IMPROVING JUDGEMENT FOR LOCAL AREA POPULATION PROJECTION PRACTICE:

A Conceptual Framework to Evaluate the Forces that Shape Future Urban Form

Anthony William Melhuish

Bachelor of Economics, Flinders University of South Australia

Graduate Diploma in Environmental Studies, University of Adelaide

Master of Spatial Information Science, University of Adelaide

Discipline of Geography, Environment and Population

Faculty of Humanities and Social Sciences

University of Adelaide

Submitted for the Degree of Doctor of Philosophy

February 2015

Dedication

This thesis would not have been possible without the love and support of the two girls in my life – my partner Kathryn and my Maltese Shih Tzu Missy.

Table of Contents

List of Tables

List of Figures

Table of Appendices

Abstract

The development of local area population projection assumptions relies on judgement; the judgement of the projection practitioner, on expert opinion of likely levels and trends in demographic factors or on the contribution of a panel of experts. This judgement is made at a point in time, with limited information, and with the knowledge that reality is complex, uncertain and continually changing. This study aims to improve this judgement.

The underlying premise of this study is that the future distribution of the population will be reflected in future urban form – the structure and density of the built environment. To better understand future urban form requires an understanding of the forces that act on the urban system to shape future urban form outcomes. To better understand these forces, this study develops a conceptual framework to evaluate the substantive arguments that may support or negate scenarios of potential future urban form, using a modified argument-based approach (Lutz, 2006; Lutz, 2009).

This study adopts a mixed-methods approach to overcome some of the problems inherent in intuitive judgement, by facilitating the 'objective judgement' of a panel of experts. The complexity of the urban system is understood through the examination of possible economic, policy, environmental and lifestyle drivers of residential location choice and urban form outcomes. This approach provides an alternative view of likely future urban pathways that is plausible, defensible and potentially more accurate than assumptions based on intuitive judgement alone (Kahneman and Tversky, 1977).

Three perspectives on likely future urban form, and therefore the distribution of the population, are taken – an interpretation of the cross-disciplinary literature around this space; the opinions of a panel of experts; and an evaluation of the substantive arguments underpinning the forces that shape future urban form.

The results from the evaluation of substantive arguments differ significantly from the literature review and panel opinion. The most likely urban form outcome based on the modified argument-based approach is for continued fringe growth; and the least likely outcome is for Transit Oriented Development (TODs) and corridor development. This is an important finding given the prominence of TODs and corridor development in the literature – particularly relating to environmental imperatives - and within government planning strategies.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part or this work will in the future be used in a submission for any other degree or diploma in any university or another tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

I give consent to this copy of my thesis, when deposited in the University Library, being made available for loan and photocopying, subject to the provisions of the Copyright Act 1968.

I give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library catalogue and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

Anthony William Melhuish: ………………………….……………. Date: ……………………

Acknowledgements

I would like to thank my supervisors Professor Graeme Hugo and Dr Dianne Rudd for their guidance and their patience over the duration of my studies. I appreciate their trust and their forward thinking in supporting an unconventional and innovative approach to a complex real-world problem. I would also like to acknowledge the advice given by my colleague and friend Dr Ross Steele at critical junctures of this study.

More generally, I have appreciated the support provided by my employer – the Department of Planning, Transport and Infrastructure. I have had the privilege to be working in an applied demographic role in which I produce the official population projections for South Australia, whilst completing my PhD. The overlap between my professional and academic pursuits has been of immeasurable benefit for this thesis. My employer has provided me with considerable time and resources to undertake this study; without which I doubt that I could have maintained both my work and my study.

I would also like to acknowledge the original author of the 'argument-based approach' on which this study is founded – Professor Wolfgang Lutz. Without the advances in the field of applied demography made by academics such as Professor Lutz, studies such as mine would not be possible. I particularly admire academic work that is creative, groundbreaking and real-world. I hope this study contributes to this approach in an incremental way.

I would finally like to acknowledge that we are all standing on the shoulders of giants – vale Graeme.

Chapter 1 Introduction

1.1 Purpose

The purpose of this study is to improve the development of assumptions for local area population projections. Population projection methodologies generally involve complex computer models that facilitate the production of consistent and plausible projection outcomes. Behind these models, there are yet more computer models that aid in the development of the demographic assumptions that determine projection outcomes. Ultimately, however, at some level the development of assumptions relies on judgement; the judgement of the projection practitioner, on expert opinion of likely levels and trends in demographic factors or on the contribution of a panel of experts. However derived, this judgement will be made at a point in time, with limited information and with the knowledge that reality is complex, uncertain and continually changing.

To make sense of the possibilities for future demographic outcomes requires "reality" to be both constrained and defined. In essence, a dimension needs to be defined through reality that captures the substantial influences that are understood to determine demographic outcomes at that point in time. This dimension or slice of reality can then be viewed through the development of an ontological[1] classification to aid in analysis and understanding. By necessity, taking a constrained view of reality, and developing a structured approach to understanding this constrained view, requires that some issues are omitted. But without this omission we are faced once again with reality.

The aim of this study is not to provide a *solution* to the problem of developing population projection assumptions, as there is no solution – it is a 'wicked problem' (Rittel and Webber, 1973, p.160). What is offered is a methodology to *aid* in developing assumptions – a conceptual framework that facilitates 'objective judgement'. Whether this approach leads to improved assumptions in terms of improved accuracy cannot be proven – other than by ex post evaluation of actual population outcomes. But accuracy is only one of the aims of population projections – plausibility and political acceptability possibly being as important (Smith et al., 2001, p.279).

[1] Ontology is used here in terms of *categories of being* and the ontological distinction and relationships between these categories. Ontology starts with defining what exists or what is real in terms of the problem being considered, and then defines the fundamental classes and entities that comprise that ontology.

The use of judgement is pervasive; whether expressed as opinion, as adjudication based on the weighing of evidence, or through the balanced view of an expert panel. However determined, judgement is ultimately founded on the capacity to reason, to apply logic, or to form beliefs, in the pursuit of truth. But how is truth itself judged? Foulkes (1976, p64), considering theories of truth, includes three tests of truth: correspondence, coherence and pragmatic theory. Correspondence requires that a judgement corresponds with reality; coherence requires that a judgement is coherent with other facts that have already been accepted as true; and pragmatic truth states that if judgement works in practice, then it is true.

