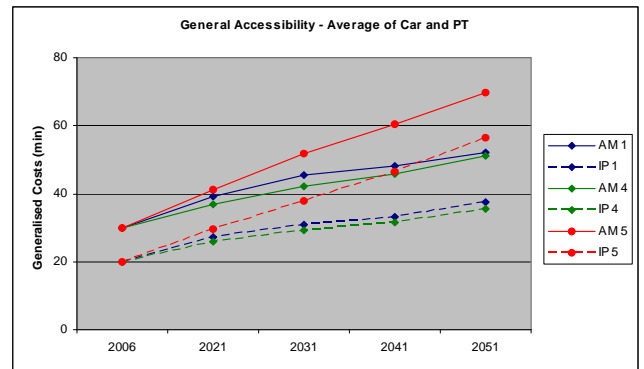


Figure 74 Generalised costs of travel - weighted average of car and PT for the AM peak and the interpeak periods



Greater housing affordability

Figure 75 Rent per square metre

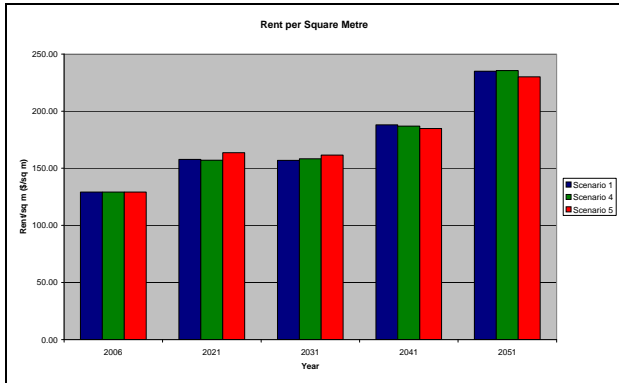


Figure 76 Total floorspace available in the region

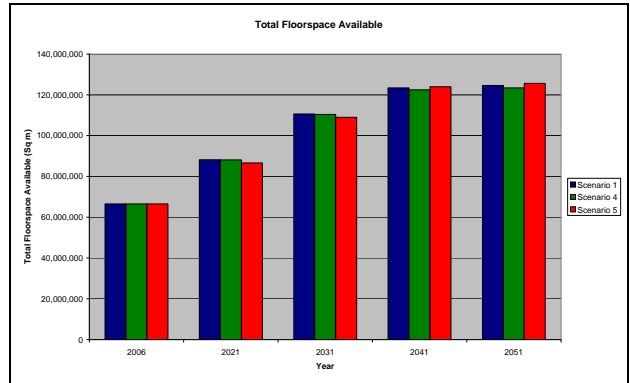


Figure 77 Total rent paid for the region

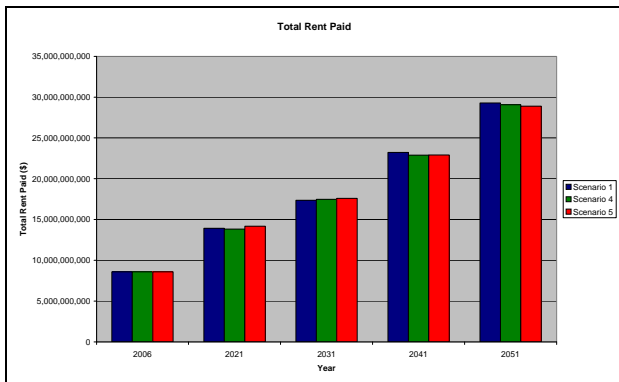


Figure 78 Lower income households – 20per cent of zones with lowest income

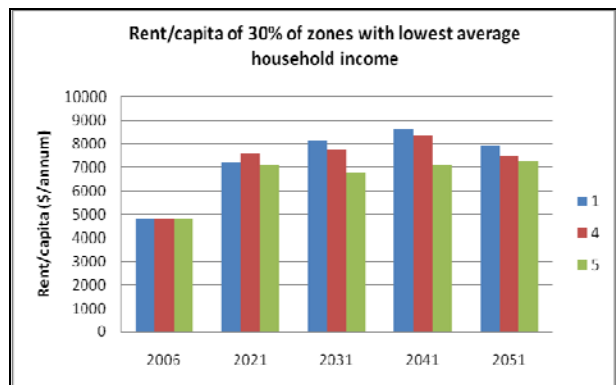
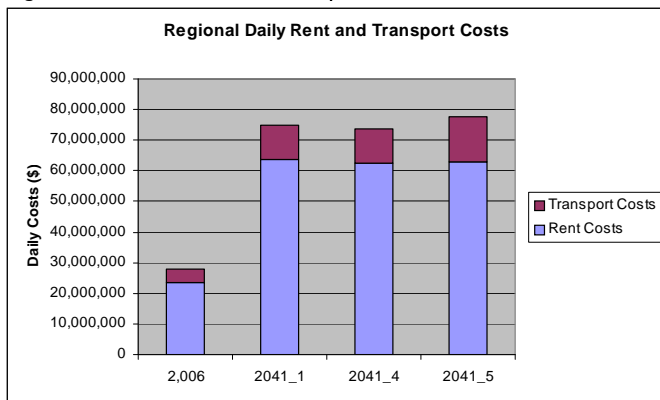
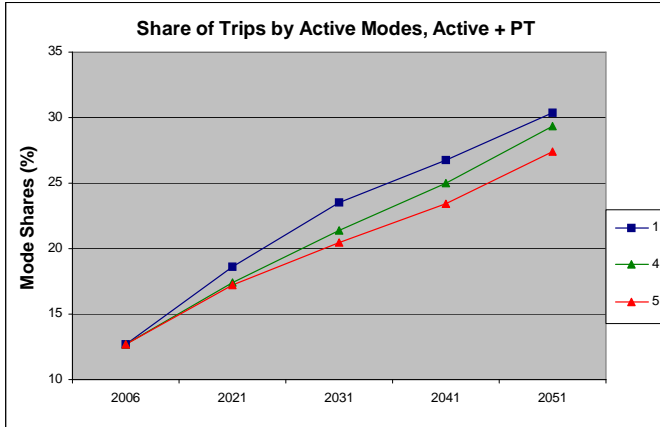


