ALTERNATIVE FUTURES FOR AUSTRALIA’S PERI-URBAN REGIONS

Michael Buxton1 and Lucy Groenhart2

1 School of Global Urban and Social Studies, RMIT University, Melbourne, Australia, michael.buxton@rmit.edu.au
2 Swinburne University of Technology, Melbourne, Australia, lgroenhart@swin.edu.au

Keywords: regional planning, scenarios, Australia

ABSTRACT

Regional communities are growing rapidly in Australia, with the population of Melbourne’s peri-urban region increasing at 2 per cent a year. Despite this, Australia has a weak tradition of regional planning with two thirds of the population concentrated in capital cities. This paper builds on the authors’ previous research into peri-urban regions by testing alternative future scenarios. Using a case study of Melbourne’s peri-urban region, an area under intense development pressure, the research explores the capacity for regional growth under a range of different spatial scenarios. The scenarios include ‘business as usual’, the concentration of growth in major regional cities, and dispersing growth in a network of smaller towns. The methodology employs a geographical information system model and iterative policy decisions. Each scenario is reported on the basis of the location of new population and jobs, and implications for agricultural and urban land consumption, housing needs, infrastructure requirements, and socio-demographic profiles. Scenarios also relate development pressure on rural land and natural resources to development options for regional cities and towns by examining the capacity for transferring development rights from rural land holdings to townships. The paper places regional development scenarios in the context of the dominant Australian paradigm of major city population concentration, and outlines comprehensive regional planning as an alternative to the metropolitan primacy of Australia’s cities.

1 INTRODUCTION

Australia is one of the world’s most urbanised countries, with two thirds of the population living in the five largest capital cities and three quarters in 17 urban centres over 100,000 people. Cities contribute 80 per cent of GDP and 75 per cent of employment. Sydney and Melbourne together have absorbed almost 40 per cent of Australia’s population growth since 2001 (Commonwealth of Australia, 2012). The country’s population growth rate is one of the world’s highest, at 1.5 per cent a year, and up to 1.8 per cent in some cities (ABS, 2008).

As Australia moves from a population of 23 million people in 2013 towards one of up to 42.5 million in 2056, this urban concentration is expected to increase, with 72 per cent of growth expected in capital cities (Commonwealth of Australia, 2011). Currently, only 15 per cent of the Australian population live in medium sized cities with populations from 100,000 to one million (Commonwealth of Australia, 2012). The lack of regional policy reflects this trend. Australian governments traditionally have been focused on cities and rural farming policy, not on cross-sectoral regional planning connecting rural land, regional population settlements and large metropolitan centres.

This paper examines alternative futures through two scenarios for change in the peri-urban region of Melbourne. Melbourne, the capital city of the State of Victoria, has a 2013 population of 4.2 million but is predicted to reach almost 7 million in 2056 in a State with a population of 8.5 million (ABS, 2008). The first scenario (Business-as-usual scenario) projects growth in the case study to 2040 on current trends assuming the continuation of current policy settings. The second (Alternative scenario) proposes an alternative future
where policy settings have intervened to redirect growth from rural areas to townships, and township growth is concentrated primarily within the existing town boundaries of larger regional settlements. The paper discusses the implications of both scenarios for Melbourne’s peri-urban region and the Melbourne metropolis. It situates these scenarios in the context of historical regional planning in Australia, regionalism, peri-urban development and scenario planning.

2 REGIONAL PLANNING IN AUSTRALIA

Successful regional planning integrated horizontally across sectors and vertically across levels of government is rare in Australia. Some attempts at integrated regional planning have been made with varying degrees of success. The most notable was by the Whitlam federal government between 1972-75 through the creation of the Department of Urban and Regional Development (DURD). DURD’s key policy initiatives included the creation of formal planning regions; increased policy co-ordination between Commonwealth, State and local governments; direct financial assistance to local governments; a regional population distribution plan; and major spending on a number of selected regional growth centres such as Albury-Wodonga (Tonts and Haslam-McKenzie, 2005). These initiatives were abandoned with the defeat of the Labor Government in 1975. The Labor Government in 2007 adopted common regional boundaries and established Regional Development Australia (RDA) but with little effect on policy or practice. The work of the Murray Darling Basin Authority is the most important attempt at integrated land use and natural resource planning.