Based on these three criteria, judgement is neither objective nor is it absolute. In the main, judgement is subjective and relative to its context. Reinterpreting Foulkes (1976), the test of judgement is whether it corresponds with reality, is coherent with other facts, and works in reality. Judgement in this study, therefore, does not attempt to find the solution, but it does attempt to provide insight that is both valid and useful in developing projection assumptions.

The use of experts in this study is an appeal to authority. Individuals who possess significant experience and knowledge in their field, and have the respect of their peers provide an authority which is above lay opinion. This is not to say that experts are infallible – it is common place for experts to disagree. Indeed, without disagreement, judgement would not be necessary as we would all know the truth.

The structured approach developed in this study is an adaptation of the argument-based approach developed at the International Institute for Applied Systems Analysis in Austria (Lutz, 2006; 2009). The approach is designed to cut-through inherent biases in developing assumptions - such as anchoring to recent events and the potential herd mentality of panels. This approach provides an alternative view of likely futures that is plausible and potentially more accurate than assumptions based on intuitive judgement alone (Kahneman and Tversky, 1977); and one that provides a rigorous and structured approach that is defensible, and therefore possibly more politically acceptable. The ultimate measure of this approach will be whether academics and practitioners in the field see value in its use.

1.2 Overview

This introductory Chapter identifies the research questions and associated aims of this study. The research questions are introduced in terms of the complexity of the urban system and the urban war that is being fought between the forces that shape our cities and population distributions. The role of local area population projection practice in planning is discussed, along with the need for a more systemic and reflexive approach to developing population projection assumptions. The conceptual framework developed in this study is introduced, followed by the contribution that this study makes to the field of population projection practice. An outline of the study is then provided.

1.3 The Research Question

The fundamental concern of local area population projections is where will people live in the future? In an Australian context, will they continue to live in detached housing on the fringes of cities? Will they drift towards amenity-based lifestyle locations? Or will we all be attracted to the 'buzz' of inner-city living? Whatever the outcomes of these decisions, the distribution of future populations will be reflected in future urban form – the structure and density of the built environment.

The underlying premise of this study is that future urban form is fundamental to the future distribution of the population; and therefore the assumptions made about future urban form are fundamental to local area population projection outcomes. Future urban form will ultimately be the result of many factors, including the type of dwellings demanded by different household types, and the life course of these households.

In any growing city, urban form will be in a state of potential flux. To borrow from the Intergovernmental Panel on Climate Change (2007, p.700)[2], cities have a multiplicity of plausible development pathways dependent on economic, social and environmental outcomes and interactions. In this study, these development pathways are explored through possible urban form outcomes, and the resultant distribution of the population.

This study addresses the complexity and uncertainty inherent in local area population projections by developing a conceptual modelling framework to evaluate the forces that shape future urban form.

1.3.1 Population Modelling

> "The critical question is, how can we tell when the model's underlying trends have started (or will start) to change? This is the most difficult question in population forecasting (or any other type of forecasting, for that matter)"

[2] IPCC Fourth Assessment Report, Climate Change 2007: Working Group III: Mitigation of Climate Change, <www.ipcc.ch/publications_and_data/ar4/wg3/en/ch12s12-2-1.html>, viewed 30 September, 2013.

(Smith et al., 2001, p.286)

In their seminal text on state and local population projection methods, Smith et al. (2001) identify three critical issues in evaluating population futures. The first is that evaluating future populations requires an understanding of the underlying trends that drive the population. The term underlying implies something more fundamental than the observed trends in population growth and spatial distribution.

The demographic equation identifies fertility, mortality and migration as the basic demographic factors that determine future population outcomes (Smith et al., 2001, p.30). The underlying trends in these factors are therefore a primary consideration in population futures. But to truly understand the underlying trends that determine population outcomes requires a much deeper evaluation of the factors that drive population outcomes. These underlying trends need to be considered in terms of the dynamic forces and processes that act in confluence or in opposition to shape future population outcomes.

The second critical issue identified by Smith et al. (2001) is that of change. Change can be incremental and relatively predictable, or rapid and come without warning. The ageing of the Australian population is indeed both slow and predictable, and has a momentum that is virtually unstoppable (Hugo et al., 2009). But where will this increase in the absolute number of retirees and the aged reside? Free from the shackles of work, will retirees move from the family home and make a lifestyle change – a 'seachange', a 'treechange'[3] or possibly a 'free-change'[4] – capitalising on the family home to fund a better retirement? Or will they age in-situ locking out the potential for ageing suburbs to be redeveloped and consolidated? These decisions will ultimately have a profound effect on the future distribution of the population and need to be considered in the local area population projection process.

Changes in the level of migration on the other hand can be rapid and dramatic. International migration to Australia has experienced historically high levels in recent years, only to see sharp falls due to changing government policies and international circumstances (Australian Government, 2012). At the local level, the City of Adelaide in

[3] The terms seachange and treechange refer to migration from urban centres to coastal and rural locations in pursuit of lifestyle change (See Costello (2007) for a discussion of the growing trend towards treechange in an Australian context).

[4] Author's terminology and definition

South Australia experienced steady declines in its residential population throughout the mid to late twentieth century. But over the past two decades, this decline has reversed and the City's residential population has doubled over this time (Australian Bureau of Statistics (ABS), 2011a). To know when these changes have started – or will start – is fundamental to providing some foresight of possible or likely changes to population trajectories and outcomes.

The third critical issue in Smith et al.'s (2001) trilogy of issues that make up their critical question may be lost at first blush, but is fundamental to understanding the purpose of this study. Any changes in underlying trends are embedded in the assumptions of the model – population projection practice is in essence an exercise in *modelling* possible population futures; which provides the context for this study. Reality is by its very nature complex and uncertain. Trying to understand reality – whether by categorising and classifying its component parts; evaluating the relationships between these parts; or by describing reality in terms of a stylised system with dynamic interaction – requires simplification. A model of reality is required.

More fundamentally, to understand this study requires the acceptance that "essentially, all models are wrong but some are useful" (Box and Draper, 1987).

This study addresses the critical question proposed by Smith et al. (2001) within the context of local area population projection praxis – a conceptual and theoretical extension to projection practice – through the development of a conceptual modelling framework to evaluate the forces that shape future urban form. To achieve this requires an approach that simplifies the complexity of the city system to provide a window through which the changing underlying trends that drive future urban form can be evaluated. This is a challenge; but one that is necessary if future urban form and future population distributions are to be better understood.