Figure 79 Total cost of transport + rent



*Improved levels of physical activity*

Figure 80 Improved levels of physical activity - share of trips by active modes + PT



*Improved access to local employment opportunities*

Figure 81 HBW trip length distribution – region

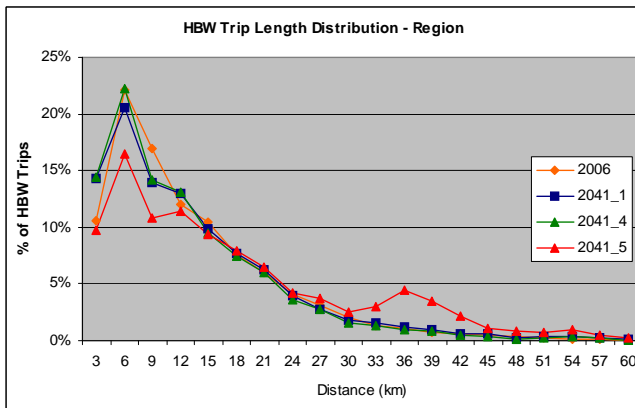


Figure 83 HBW trip length distribution - northern sector

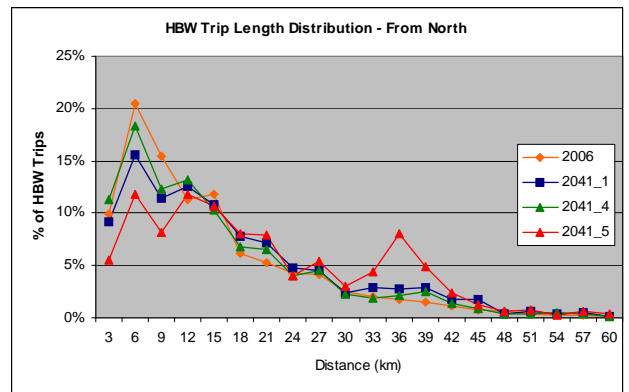


Figure 82 Improved access to local employment opportunities - commuting trip length distribution (from western sector)

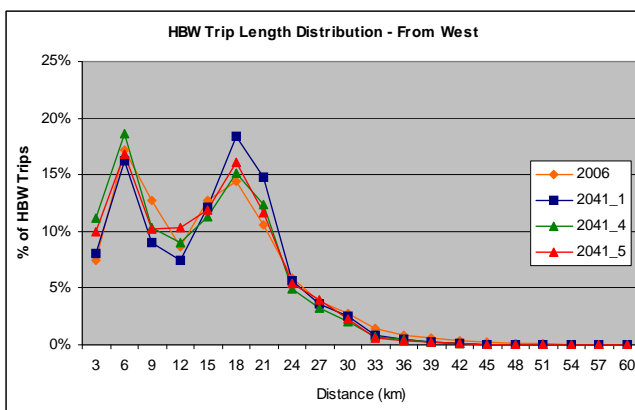
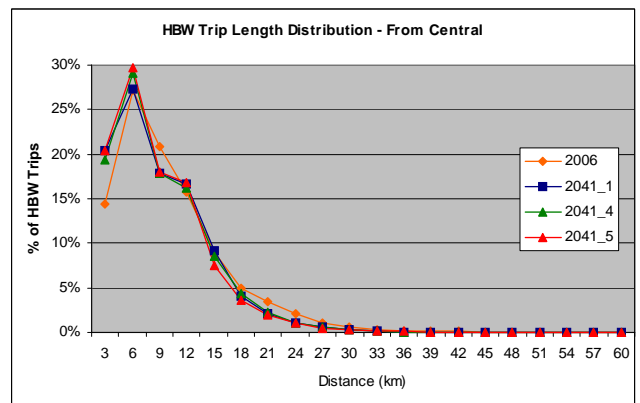


Figure 84 Improved accessibility to local employment opportunities - commuting trip length distribution (from central sector)



### 13.3 Economic wellbeing graphs

*Improved travel reliability*

Figure 85 Percentage of congested VKT (arterial roads)

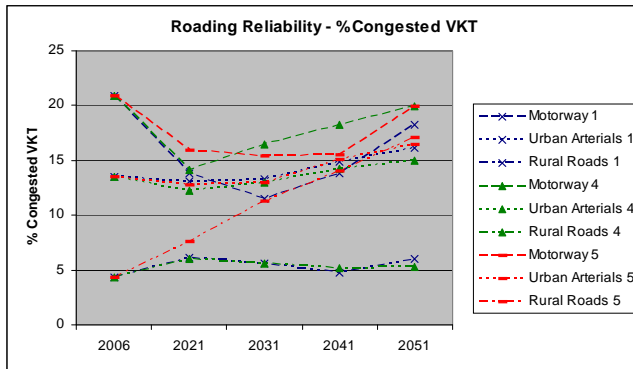


Figure 86 Percentage of congested VKT (north and central)

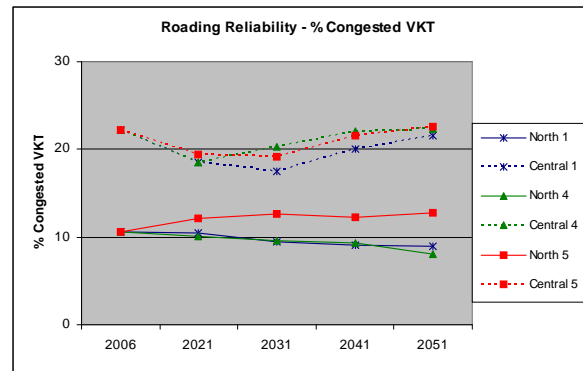


Figure 87 Percentage of congested VKT (west)

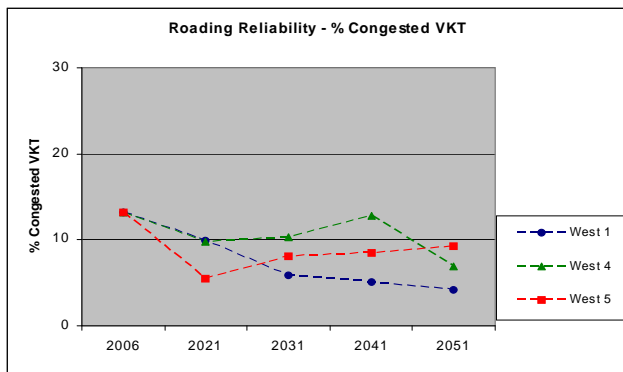


Figure 88 Percentage of congested VKT (south)