The Western Australian government has developed strategic plans for most of the state’s spatially defined regions (WA Government, 2012). The government is directing large financial payments to regions for improved infrastructure. The New South Wales government introduced some regional planning measures over time in dispersed settlements away from Sydney to plan for environmental improvement and economic performance. The Queensland population is even more dispersed. The most notable large scale regional planning program in Australia has been the South East Queensland (SEQ) planning process. The SEQ2001 plan proposed primarily a scenario of trend growth. The SEQ2005 and more significantly the 2009-2031 plans seek to identify a preferred settlement pattern and encourage more compact development, increasing the proportion of infill to 44 per cent of new housing and concentrating growth in the Western corridor away from the coast (see figure 1) (DIP, 2009). In Melbourne, the 2002 Melbourne 2030 strategic plan also sought to redirect up to 40 per cent of trend growth away from outer urban growth corridors into the established city in an alternative settlement pattern (DOI, 2002) but was abandoned in 2008 in a reversion to trend growth when the urban growth boundary was expanded by 43,000 hectares (see figure 2) (DPCD, 2008). The Victorian government is developing Regional Growth Plans for its five rural regions and is seeking alignment with the Commonwealth RDA committees. However, these tend to be directed towards accommodating trend growth.
Figure 1: SEQ 2009-31 regional plan

Source: DIP, 2009

Figure 2: Melbourne 2030 Plan

Source: DOI, 2002
The most successful example of integrated regional planning in Victoria was for environmentally significant peri-urban regions of Melbourne between 1974 and 1991. In 1971, the State government introduced statutory policy to protect two peri-urban regions, Westernport Bay-Mornington Peninsula, and the Upper Yarra Valley-Dandenong Ranges (UYVDRA). Acts of parliament established regional planning authorities for these two regions, integrated vertically across state and local authorities, and horizontally across a range of sectors. This legislation required the authorities to implement state policy through the development of regional strategy plans and their implementation. Regional plans integrated policy across a range of natural resource, social and economic sectors.

These policies and ultimately the strategy plans were interventionist, seeking alternative futures to path dependent trajectories associated with trend analyses. They included a range of requirements to regulate subdivision and development of land and contain development within defined urban boundaries in order to protect rural land uses, including agricultural practice, landscapes and environmental features. The UYVDRA policies and plan, for example, required the regional authority to “retain and improve where possible, the amenity of the...[region]...for present and future residents, the farming community and other users and the conservation of its natural resources” (UYVDRA, 1980, p. ii). The regional authority identified land fragmentation and development as the main threat to achieving this objective. It severely limited future subdivision and dwelling development on the 62 per cent of 17,272 rural lots and the 42 per cent of 43,334 urban lots without dwellings (Loder and Bayly, 1980). This removal of development expectations controlled land speculation, protected environmental qualities and increased the capacity for agriculture to persist by maintaining comparative rates of return and the potential to innovate. This kind of regional planning is rare in Australia.

### 3 PERI-URBAN THEORY AND REGIONALISM

A peri-urban area can be defined in relation to a nearby metropolitan area on its inner boundary (Burnley and Murphy, 1995), a rural area on its outer boundary (Bunce and Walker, 1992), or as a distinct settlement pattern as the land in between, neither urban nor rural but an interface, a transitional zone (Audirac, 1999, Nelson and Dueker, 1990). The Melbourne peri-urban region can be defined structurally by its physical structure and form, or functionally, or by a combination of spatial and functional factors (Buxton et al, 2006). Structural characteristics include lower population and building densities compared to urban regions, the heterogeneous nature of land uses and rapid rates of change; while a functional analysis of social and economic processes is both interactionist and system based. The resilience of peri-urban systems therefore is determined by both the system components and how they interact, that is by multiple physical and social states. Thus, the relationships between elements determine the system’s function and its capacity to respond to change.