1.3.2 An Urban War

The city is a complex system comprised of dynamic forces that push and pull its urban fabric between urbanity and suburbia and everything in between. The economic, policy, environmental and social forces that drive the continuous change of a city are in constant conflict. Planning policy has a maternal view of nurturing urban form to address issues such as climate change, social exclusion and efficiencies of public infrastructure. Developers are driven by the pursuit of profits and may take the easy road of detached housing on greenfield sites on the urban fringe. Australian families have traditionally been drawn to suburbia and the quarter acre block (Victorian Department of Infrastructure, 1998, p.3), and the lifestyle that this traditional form has to offer. Young singles and retirees are increasingly attracted to the amenity lifestyle, whether the 'buzz' of inner-city living or the smell of coastal ozone. These forces are complex, dynamic and at odds with one another; and the actors that manifest these forces and are influenced by them, are in conflict. There is a silent war raging in the cities and the suburbs, in corporate boardrooms and behind parliamentary walls. This war is real and will have a profound influence on where and how we live our lives.

This study develops a conceptual framework to better understand this urban conflict. Through a better understanding of the forces acting on urban form, possible urban form outcomes can be evaluated along with possible spatial distributions of the population embedded within this urban form.

1.3.3 Local Area Population Projection Practice

Population projections for local areas are essential for planning the future of our cities. Projections of the future distribution of urban populations are fundamental to urban, transport and infrastructure planning and for the efficient provision of services. The network of arterial roads that connect us to the myriad of activities that consume our days; the location of health services, schools and aged care; the location of employment relative to where we live; and access to the more frivolous, yet imperative wants, such as a local café, all depend on appropriate land use planning - which ultimately relies on well founded projections of future populations. Local area population projections provide an evidence-based assessment of the possible and most likely future levels and distribution of the population; and provide a measure of the gap between desired planning outcomes, and the current trajectory and distribution of growth.

The mainstay of population projection methodology is the cohort-component method introduced by Pascal K. Whelpton in the 1930s and based on earlier work of Cannan (De Gans, 2003, p.60; Whelpton, 1936). Pittenger (1976) later summarised a constrained cohort-component application to local areas. Since Pittenger, there has been little advance in local area population projection methods (Alho, 1997, p.71; Wilson and Bell, 2011, p.105). Although a range of bespoke and hybrid local area projection models are in use (Bell, 1997), most approaches are fundamentally empirically based, and rely heavily on past trends in age-specific net-migration and migration profiles (Rogers et al., 1978; Wilson, 2010); the availability of land for future residential development (Hooimeijer and Heida, 1994; Pittenger, 1976); and previous rates of redevelopment and urban infill (see Wilson, 2012 for a recent review of sub-regional population projection methods). Although these empirical approaches will remain fundamental to local area population projection practice, this study offers a more systemic and reflexive approach to developing local area population projection assumptions – one that looks beyond observable demographic trends and potential land availability towards the forces and processes that determine where people will live. It is argued that such an approach can provide additional insight into likely future distributions of the population.

The development of local area population projections requires assumptions to be made about the level, composition and spatial distribution of future populations. The spatial distribution of the population is expressed by the structure, form and patterns of the built environment – commonly referred to as urban form. Future population distributions will be reflected in this future urban form. An important assumption to consider in developing local area population projections is, therefore, the likely nature of future urban form.

As will become apparent in the cross-disciplinary literature review in Chapter four, consideration of future urban form involves both the supply of dwellings and the demand – this demand manifesting in household location choice and dwelling type preferences. As will also become apparent in Chapter two, many local area population projection models require an external constraint based on dwelling potential at the local level. In turn, this dwelling potential requires assumptions concerning future urban form.

To better understand likely future urban form and population distribution the determinants of urban form need to be identified and evaluated – the urban war must be unravelled.

1.3.4 A More Systemic and Reflexive Approach

There are many examples of large-scale urban system models that incorporate economic, landuse and transport data, to develop statistically-based small area population and housing estimates and projections (see Smith et al., 2001, p.215-237 on a range of urban system models – many still in use today). Although the systems approach promoted in this study incorporates the economic, landuse and transport facets of these large-scale models, the system is considered at the conceptual level and not modelled using historical data and statistical techniques. Urban form scenarios are developed as a way of visualising possible future development pathways. The underlying forces that shape urban form, and the substantive arguments underpinning these forces, are derived from a comprehensive review of the literature. These substantive arguments are then evaluated using an expert-panel and a structured argument-based approach – covered in depth in Chapter three.

The complexity of the urban system, and the uncertainty of future outcomes, makes the development of assumptions around future urban form, what Rittel and Webber (1973, p.160) call a 'wicked problem' - problems that are difficult to clearly define; have many interdependencies; are often multi-causal; are often unstable and have no clear solution; are socially complex; and are characterised by chronic policy failure (the Australian Public Service Commission, 2007).

To address such intractable problems Rittel and Webber (1973, p.162) state that the city system:

> "… should be based on a model of planning as an argumentative process in the course of which an image of the problem and of the solution emerges gradually among the participants, as a product of incessant judgement, subjected to critical argument".

O'Neill (2011, p.238) commenting on population discourse in Australia over the past one or two decades suggests that:

> "[p]erhaps good judgement is the thing most lacking … [and that poor judgement] …can come from an inability to assess the relative importance of various factors, or understand how interactions among factors shift outcomes or consequences".

O'Neill also states that integration of the sub-themes of community, migration, settlement patterns, economic viability and environmental impact and sustainability is central to geographic enquiry (O'Neill, 2011, p.238); and that mature judgement skills are needed:

> "… to assess the possible consequences of things not yet happened and to propose options for potentially better outcomes …". (O'Neill, 2011, p.241)

Rittel and Webber's suggested approach, and O'Neill's call for mature judgement, strongly align with the principles of the argument-based approach developed by Lutz (2006; 2009) and modified for this study. The argument-based approach is a formal and structured method that seeks to elicit the views of an expert panel on the underlying forces that influence the levels and composition of future populations. This study applies the argument-based approach to local area population projections. A modified argument-based approach developed for this study is covered in Chapter three.

1.3.5 Research Question and Aims

In the context of the changing nature of postgraduate research, the 'Group of Eight'[5] peak Australian research universities have raised the concern whether conventional requirements that a PhD must focus on a narrow issue needs to be reconsidered. Quoting from a recent independent inquiry by the UK Higher Education Commission (2012) into postgraduate education, the discussion paper states:

> *"A sizeable number of people giving evidence to the inquiry, scientists and economists, Vice Chancellors and industrialists, thought that the PhD was too narrow, with candidates knowing everything about a tiny area and not enough about the broader discipline."* (UK Higher Education Commission, 2012, p.26)

The Group of Eight go on to say:

> "… there is ... a need for broad, strategic and creative understanding flowing from the application of high-level analytical and conceptual skills that build on broad, cross-disciplinary knowledge." (Group of Eight, 2013, p.13)

In line with the comments of the Group of Eight (2013, p.13), this study aims to provide new knowledge which is significant at a broad, strategic level. To achieve this requires that the research question and aims of the study are equally broad and strategic.