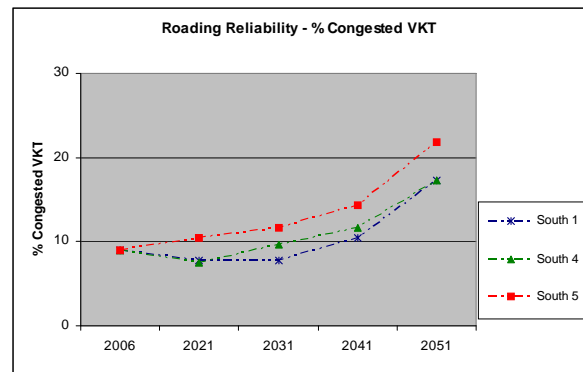


Figure 89 Percentage of congested car VKT on QTN in north and central (no bus lanes)

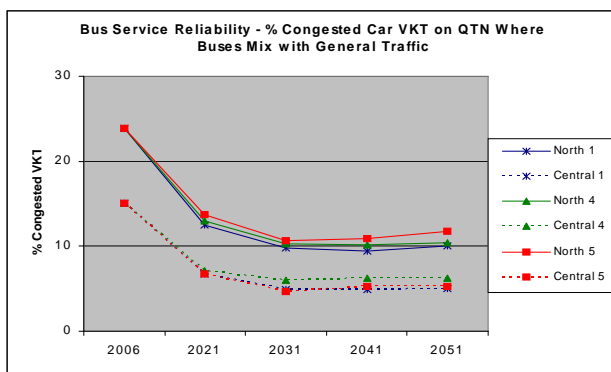


Figure 90 Percentage of congested car VKT on QTN in west (no bus lanes)

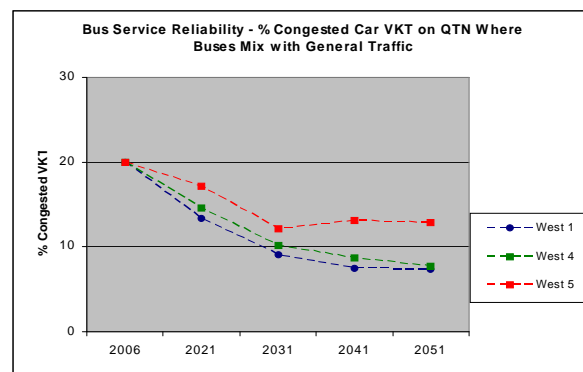
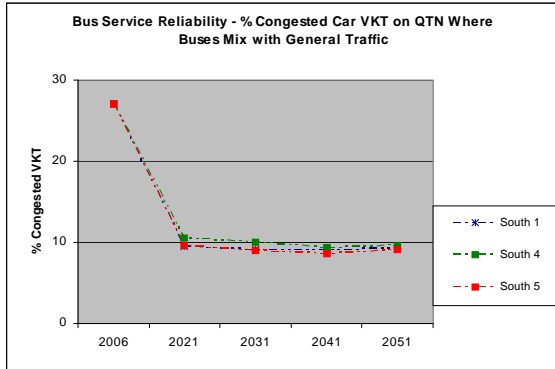


Figure 91 Percentage of congested car VKT on QTN in south (no bus lanes)



*Improved accessibility to economic activity*

Figure 92 Access to strategic economic sites

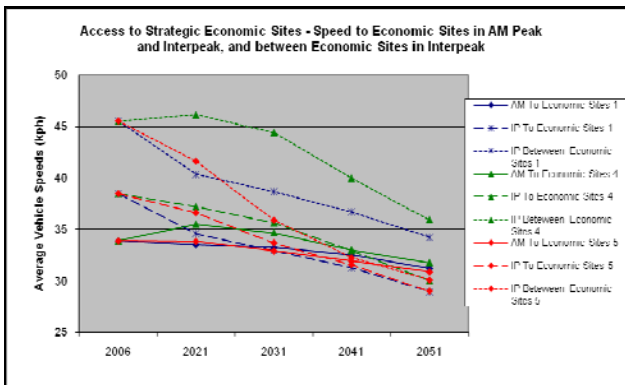


Figure 93 Access to key economic centres (CBD, Port, Airport, Wiri)

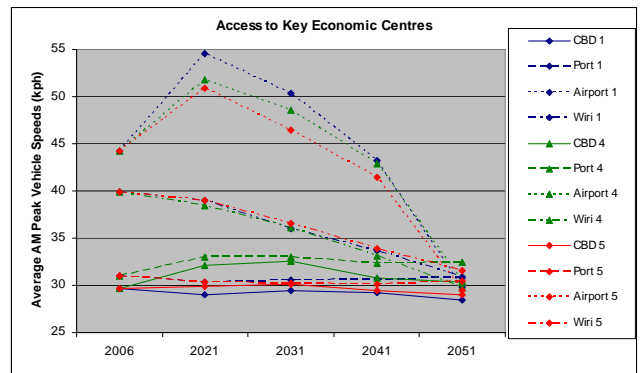
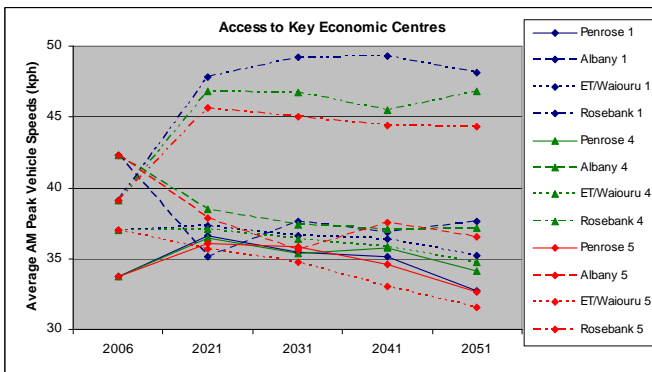


Figure 94 Access to key economic centres (Penrose, Albany, East Tamaki, Rosebank)