Regions have undergone various stages of conceptualisation. At the most general level, they are adjoining areas or places which share common characteristics (Beer et al, 2003, Agnew et. al. 1996). These common elements may range from formal to functional attributes (Beer et al., 2003, Väyrynen 2003). Regions have been defined according to their social characteristics (Gilbert 1988), physical landscapes (Hamin and Marcucci, 2008), bio-regions (Holloway 1981), or as a locus of economic growth (Storper, 1995 and Scott, 2001). Paasi (1991) describes the region as a socio-spatial unit that is characterised by institutionalised practices that are embedded in the history of the region. Regions are therefore socially produced and reproduced through communication and symbols.

Differentiating between structural and functional definitions can lead to different understandings. A formal region is constituted by the grouping together of smaller geographic units according to identified similarities in contrast to functional ties such as transport patterns and capital flows which connect a hierarchy of settlements internally and to
external urban areas, and which relate sectoral activities such as agriculture and manufacturing to each other. Increasingly, the view has been accepted that regions can only be understood through an analysis of their operation internally and externally. A ‘networked’ relational conception of the region (Castells, 1996, Jones, 2009) recognises regional scale as ‘functional space’ for the deployment of a range of connected activities such as economic and political processes.

In turn, such a concentration on functional connections has implications for urban centres. The concept of the ‘city region’ can reorient urban areas towards their hinterlands and the complex relationships between metropolitan and regional urban and rural areas. The term ‘city-region’ has grown to encompass a breadth of alternative descriptors including: urban regions, metropolitan areas, sub-regions, polycentric regions and functional urban areas (Healy 2009, p. 833). This orientation can supplement or replace a concentration on global city connections and a traditional monocentric and hierarchical centre-periphery model of the city region with ‘aspatial conceptualisations’ and ‘polynucleated urban landscapes’ (Batty 2001 cited in Green, 2007).

4 MELBOURNE’S PERI-URBAN REGION

Melbourne’s peri-urban region consists of two non-urban belts of land round the city and their associated townships extending to about 150 kilometres from the Melbourne central business district. The first, or inner belt, is the Melbourne green belt extending from the metropolitan urban growth boundary to the outer rural boundary of the 17 municipalities which form the Melbourne green belt. The second, or outer belt, includes eight municipalities in a broader arc extending from the western to the eastern coastline. This outer peri-urban zone along with two regional centres, Bendigo and Ballarat, sited just outside this zone, forms the study area for this research (see figure 3).

Figure 3: Melbourne inner and outer peri-urban areas

Source: Buxton et.al, 2011.
The eight outer peri-urban municipalities cover 13,020 square kilometres and include a range of landscapes from mountain forests, woodlands and lowland forests, cleared farming land, and coastal areas. The population in 2013 was about 165,000 on 5.9 per cent of the land area of Victoria. Two regional settlements dominate the study area, Bendigo with a population of 86,000 and Ballarat with a population of 92,000 people (ABS, 2011). The township settlement pattern also includes towns with populations of 500-9,000 people and a small number of larger towns of up to 15,000 people. Many of the towns retain significant heritage character dating from the gold rushes of the nineteenth century. Townships are separated by non-urban areas consisting of important environmental areas of public land, productive landscapes, and rural landscapes with scattered housing. The region is growing at a rate of 1.7 per cent annually (Buxton et al, 2009).

The relationships between agriculture, a range of other system elements such as water, and land tenure illustrate the region's importance for the nearby Melbourne metropolitan area. Australian peri-urban agriculture is highly significant. Houston (2005) estimates that Australia's peri-urban regions comprise less than 3 per cent of the land used for agriculture but are responsible for almost 25 per cent of the gross value of agricultural production in the five mainland states, an underestimate because Australian Bureau of Statistics data measures broadscale agricultural production only. The inner Melbourne green belt is the second highest producer of agricultural products in Victoria with a gross production in 2001 of $890 million from 4,010 farms, although the true value may be closer to double this figure (Gardner, 2002, Langworthy and Hackett, 2000 cited in Parbery, Wilkinson and Karunaratne, 2008). The agricultural output per hectare of this area is the highest in Victoria, at least three times greater than any other region in the state and four times the state average (PPWCMA, 2004). Five municipalities in Melbourne's outer peri-urban belt contributed over 5 per cent, or $390 million, of Victoria's $7.5 billion farm business turnover in 2006, an increase from the region's share of 4.1 per cent in 1997. These municipalities contain almost 2,500 farm businesses, or 7.6 per cent of the total farm businesses in the state. The number of small farm businesses in these municipalities has remained stable since 1997 while declining across the state (Buxton, et. al, 2009). Land tenure is the key factor in a complex network of interacting variables and reciprocal relationships. The findings in the case study and related discussion will show that development impacts would be severe and extensive, detrimentally affecting agriculture, biodiversity and water resources, and lead to high costs in the provision and maintenance of social and physical infrastructure.