The primary question addressed by this study is:

> How can the judgement required in developing assumptions for the future spatial distribution of local area population projections be improved?

The secondary question addressed is:

> Can a conceptual framework that evaluates the substantive arguments that underpin possible future urban form outcomes *aid* in improving the development of these assumptions?

In addressing these questions, the aims of this study are to:

---

[5] Group of Eight, March 2013, *The Changing PhD, Discussion paper*, ACT, Australia, <www.go8.edu.au>, viewed 9 November 2013.

1. Develop a conceptual framework that uses scenarios to identify possible future urban form outcomes
2. Identify the major forces shaping future urban form
3. Use an expert panel to evaluate these major forces based on a modified argument-based approach[6]
4. Identify the most likely future urban form outcome by evaluating the substantive arguments associated with each major force and each urban form scenario
5. Produce a local area population projection scenario of the most likely distribution of the population based on the most likely urban form outcome.

1.4 A Conceptual Framework

Willekens (1990, p.12) discussing a conceptual framework to guide future research states that:

> "[f]orecasting-oriented population research should emphasise the dynamics of demographic phenomena and their interdependence with the changing social, economic and cultural contexts"

and

> "[t]he [conceptual] framework is not a theory nor a methodology, but a way of thinking about complex structures that are changing over time".

Figure 1.1 illustrates the conceptual framework developed in this study. Following Willekens, this framework emphasises the dynamics of demographic phenomena and the relationships with changing social, economic, environmental and lifestyle contexts. This conceptual modelling framework is designed to provide a visual key to the major elements of this study and the relationships between these elements. The major components of the framework are:

- the forces that shape future urban form
- the scenarios of future urban form
- the relationships between these forces and scenarios
- the modified argument-based approach used to evaluate likely future urban form outcomes.

[6] The argument-based approach was developed by the International Institute for Applied Systems Analysis (IIASA) in Austria and is currently used by the UK Office for National Statistics in the development of assumptions for official UK population projections (Lutz, 2006; 2009).

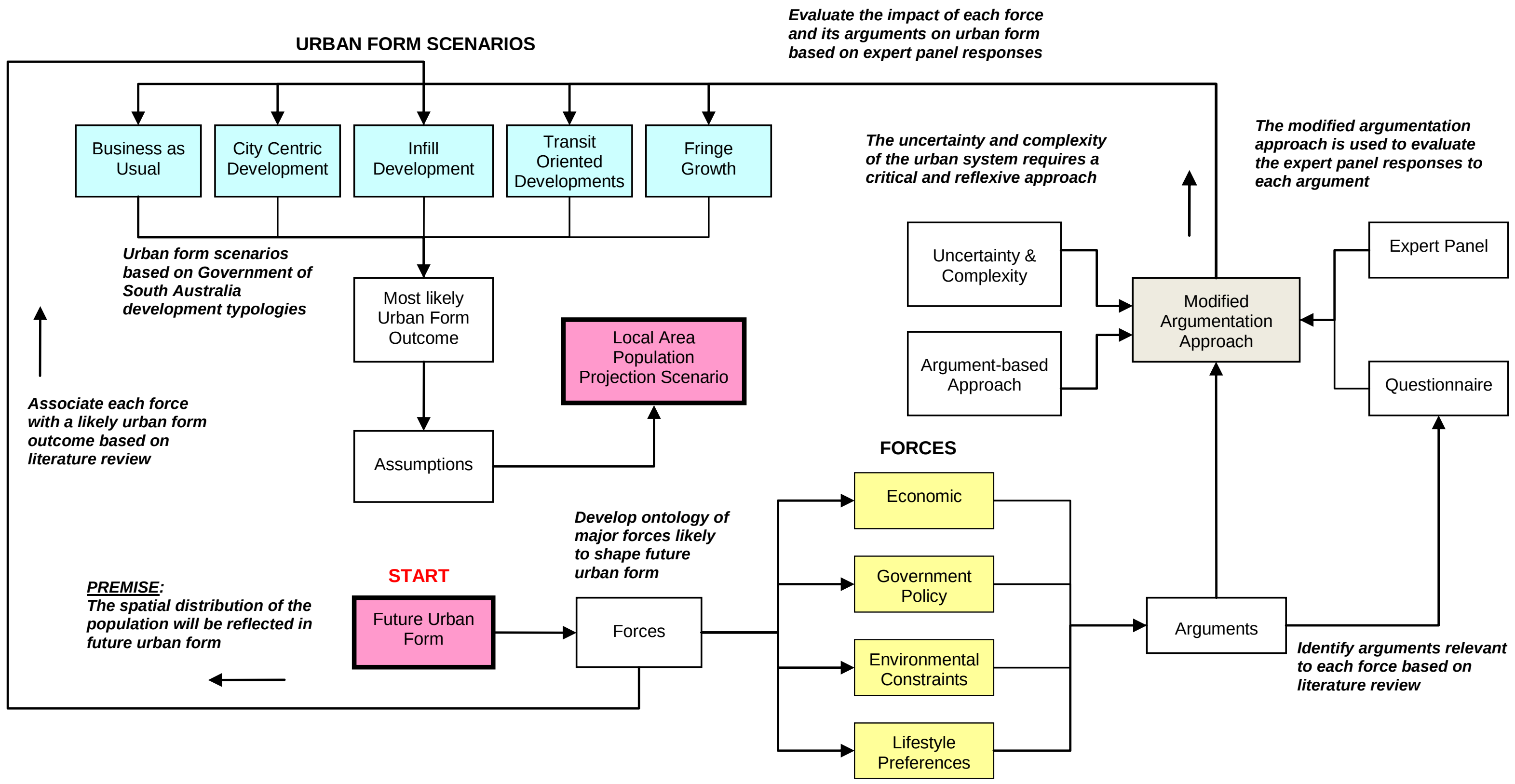
Two important elements of the conceptual framework developed in this study are the uncertainty inherent in population futures, and urban form scenarios. Willekens (1990, p.12) relates uncertainty and scenarios by suggesting that the use of scenarios is a method for dealing with uncertainty. Willekens (1990, p.12) states that the goal of scenarios is not to predict the future "… but to provide the user with alternative, internally consistent futures against which decisions can be tested and actions planned". Willekens (1990, p.12) goes on to say that "[b]oth scenarios and forecasts may include judgemental factors. Expert opinions and the individual's expectations may be considered in the exploration or prediction of the future".