Improved access to labour pool

Figure 95 Access to labour pool within 30 minutes by PT

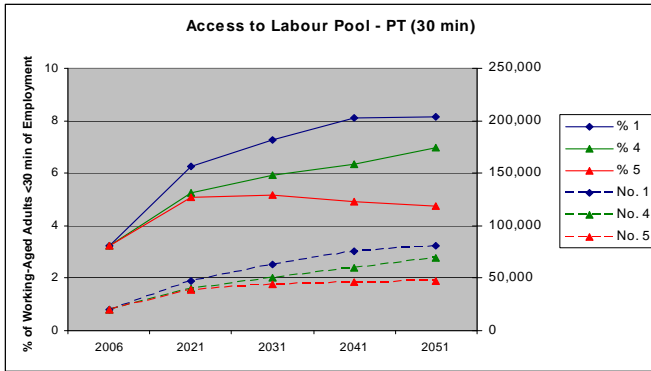


Figure 96 Access to labour pool within 30 minutes by car (north and central)

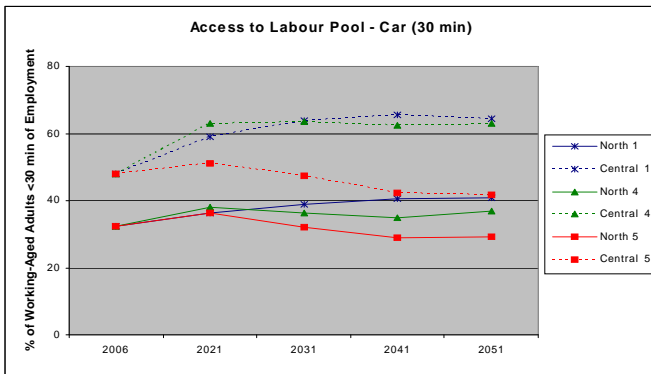


Figure 99 Access to labour pool within 30 minutes by car (south)

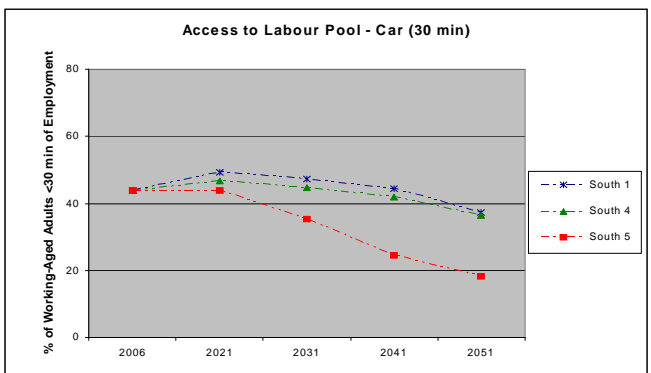


Figure 97 Access to labour pool within 45 minutes by car

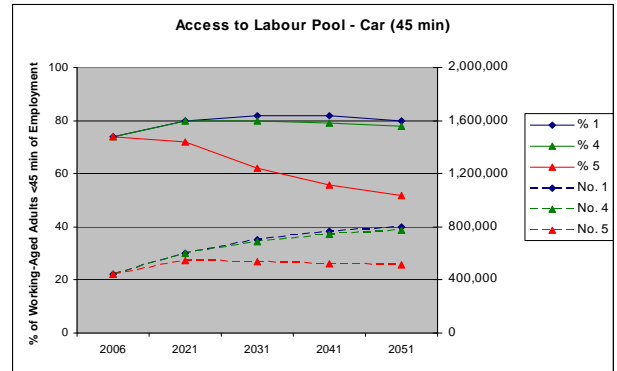


Figure 98 Access to labour pool with 30 minutes by car (west)

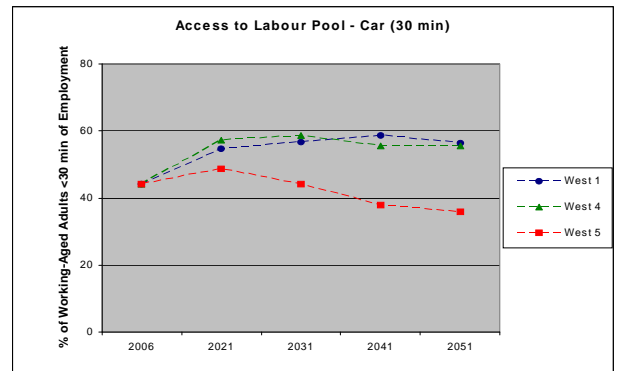


Figure 100 Access to labour pool within 30 minutes by PT (north and central)

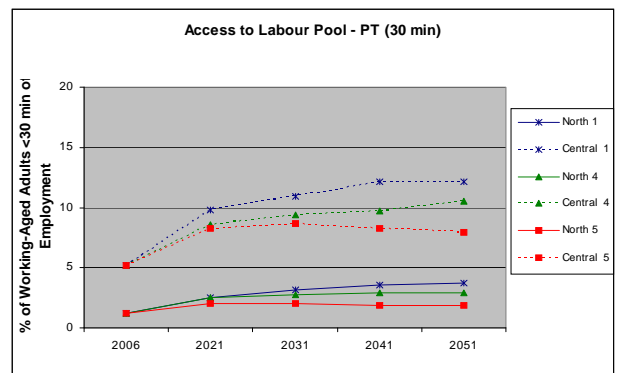


Figure 101 Access to labour pool within 30 mins by PT (west)

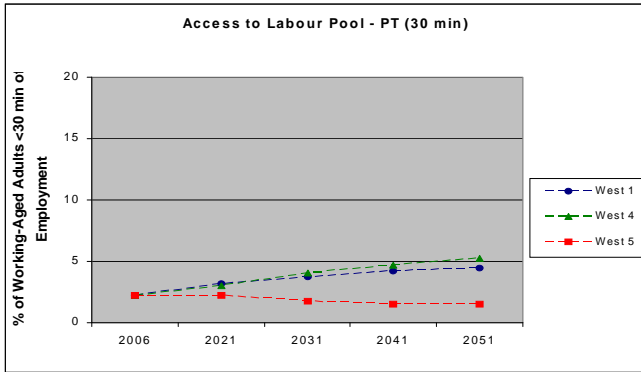


Figure 102 Access to Labour Pool with 30 mins by PT (south)