5 CASE STUDY METHODOLOGY

Findings for the rural areas of both parts of the study area will be reported for the outer peri-urban belt, and for settlements will concentrate on the regional city of Bendigo.

The approach to regional planning adopted in this paper is part of a growing body of research that uses scenarios as a method to examine the impacts of current trends and practices on the future. A scenario can be defined as a story involving an internally consistent and plausible explanation of how events unfold over time (Swart et al 2004). Scenarios generally are not regarded as predictions but as statements of possible future states. They can be normative subjective narratives which explore plausible futures, or quantified. Various scenario typologies have been proposed. Linear approaches explore a continuation of trends to varying extents, while systems approaches investigate the multiple and complex interactions of elements. Such elements can be physical and social. The concept of risk is central to complex system analyses. Scenarios can be forward looking or involve backcasting. In backcasting, scenarios “define a normative state in the future...then diagnose how to achieve that state over time” (Jones, 2010: 5).

The comparative approach followed in this project uses both a forecasting approach, projecting current trends forward, and a backcasting approach in proposing how to achieve
an alternative future state. The study also uses a modified scenario approach by adopting a game workshop method that tests assumptions about regional futures, visualises outcomes associated with different futures and evaluates different policy and practical outcomes. Glenn and Gordon (1997) propose two types of scenarios, exploratory and normative. Exploratory scenarios follow a foresighting approach, projecting trends based on the question “What do you think the future will be?”, while a backcasting approach is based on the normative question “What kind of future would you like to see”. Backcasting is an imaginative exercise. It requires “working backwards from a particular desired end point to the present in order to determine the feasibility of that future and what policy measures would be required to reach that point” (Robinson, 1990 p.823). Nordlund (2008), Beer (2006) and Jones (2010) also discuss this approach.

Porter (1985), Schwartz (1991), Ringland (2002) and Shoemaker (1995) agree that scenarios are not simply random imaginings but are part of a consistent methodical tool kit for thinking strategically about the future. In the Borjenson et al (2006) typology of scenarios, three main categories of the future are identified: possible, probable and/or preferable futures.

For Scenario 1, business-as-usual projections of population increase were derived from the Victorian government’s ‘Victoria in Future’ (VIF) projections (DPCD, 2008). These were spatially distributed throughout Statistical Local Areas (SLAs) in the case study region on both rural and urban land. Every individual land parcel was plotted for SLAs. Projected future growth was then applied to individual rural and urban land parcels to build a picture of housing growth at a highly localised level beyond that of the more general VIF trends. The concept of an attractiveness index was developed to distribute VIF projections to individual land parcels for a one square kilometre grid surfaces. This index used criteria such as infrastructure, environmental, settlement and demographic factors as indicators of preferences for location and timing of development, and so to identify the most probable settlement pattern within each SLA. Business-as-usual land supply was determined by the number and size of and existing individual land parcels without dwellings; potential for future subdivision; the impact of constraints such as biodiversity, water resources, primary production and flood potential on land use; and land use planning provisions. Demand was distributed by applying the attractiveness index to supply, demonstrating how soon demand would be met in SLAs. The impacts of the BAU scenario of land parcel housing development on agriculture, water use and biodiversity was then analysed.