The conceptual framework developed in this study is designed to evaluate the forces that shape future urban form, with the goal of identifying the most likely future urban form outcome. The most likely future urban form can then be incorporated into the assumptions for the future distribution of the population within the population projection process. To achieve this goal requires that the complexity of the urban system, the myriad of forces acting within that system, and future urban form outcomes, are reduced to their fundamental form to enable the system to be better understood.

Following Willekens (1990) the complexity and uncertainty inherent in population projections and future urban form is addressed through the use of scenarios – scenarios of future urban form and population projection scenarios based on this urban form. The forces acting on future urban form are equally complex and uncertain. To address this complexity and uncertainty, the concept of ontology – or classification – of forces is adopted. Based on the broad, cross-disciplinary literature review in Chapter four, the four forces of economics, government policy, environmental constraints, and lifestyle preferences are identified. The literature review is used later in this study to derive arguments associated with each force that may either support or negate each urban form scenario.

The argument-based approach developed by Lutz (2006; 2009), is modified to enable a comparative evaluation of the likelihood of each urban form scenario, based on the responses of a panel of experts to a questionnaire on urban form. The results of the argumentation exercise can then be compared with the findings from the literature review, and the subjective opinion of each panel member on the most likely outcome for future urban form.

Figure 1.1: A Conceptual Framework



Logic:

- The spatial distribution of the population within the metropolitan area will be reflected in future urban form
- Identifying likely future urban form outcomes will, therefore, inform the likely population distributions represented in local area population projections

Method:

- Develop plausible urban form scenarios
- Identify the major forces that shape future urban form and the substantive arguments that support or negate each urban form scenario, based on the literature review
- Determine the likely urban form outcomes associated with each force based on the literature (e.g. If successful, planning policy will result in city-centric and transit oriented development)
- Identify the likely impact of the arguments on future urban form by evaluating the expert panel responses, using a modified argument-based approach
- Identify the likely future urban form outcome based on the expert panel responses
- Develop local area population projection assumptions based on the likely future urban form outcome

In essence, the conceptual framework provides the structure for analysis; and the panel responses and their evaluation calibrate this structure to identify the most likely future urban form outcome.

Finally, the future population distribution embedded within the assumed future urban form is used to project a local area population scenario for the study area - Greater Metropolitan Adelaide.

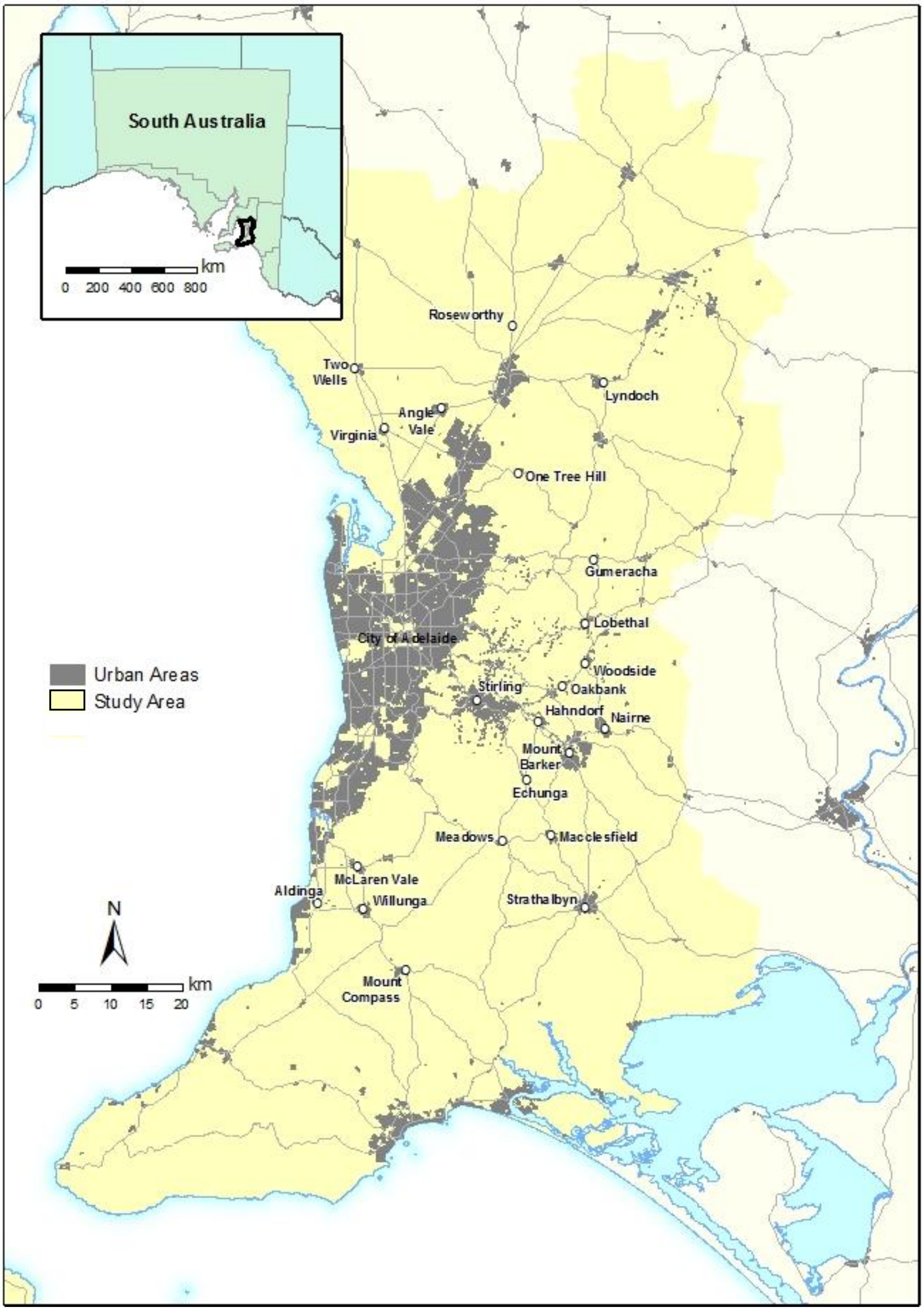
1.5 The Study Area

The conceptual framework developed in this study is not designed to be applied to a particular urban location. The location-specific elements of the framework are contained in the development of urban form scenarios, and the interpretation of the literature review for the generation of arguments relevant to the study area. The responses to the expert panel questionnaire will also be informed by a local understanding of the study area.