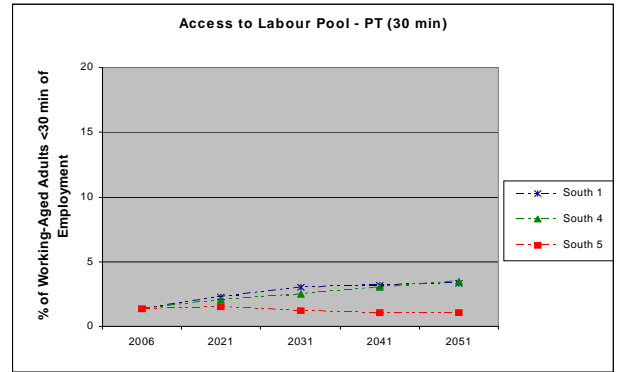


Figure 103 Access to labour pool within 45 mins by car (north and central)

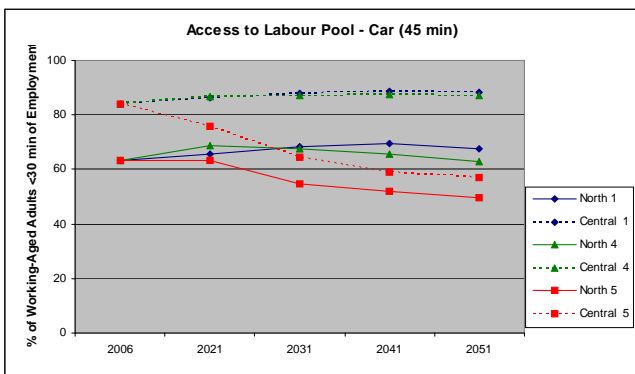


Figure 104 Access to labour pool within 45 mins by car (west)

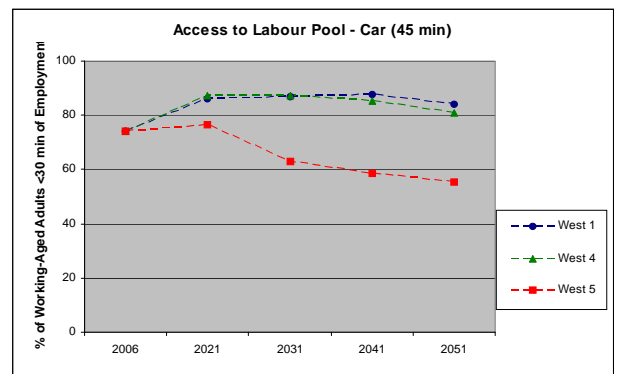


Figure 105 Access to labour pool with 45 mins by car (south)

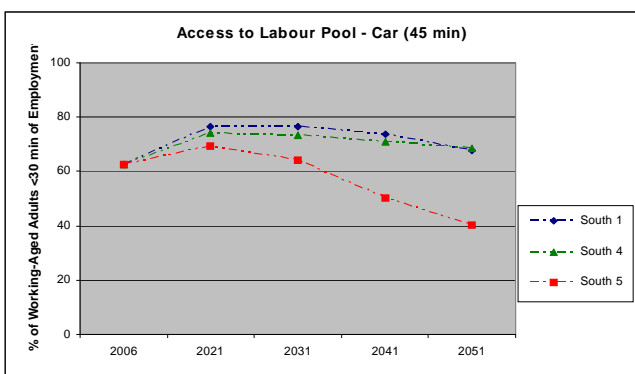


Figure 106 Access to labour pool within 45 mins by PT (north and central)

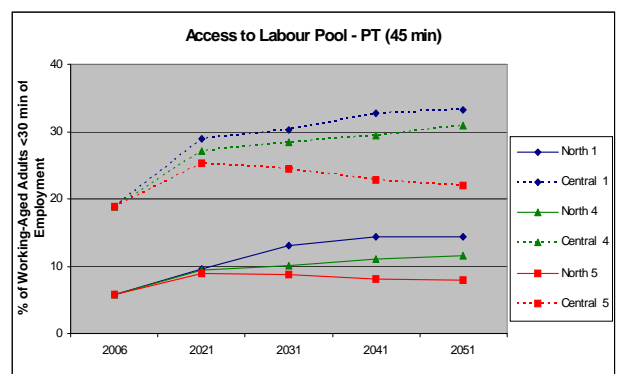




Figure 107 Access to labour pool within 45 mins by PT (west)