For the alternative scenario, Scenario 2, most BAU rural development on existing land parcels would be prevented and rural land subdivision restricted. Existing landscapes and natural resources would be protected. Potential rural development would be transferred to nominated townships. These results and those for the Scenario 1 rural areas were reported in Buxton et. al, (2011). ABS census data on trends in household composition were then applied to VIF population and dwelling projections to 2041 for case study townships (DPCD, 2012). Three development scenarios were adopted within townships: business-as-usual involving primarily detached housing on large lots on the fringe of townships; accommodating most township population increase in higher density infill sites within township boundaries; and increasing urban density on fringe sites. For each of these three options, estimates of alternative dwelling supply were gained for categories of minor infill, major infill or broadhectare land assuming different proportions of apartments, townhouses, compact detached and detached housing under each option.
6 FINDINGS

6.1 Rural land development and substitution

If current trends continue under the BAU scenario, by 2040 the existing rural land supply will be exhausted in most locations (Buxton et al., 2011). Rural land supply will come under increasing pressure from 2020, with areas under most pressure those on major transport and infrastructure corridors closest to the Melbourne metropolitan fringe, as well as those on the coast (see figure 5). Landscapes will become progressively fragmented, with housing radically changing the appearance and function of relatively open rural landscapes.

Within ten years planning authorities will either need to provide additional supplies of rural land to cater for demand, further altering landscapes, or will be forced to shift supply to other locations such as townships by limiting or preventing further rural development in rural and coastal landscapes.

Land use and development posed the greatest threat to resilience. Across the eight outer peri-urban municipalities, 53,629 rural lots currently exist, of which 28,802 are estimated to contain occupied dwellings. This existing rural development capacity of 24,827 additional dwellings plus the potential total subdivision capacity of 6,881 parcels provides a potential development capacity of 31,708 dwellings with 80 per cent comprising lots less than 10 hectares in size. Population growth rates of about 1.7 per cent per annum are expected to increase. Under a BAU scenario, dwellings will be constructed on most of these lots by 2030. A similar pattern of fragmented lots and development pressure exists for the inner peri-urban zone where 60-80,000 rural lots without dwellings exist (DOI, 2002).
Development impacts would be severe and extensive, detrimentally affecting agriculture, biodiversity and water resources, and lead to high costs in the provision and maintenance of social and physical infrastructure. The values of the peri-urban area would be degraded to the disadvantage of the people of the region, and its potential future value to Melbourne and large regional urban centres. Residents would be further exposed to risks from climate change and extreme weather events. A cycle of land speculation, small lot subdivision and higher land prices would progressively lower farm viability and eliminate existing agriculture.

The impacts of small rural lot development on habitat would also be severe. Most remnant native vegetation is located on large lots of 40 hectares or more, comprising 28 per cent of the rural peri-urban area, while 71 per cent of vegetation with a bioregional conservation status is situated on lots greater than 40 hectares. Larger lots represent a significant component of the peri-urban region’s future, allowing the maintenance of future options for agriculture and the protection of landscapes, biodiversity and agriculture.

Up to 31 per cent or 7,995 parcels of development capacity used to meet projected demand by 2040, have significant environmental attributes, primary production values, and characteristics representing climate related risks. If development proceeds on these sites large numbers of people will be living in areas of increasing risk from bushfires, flooding and sea level rise with the risk escalating with climate change. Moreover, scattered development has the potential to impose future costs on communities and individuals if transport scenarios beyond peak oil are considered.

Reciprocal impacts are exerted between sectors. Based on the attractiveness ratings in the modelling, in the next 10 years, significant take up of parcels with high biodiversity value will occur in many SLAs. Rural dwelling construction has important implications for private farm dam construction, water capture and stream flow. Farm dam construction is largely unregulated. Many farm dams in this area are also used for other purposes than stock and
domestic. Construction of a further 16,252 dwellings on rural lots in 14 peri-urban catchments will increase stock and domestic dam capacity by 68,262 ML or 35 per cent leading to major reductions in stream flows.