This study focuses on the urban and peri-urban areas of Greater Metropolitan Adelaide in South Australia. This area has been chosen as a case study as it is growing in both population and in dwelling stock. Although traditionally a low density city dominated by detached houses within ever-expanding suburbs, Adelaide and its surrounds are at a potential cross road in its development pathway. Government strategic planning in the form of a '30 Year Plan for Greater Adelaide' (Government of South Australia, 2010a) has taken a high profile in attempting to redirect future urban growth to higher density living in the City of Adelaide and other centres; along major transport corridors; and to growth areas beyond the fringe. A critical question for the future of Greater Metropolitan Adelaide is to what extent will aspirational strategic policies actually influence future urban growth, compared to the preferences of households and developers, and other key influences on future urban form?

The geographic and commercial centre of Greater Metropolitan Adelaide is the City of Adelaide – an area of approximately 2.5 square kilometres surrounded by a greenbelt known as the Adelaide Parklands. Metropolitan Adelaide covers an area of approximately 1,800 square kilometres bordered by Gulf St Vincent to the west and the Adelaide Hills to the east. For the purposes of this study, Greater Metropolitan Adelaide is defined as metropolitan Adelaide with the addition of Adelaide's adjacent peri-urban areas to its north, east and south. In 2011, this region had a population of

Figure 1.2: The Study Area – Greater Metropolitan Adelaide



approximately 1.3 million residents (ABS, 2011a). Figure 1.2 shows the study area and its location within South Australia.

1.6 Contribution to the Field

Although there are exceptions (Torrens, 2006; Waddell, 2000), many local area population projection methods rely on demographic and land-use models to distribute likely future populations within the urban space (Hooimeijer and Heida, 1994; Pittenger, 1976; Wilson, 2012). This study makes a conceptual and theoretical leap from this empirically and methodologically dominated approach, towards an approach that considers the processes and behaviours that drive spatial urban outcomes. The development of a conceptual framework takes local area population projection practice toward the level of praxis – the nexus between practice and theory. This is considered to be an improvement on the land availability and development capacity approach, as it provides a mechanism to incorporate the underlying drivers that may influence different development pathways, and therefore future distributions of the population.

Chapter two argues that local area population projections have a very strong empirical basis – particularly the application of past trends; with recent developments toward probabilistic techniques that address the uncertainties[7] of projections. It is argued in this study that although trend analysis is necessary, many future trends and population behaviours will potentially differ from the past. As such, a deeper understanding of current and potential future trends and behaviours is required. One method to better understand these possible future trends and behaviours is through the exploration of the literature relevant to this space. In this study, the complexity of the urban system is understood through the examination of possible economic, government policy, environmental and lifestyle drivers of residential location choice and urban form outcomes, covered in the very broad and well developed literature around these topics. This study forms a nexus between the conceptual and theoretical literature on the drivers of urban form, and the likely distribution of future urban populations represented in local area population projection outcomes. More fundamentally, this study addresses the conflict between the forces and between the actors that ultimately determine future urban outcomes, and their spatial manifestations.

The major contribution that this study makes to the field of local area population projection practice is an alternative to 'intuitive judgement' – referred to in this study as 'objective judgement'. This alternative approach can provide population outcomes that differ fundamentally from those based on past trends, expert opinion or conventional

[7] The issue of uncertainty is addressed in Chapter two with a distinction made between uncertainty and risk.

wisdom. These outcomes are based on an approach that is both structured and defensible.

This study also extends the role of expert judgement, and the argument-based approach in population projection practice, beyond current demographic applications at the national and regional level (Bell et al., 2011; Dunstan, 2011; Lutz, 2009; Shaw, 2008) to local area population projections, and the dimension of space.

1.7 Study Outline

Following this introduction, Chapter two considers the current state of local area population projection practice with its largely empirical base. Uncertainty in population projection practice is then addressed. The issue of uncertainty, which pervades population projection practice, is discussed in terms of knowledge – what do we know and how do we know it? A distinction is made between Knightian uncertainty and measurable risk (Knight, 1921), and the need for a critical and reflexive approach to developing population projection assumptions is advocated. A broad coverage of mixed-methods research methodologies then establishes the need to move away from predominantly quantitative methods, towards a more reflexive approach to developing assumptions for local area population projections.

Chapter three is an in-depth discussion of the argument-based approach and its application to the setting of assumptions for population projections. The need for a modified argument-based approach is discussed in terms of the categorical nature of urban form scenarios. A modification to the argument-based approach is introduced that enables urban form scenarios to be evaluated and compared within the conceptual framework. An argument-mapping approach that leverages arguments to both the underlying forces and five urban form scenarios, is developed for this exercise.

Chapter four contains the major literature review for this study. It discusses the city as a complex system and the need to understand the forces that shape future urban form to better understand this system. An ontology of the forces that may shape future urban form is developed. The relationships between the very broad literature on economic, government policy, environmental constraints and lifestyle factors, and urban form, are also developed. This Chapter also provides support for the development of urban form scenarios in Chapter six; and forms the basis for the arguments to be evaluated in the modified argument-based approach.

Chapter five provides an Australian perspective on urbanisation and the ontology of forces discussed in Chapter four. It also discusses Australia's changing demography in relation to the ageing of the population, and relatively high levels of overseas migration.

Chapter six considers the concept of urban form in terms of the relationship between spatial form, and social and economic activity. An overview of the current structure of urban form in the study area - Greater Metropolitan Adelaide in South Australia - is provided in terms of history and key influences since the establishment of the City of Adelaide as a municipality in 1840. The concept of scenarios to characterise urban form is also introduced, along with the development of five urban form scenarios based on an approach developed by the urban planning authority for South Australia[8].

Chapter seven makes the link between the forces that shape future urban form and urban form scenarios. A set of substantive arguments is then developed based on the ontology of forces that shape future urban form.

In Chapter eight the results of the expert-panel questionnaire are presented; including the transformation of the qualitative responses to quantitative outcomes and their interpretation.

Chapter nine concludes this study by restating the need for improved methods for assumption setting for local area population projections; and the contribution that the conceptual framework, and the modified argument-based approach, make to this improvement. The three results for likely future urban form from the literature review, expert panel opinion, and the evaluation of arguments, are compared to illustrate the benefits of using the modified argument-based approach. Suggestions are then made for future work that will further develop the conceptual framework, use of scenarios and the modified argument-based approach, in local area population projection practice.