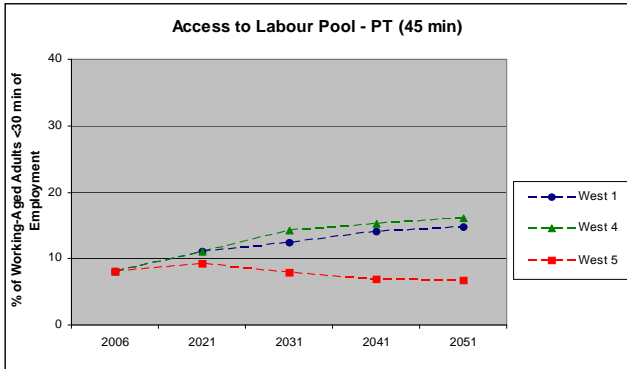
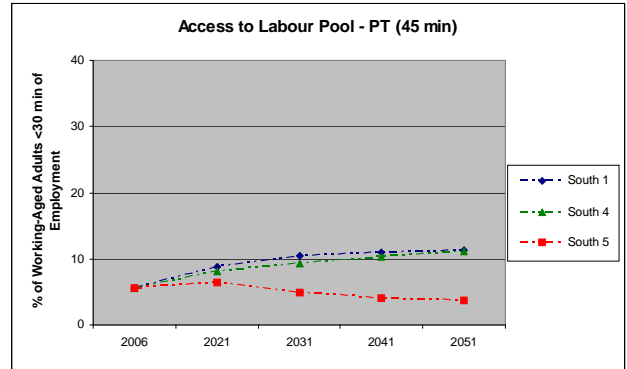
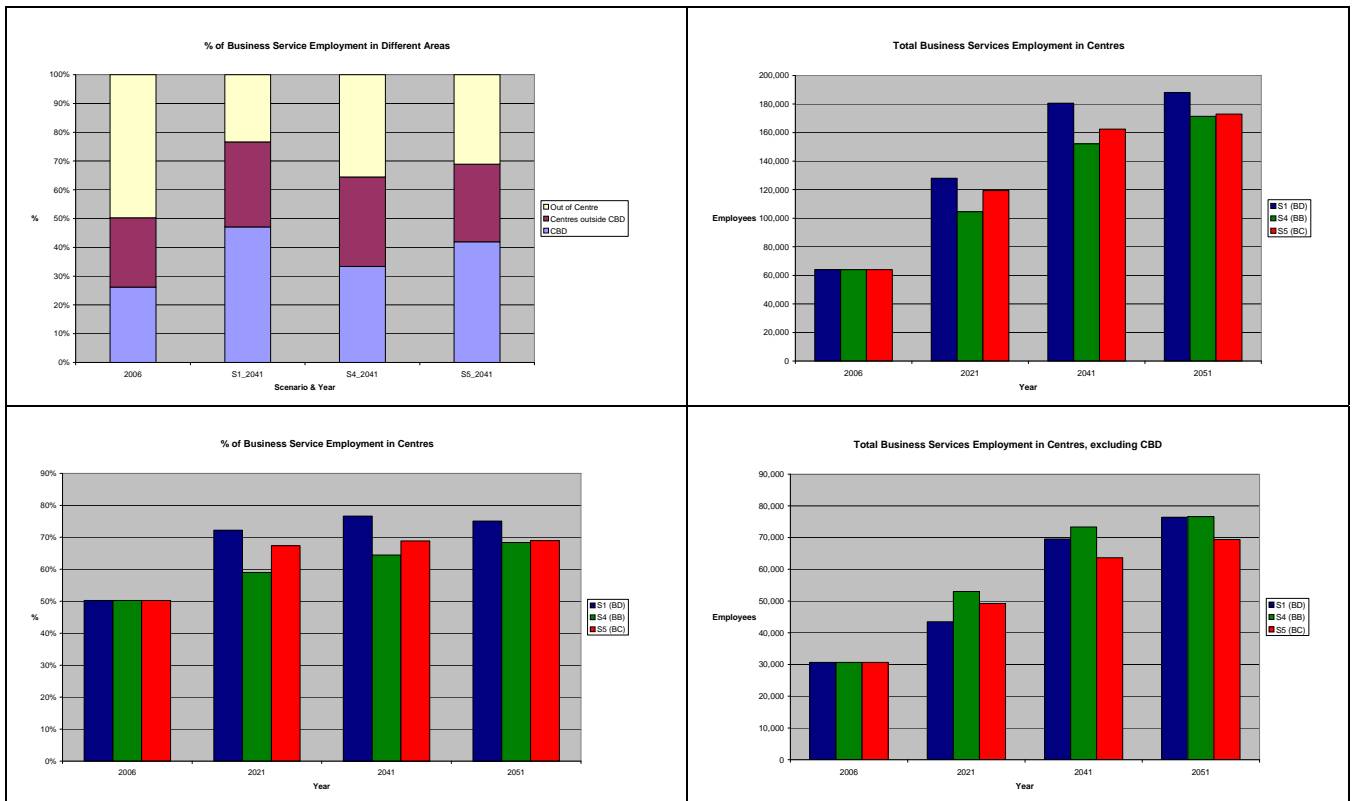


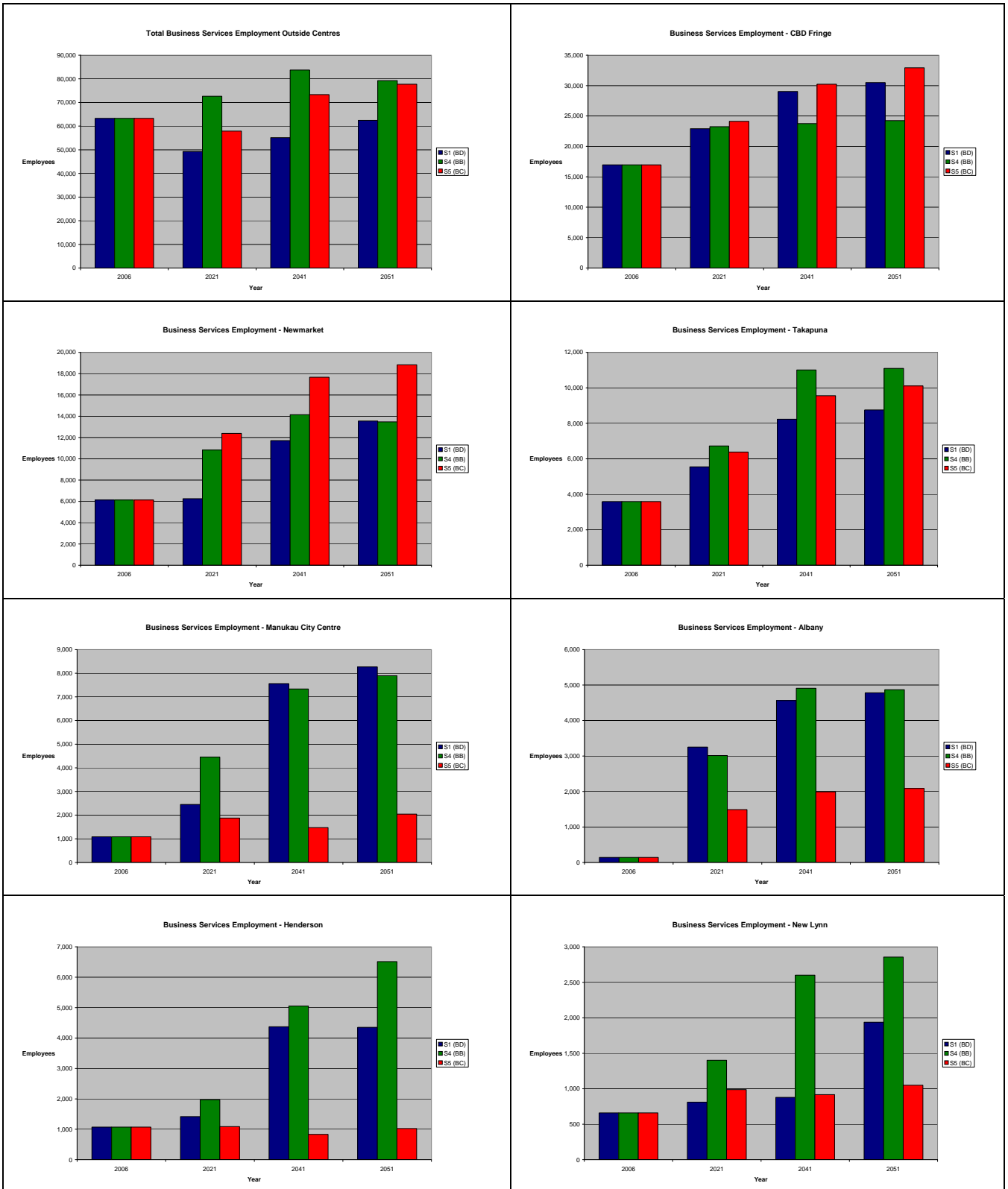
Figure 108 Access to labour pool within 45 mins by PT (south)