Examples of policy and land use measures which can support the achievement of the alternative rural scenario include: preventing further fragmentation of holdings through rural subdivision controls; proscription of new development on existing small lots through the use of minimum lot sizes for dwelling construction; and the use of tenement controls to hold together existing small jointly owned lots. For example, requiring a minimum rural lot size of 40 hectares would reduce the maximum number of future rural dwellings in protected water catchments from a potential 7,178 to 343. Regulating to prevent dwelling construction on multiple lots held in single ownerships could reduce the number of rural dwellings by up to 95 per cent. In many places, levels of fragmentation are extreme and the restructure of existing lots would be necessary. Other policy positions include the purchase or transfer of development rights, and land purchase. The state government has initiated a limited land purchase system for high fire prone lots, but the transfer or purchase of development rights has been practiced rarely in Australia.

A number of options for transferring demand from rural to township locations were modelled (Buxton et. al, 2011). The transfer of existing rural development capacity of 16,250 dwellings (representing excess of projected rural dwelling growth over demand) to townships would require about 464 additional ha of land at a density of 35 dwellings per ha while the transfer of an excess demand by 2040 for 9,458 rural lots would require 270.2 ha of land at a density of 35 dwellings per ha, or 756 ha at 12.5 dwellings/ha. The land required for township expansions under these projections is a small proportion of the land required for rural residential development of existing or newly subdivided lots in rural locations. In some areas this represents a significant increase in urban land supply to be accommodated in existing towns and their fringes, itself suggesting impacts on infrastructure and community identity.

6.2 Urban land development scenarios

Large amounts of land remain within the existing urban areas of the major regional centres and many medium sized and smaller towns. Substantial land supplies are available also on the fringes of townships. However, both township and fringe urban land is being consumed rapidly because of the use of the dominant model of low density detached housing. Increasing average densities by building a range of housing types would substantially increase the supply of housing in townships, provide greater housing diversity and enable more efficient use of existing residential zoned land.

The three urban development scenarios of BAU, Infill and Fringe density were applied to the State government’s Urban Development Program (UDP) estimates of land supply in the three UDP categories of minor infill, major infill and broadhectare land to gain various estimates of lot yields under different scenarios.

To test different development futures for Bendigo, three options were developed (table 1). Option 1, BAU, assumes that there will be a small proportion of apartments and townhouses on Minor Infill sites and some townhouses on Major Infill sites. The majority of dwellings will be detached, with Broadhectare sites developed at 15 dwellings per ha. Option 2, Urban Density, focuses development on Minor and Major Infill sites, with a higher proportion of apartments and townhouses than Scenario 1. Option 3, Fringe Density, has the same small proportion of apartments and townhouses as Option 1, but the majority of detached dwellings are developed on compact sites, delivering 20 dwellings per ha.
Recent development on major and minor infill sites has been predominantly in the form of detached housing on large average lot sizes between 786 – 1,114 sq. mt. For future development, Bendigo has over 300 ha of land in 826 major and minor infill sites which the UDP calculates will deliver 4,801 lots at an average lot size of 626 sq. mt. For Broadhectare land, Bendigo has 800 ha of supply in 63 parcels to deliver 6,057 lots, at a large lot size of almost 1,466 sq. mt. The three alternative development options were applied to the UDP total land supply for each supply type as shown in table 2.

Table 2: Bendigo Scenario Dwelling Results

<table>
<thead>
<tr>
<th></th>
<th>Apartment</th>
<th>Townhouse</th>
<th>Compact detached</th>
<th>BAU detached</th>
<th>Total</th>
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<tr>
<td><strong>Scenario 1 BAU</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor Infill / Township</td>
<td>639</td>
<td>320</td>
<td>1,096</td>
<td>1,644</td>
<td>3,699</td>
</tr>
<tr>
<td>Major Infill</td>
<td>2,104</td>
<td>4,208</td>
<td>2,405</td>
<td>451</td>
<td>9,168</td>
</tr>
<tr>
<td>Broadhectare</td>
<td>-</td>
<td>-</td>
<td>12,428</td>
<td>3,995</td>
<td>16,423</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3,383</td>
<td>6,766</td>
<td>16,295</td>
<td>4,720</td>
<td>31,163</td>
</tr>
<tr>
<td><strong>Scenario 2 Urban Density</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor Infill / Township</td>
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<td>1,461</td>
<td>274</td>
<td>5,572</td>
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<tr>
<td>Major Infill</td>
<td>2,104</td>
<td>4,208</td>
<td>2,405</td>
<td>451</td>
<td>9,168</td>
</tr>
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<td>4,720</td>
<td>31,163</td>
</tr>
</tbody>
</table>