[8] The Department of Planning, Transport and Infrastructure is responsible for strategic urban planning in South Australia.

Chapter 2 Population Projections, Uncertainty and the Research Methodology

2.1 Introduction

The two broad themes of this study are local area population projections and urban form. This Chapter discusses population projection methods in general with a focus on local area population projection practice – particularly as it is applied in the South Australian context. A central tenet of this Chapter is the empirical nature of population projection practice and the uncertainty associated with all projections. Uncertainty is considered in terms of knowledge and the distinction is made between measurable risk and unmeasurable uncertainty.

The research methodology used in this study is then considered; comprising a broad coverage of mixed-methods research methodologies.

2.2 Local Area Population Projection Practice

Although there are numerous methods that can be used to project population, the cohort-component model - which accounts for births, deaths and migration - is the most commonly used at the national and state level (Smith et al., 2001). At the local level the choice of method is more diverse and depends on data availability, output requirements, available resources and possibly most importantly, the knowledge and experience of the projection practitioner (Bell, 1997; Wilson, 2012).

At the local area level, it is migration that is generally the most significant, the most volatile, and the most difficult component to model (Wilson, 2012, p.33; Wilson and Rees, 2005, p.337). There are a range of approaches that can be taken to project migration. Wilson (2012, p.34) lists the following broad approaches (only those likely to apply to local area projections have been included here):

- Assume no change to past migration levels
- Extrapolate past trends into the future
- Use judgement (this can be subjective judgement or through the use of a structured approach such as the argument-based approach adopted in this study)
- Follow observed trends from a suitable reference region

- Use leading indicator data such as development applications and development plans
- Link migration to separate projections of independent variables that may influence migration, such as economic or social factors
- Project migration as the outcome of demand and supply factors, such as the demolition or construction of housing.

In practice, local area population projection methods tend to use an integrated approach, coupling the inputs and outputs of several models to derive projection outcomes (Wilson, 2012, p.41).

The coupling of land use allocation models with cohort-component outputs is one example of an integrated approach to local area population projections (Pittenger, 1976; Smith et al., 2001). The incorporation of land use allocation in multi-regional population projection models can be extremely sophisticated, such as the uncalibrated growth module in the California Urban Futures Model used in California in the United States (Landis and Zhang, 1998). This approach to allocating land use includes multiple urban land uses (including single-family residential, apartments, retail and industrial), and allows competitive bidding for preferred sites. This level of sophistication is beyond the capacity of most local area population projections. A more direct approach to land use allocation is to derive an independent projection of the likely future distribution of dwellings (Pittenger, 1976; Smith et al., 2001). Examples of this type of approach include POPGROUP used extensively by local authorities throughout the United Kingdom (Andelin and Simpson, 2005), and QSAM used by the state of Queensland in Australia (Wilson, 2012). Coupled with the housing unit method which calculates total population by multiplying the total number of occupied private dwellings by the average number of persons per dwelling, the land use allocation model provides a total population constraint for each local area (Shryock et al., 1976, p.427). In general terms, the land use allocation approach potentially aligns with Wilson's (2012) extrapolation of past trends, the use of leading indicator data, and the outcome of demand and supply. This study extends the land use allocation approach by introducing future urban form as a key determinant of future land use and therefore population distribution; and by incorporating expert judgement within the structured argument-based approach to guide this process.

2.2.1 Household Formation

Growth in the number of households is the primary driver of the increase in demand for housing. This growth is a product of population growth, changing age structure and the rate of household formation (National Housing Supply Council (NHSC), 2013, p.108). Net migration is a major contributor to both population growth and the increase in the number of households. Household numbers also increase when children move out of home, couples separate or group households fragment. Conversely, the number of households decreases when couples marry or cohabitate, and potentially when group households form.

Current ageing of the Australian population has been projected to lead to an increase in the proportion of dwellings occupied by a single person (NHSC, 2011, p.26). Although the number of dwellings occupied by a lone person increased by almost 270,000 between 2001 and 2011, the proportion of dwellings occupied by a lone person actually remained stable (NHSC, 2013, p.35). The increase in the proportion of lone person households – ceteris paribus - would lead to a fall in the average household size as was observed in the ten year period prior to 2001 (NHSC, 2013, p.31). The potential increase in the proportion of lone person households will be driven by the ageing of the baby boomer[9] generation, due predominantly to the death of a partner (NHSC, 2013, p.35). Although this process would lead to a reduction in household size, in itself it does not increase the number of households or the overall demand for housing.

The relevance of household formation, migration and changing household size to this study – particularly in aged households – is *where* will these households live? Some projection models project households by household type and allocate particular household types to detached or attached dwelling type (Wilson and Cooper, 2013, p.7). This approach is based on the propensities of different household types to live in a particular dwelling type (Wilson, 2013); but also requires adequate “sorting” of households toward their preferred type; and sufficient availability of and access to particular dwelling types (see Wulff et al., 2004, for a discussion on why small households don’t necessarily live in small households).

[9] Although the exact definition of the baby boomer generation varies between sources, the ABS defines the baby boom period in Australia to be people born between 1946 and 1965, inclusive (ABS, 2003). This group comprise a cohort of more than 4 million Australians who are now entering its retirement years.

Examples of the type of relevant questions concerning households in this study are:

- Will ageing households remain in their detached dwellings - locking out potential family households from existing suburbs – or will they move to aged care, downsize to a city apartment or make a ‘seachange’?
- Will large numbers of international students reside in student accommodation, live in group housing or demand private apartment living?
- Will families continue to live in large, detached dwellings in the suburbs and on the fringe, or choose a smaller dwelling closer to urban amenities?

Addressing these types of questions provides some insight into the broader patterns of possible future demand for housing location; but household preferences are not always satisfied. The provision of housing is influenced by demand but there is a greater context to what housing type is provided and where. This study takes a broad, strategic approach to understanding the economic, government policy, environmental and social forces that influence what type of housing is provided and where, and therefore a city’s future urban form.