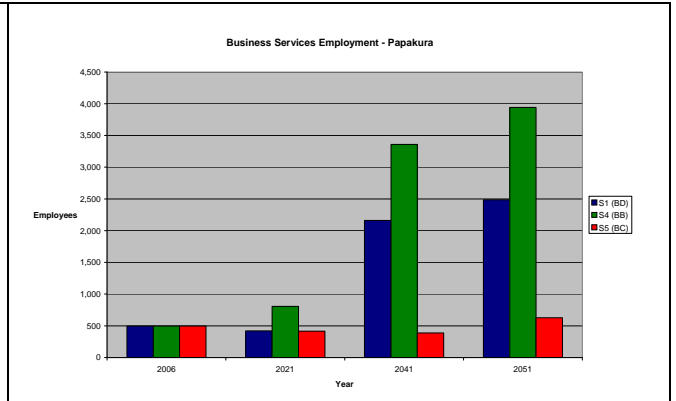
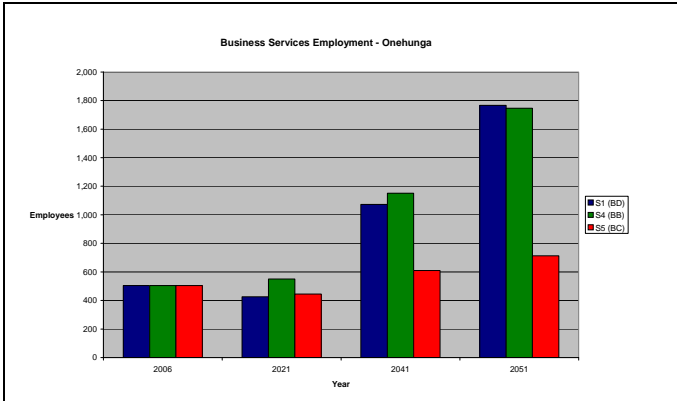


*Increased productivity*

Figure 109 Productivity graphs

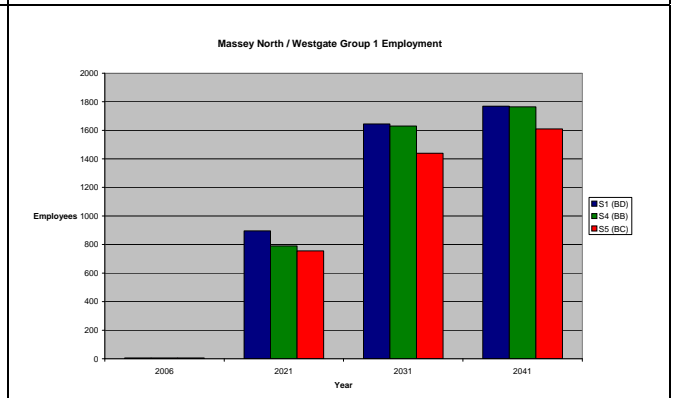
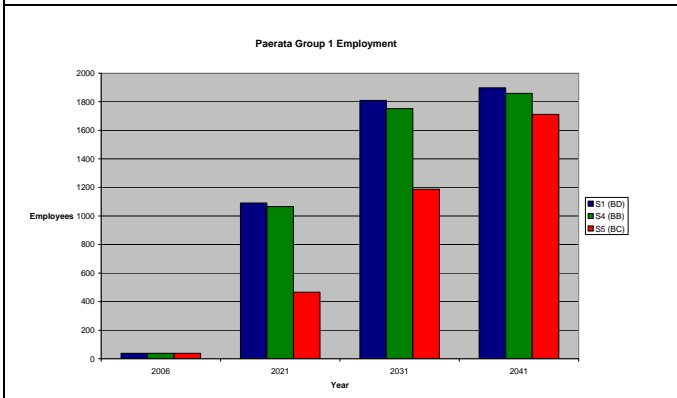
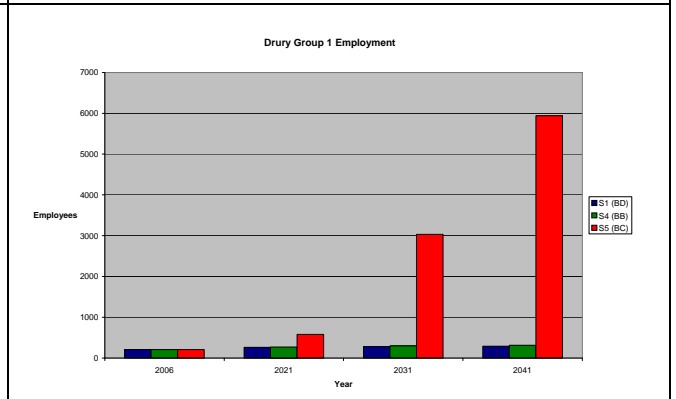
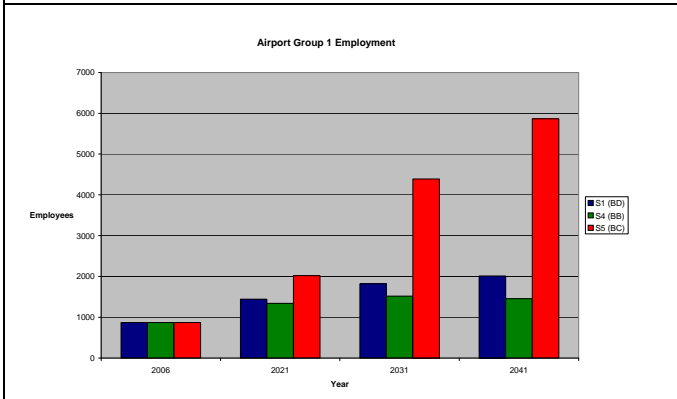
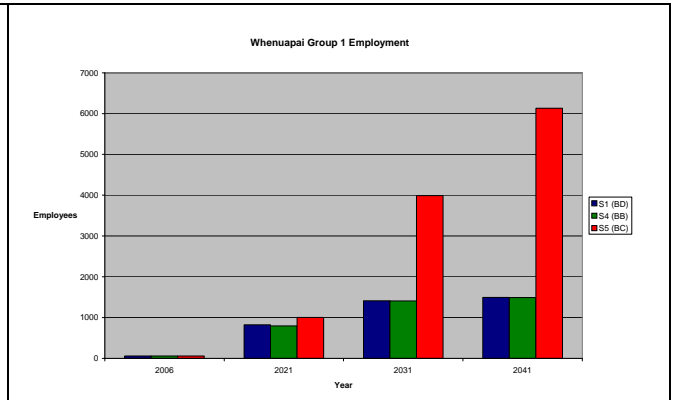
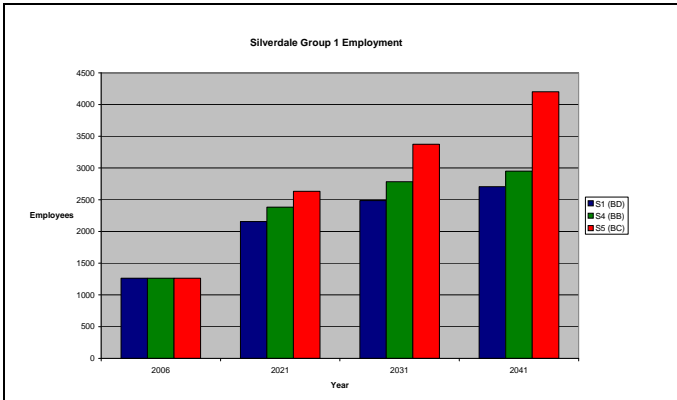