Table 2 showns that under option 1, BAU, a total of 22,000 dwellings can be accommodated on the current UDP land supply in Bendigo. The majority of these are ‘BAU’ detached dwellings on larger lots, with just over 18,000 delivered under this scenario; 2,600 compact detached dwellings are located on Minor and Major Infill sites only, along with around 1,500 apartments and townhouses. Option 2 Urban Density has the largest total dwelling yield for
Bendigo, with a total of 31,000 dwellings accommodated on the current UDP land supply. Just over half of this total are compact detached dwellings on smaller lots, with around 16,500 delivered; 4,700 BAU detached dwellings are included in this option; 9,000 apartments and townhouses would be accommodated on Minor and Major Infill sites. Option 3 Fringe Density has a yield of 28,345 dwellings on the current UDP land supply. The majority of these are compact detached dwellings on smaller lots, with 20,000 delivered under this option; 4,000 BAU detached dwellings are included. Just over 4,000 apartments and townhouses would be accommodated on Minor and Major Infill sites.

**Figure 6: Bendigo Land Supply and Demand, All Sites**

Figure 6 shows that utilising all of Bendigo’s developable land, between 22,000 and 31,000 sites can be generated using all the development options studied. Demand for housing in Bendigo is satisfied by supply under each of the three development scenarios. Utilising Bendigo’s Minor and Major Infill sites only, under the BAU, demand for housing in Bendigo would take up all of the Infill sites before 2026, and would extend to 2028 under the Fringe Density scenario and to 2031 under the Urban Density scenario.

7 DISCUSSION

The Melbourne peri-urban region is an archetypal socio-ecological system undergoing rapid alteration. Applying a functional analysis to the region, system elements are interacting to cause progressive reciprocal impacts which are leading to substantial sectoral change and are progressively moving the region to a new state. Substantial interactions occur between the peri-urban region and the Melbourne metropolis, such as daily recreational and work population movements, long term in and out migration, the use of natural resources such as water, and food production particularly of intensively farmed produce. However, regional settlement is not acting as an alternative to metropolitan growth either informally or in a planned manner. Melbourne continues to exercise its dominant role taking the vast proportion of population growth and infrastructure expenditure. In turn, the larger regional centres accommodate most of the remaining urban development. There is no evidence of a
network city model or polycentric model supplanting this traditional monocentric approach to settlement.

Land tenure is the key factor in a complex network of interacting variables and reciprocal relationships. Population growth rates of about 1.7 per cent per annum are expected to increase. The rural development capacity primarily of existing small rural-residential lots will be substantially utilised by 2020 in areas closest to Melbourne and along major transport corridors. Under a business-as-usual scenario, dwellings will be constructed on most of the vacant and subdivided rural lots by 2030. Such rural development would deplete many natural resources and remove options for maintaining metropolitan resilience in times of potentially rapid change.

Effective land use planning is a necessary though often not a sufficient tool for the maintenance of landscapes and other environmental features, productive activities, employment and agricultural land markets. However, without the use of stronger spatial planning techniques to prevent further land fragmentation and remedial measures to prevent dwelling construction on existing rural lots, it is unlikely that other measures will maintain the landscapes associated with Scenario 2.

Achieving the alternative rural landscape scenario would require intervention to restrict non-agricultural rural land markets through the use of backcasting techniques to achieve fundamental policy change. A radical reduction of the existing supply of small rural lots would be required along with strong controls over subdivision and a transfer of demand for future rural land holdings to regional settlements. Under the alternative settlement scenarios, extensive capacity exists in the developed areas of larger regional centres and the network of smaller towns to accommodate expected township growth and transferred rural development. This capacity would enable a shift to occur from fringe area, greenfield, township development to existing built up areas of settlements through a policy of increasing existing urban density. Such change would require integrated policy settings, vertically across all areas of government, and horizontally across all social, economic and natural resource sectors.

Acknowledgements
The authors acknowledge the assistance of Andrew Butt and Melissa Kennedy in the preparation of this paper.

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