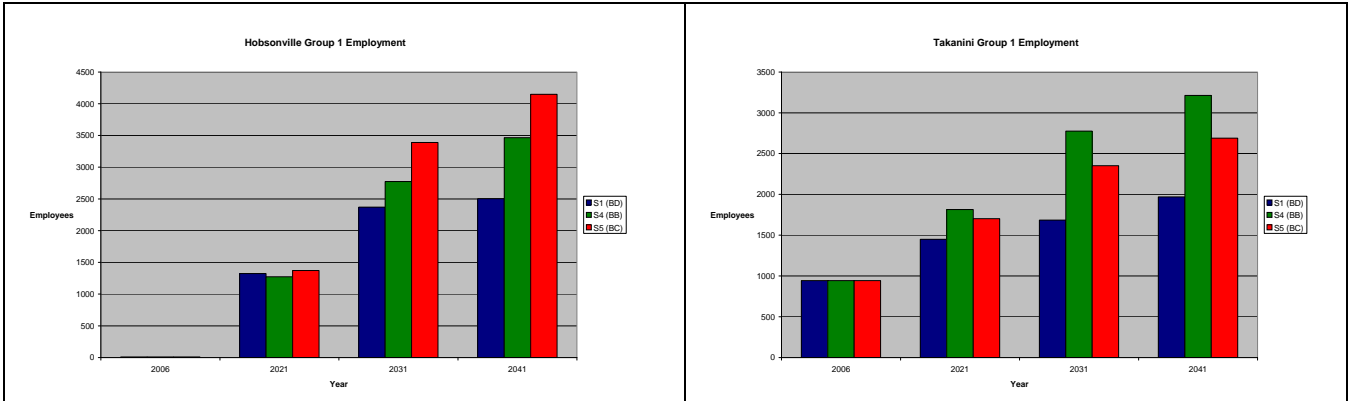




*Group 1 Business land*

Figure 110 Group 1 Business land (specific sites)





*Minimised infrastructure costs*

**Table 6 Transport infrastructure costs (\$ billions)**

	1.1	4.1	5.1
<b>Model Outputs</b>			
Infrastructure (Road)	\$15.5	\$15.5	\$31.4
Infrastructure (PT)	\$9.3	\$7.8	\$4.1
PT Operating	\$7.0	\$7.3	\$4.7
<b>Sub Total</b>	<b>\$31.8</b>	<b>\$30.7</b>	<b>\$40.2</b>
<b>RLTS Fundability Assessment</b>			
Maintenance (Road) <sup>(1)</sup>	\$6.0	\$6.0	\$9.0 <sup>(2)</sup>
Renewal (Road) <sup>(3)</sup>	\$7.2	\$7.2	\$10.8 <sup>(4)</sup>
Travel Demand Management <sup>(5)</sup>	\$2.3	\$2.3	\$2.3
<b>Sub Total</b>	<b>\$15.5</b>	<b>\$15.5</b>	<b>\$22.1</b>
<b>Grand Total</b>	<b>\$47.3</b>	<b>\$46.2</b>	<b>\$62.3</b>
Additional to historic	\$12.3	\$11.2	\$27.3

(1) This is state highway and local road maintenance expenditure 2009 - 2039 as per RLTS 2010 Preferred Option Fundability Assessment. Factored upwards by 16 per cent to meet 2041 horizon of ART3 network value cost.

(2) Factored upwards by 50 per cent to proportionally match 50 per cent increase in total urban area footprint.

(3) This is state highway and local road renewal expenditure 2009 - 2039 as per RLTS 2010 Preferred Option Fundability Assessment. Factored upwards by 16 per cent to meet 2041 horizon of ART3 network value cost.

(4) Factored upwards by 50 per cent to proportionally match 50 per cent increase in total urban area footprint.

(5) This is demand management and community programmes and walking and cycling facilities expenditure 2009 - 2039 as per RLTS 2010 Preferred Option Fundability Assessment. Factored upwards by 16 per cent to meet 2041 horizon of ART3 network value cost.