2.2.2 Current State of Population Projection Practice in South Australia

For more than 30 years, South Australia’s official population projections have been the responsibility of the State planning agency – currently the Department of Planning, Transport and Infrastructure (DPTI) (Government of South Australia, 2010c, p.3). DPTI and its predecessor agencies produce population projections at the all-of-State, regional and local area levels. Traditionally, three population projection series are produced for South Australia and its Statistical Divisions (SDs)[10] by age and sex based on high, medium and low demographic assumptions for migration, fertility and mortality. In addition, a single series is also produced for Statistical Local Areas (SLAs)[11] by age and sex, based on the medium series for SDs. Projections are updated every five years following the release of detailed data on population, mortality, fertility and migration around the five-yearly Census of Population and Housing conducted by the Australian Bureau of Statistics (ABS) (Government of South Australia, 2010c, p.4)

---

[10] Until 2011, the Australian Bureau of Statistics (ABS) defined the hierarchy of geographic regions known as the Australian Standard Geographical Classification (ASGC) which included the State, its Statistical Divisions and Statistical Local Areas; comprehensively covering the whole of Australia. The ABS has now adopted a new geographic standard.

[11] SLAs within Greater Metropolitan Adelaide have an average population of approximately 20,000 people.

South Australia currently uses two cohort-component systems to produce population projections for South Australia and its regions (Government of South Australia, 2010c):

- NEWDSS (New South Wales Demographic Simulation System)[12] is used to produce age-sex projections for South Australia and its seven Statistical Divisions (Wilson, 2011)
- SAASPPS[13] (Small Area Age-Sex Population Projection System) is used to produce age-sex projections for Statistical Local Areas (SLAs).

NEWDDS and SAASPPS are cohort-component models that project single and five year age groups over one and five year projection intervals (respectively) by applying a set of assumptions for fertility, mortality and migration to the base population of the State, its Statistical Divisions and each of its SLAs. SLA projections within Greater Metropolitan Adelaide are constrained to independent projections of total population derived from a land use allocation model known as HAM – Housing Allocation Model. Conceptually, HAM is driven by two processes – the availability of residentially zoned broadacre land generally on the urban fringe; and recent rates of infill development within the existing urban footprint. HAM is designed to shift the share of residential development from local areas that become constrained as the available development opportunities decline, toward local areas that have significant land availability[14]. The assumptions regarding available residential land provided to HAM for each local area are therefore critical to dwelling and population projection outcomes. To achieve a population distribution based on an assumption of continued fringe growth would require significant development opportunities to be made available within the model on appropriately zoned land on the fringe. To achieve an urban consolidation outcome

[12] NEWDSS was designed and coded by the New South Wales Department of Planning in Australia and amended to produce population projections for South Australia and its seven Statistical Divisions.

[13] SAASPPS was designed and coded by the Applied Population Research Unit at the University of Queensland. See Cooper, J, July 2005, *Operations Workbook SAASPPS Population Projections For Statistical Local Areas Of South Australia*, Demographics Australia, University of Queensland for details on this projection system.

[14] Pers. Com.: Ian McQueen, previously Department of Planning and Local Government in South Australia, June 2012.

would require significant infill opportunities within brownfield[15], and existing residential locations.

The South Australian government conducts an extensive residential land supply monitoring program known as the Housing and Employment Land Supply Program (HELSP) (Government of South Australia, 2010b), which captures all known developments in the development pipeline; all residentially zoned land; and contains assumptions on redevelopment potential based on factors such as site area and the ratio of the capital value to site value – the proportion of the overall value of the property which is land value. HELSP is augmented with additional development potential for those local areas identified in strategic planning documents for rezoning in future years; in particular policy directions in the 30 Year Plan for Greater Adelaide.[16]

Altering the assumptions for development opportunities within HAM is the mechanism by which scenarios for urban form can be built into the projection process - population projection outcomes will then reflect these urban form scenarios. Appendix A20 contains a detailed description of the inputs and outcomes for the five distributional scenarios.

2.2.3 What is local?

Using the administrative areas of SLAs for planning policy may be problematic when they do not align with community, social or economic aspects of the urban environment, for which policy is designed. As urban environments evolve and become more complex, this issue may become more apparent (Parker et al, 2012, p.54).

Defining neighbourhoods on the basis of social communities may also have difficulties as desired policy outcomes are generally on a larger scale (Bates, 2006, p.6). Bates (2006, p.7) suggests that the complexities of market responses to policy intervention require "… areas explicitly based on housing-market segmentation rather than convention".

The ABS SLA was a general purpose spatial unit used for the collection and dissemination of statistics. The new geographical area which has replaced the SLA – Statistical Areas Level 2 – is intended to represent a community that interacts together

[15] Brownfield sites are land currently used for non-residential uses such as industry that can be converted to residential.

[16] The 30 Year Plan for Greater Adelaide is part of the urban planning strategy for South Australia. This, and other state plans are dealt with in Chapter four.

socially and economically (ABS, 2015). Although, some attempt has been made to introduce a more meaningful spatial unit, it is unlikely that any generic spatial unit will be appropriate for all government policy purposes.

2.2.4 The Use of Judgement in South Australian Projection Practice

The demographic assumptions used in the SAASPPS model require judgements to be made concerning fertility, mortality and net migration. Of these, net migration is by far the most important, the most complex and the most confounding. In the main, these judgements are made by the population projection practitioner with internal peer review by DPTI staff.

The focus of this study, is the future spatial distribution of the population and, in the context of South Australia, this depends on the outcomes of HAM. As discussed above, the primary input to HAM are assumptions regarding the availability of land for residential development. These assumptions are derived from extensive land data collected and maintained by the State government. Urban development is, however, dynamic, and zoning will change with the changing strategic vision of the government of the day. Over the medium to long term, the planning regulations will evolve providing more development opportunities in some areas and affording protection to others. As this strategic policy changes, assumptions need to be made about their impact on development and urban form. At this time, this judgement is both subjective and pragmatic, with spatial outcomes being guided as much by data as by the judgement of the practitioner, conditioned by the decision making of the Executive.

The primary purpose of this study is to provide a more structured approach to evaluating the likely future of urban form and therefore the assumptions that are provided to HAM. This is likely to result in population projection outcomes that are significantly different to current outcomes. Difference, however, does not necessarily mean better. Although accuracy is an important measure of population projection outcomes, it may also be a misleading indicator of a projection's value. If a projection is credible, feasible and politically acceptable, then one of the more useful applications of a projection is gap analysis. If a projection is considered to have some foresight of future population outcomes, a judgement can be made whether this is a desirable outcome. If it is not, then policy intervention is required to redirect possible population outcomes towards a more desirable trajectory of growth. A post-hoc evaluation of a projection that deviates significantly from actual outcomes may indicate successful policy intervention, as much as a poor projection.

The improvement in the projection process offered by this study is the potential for increased credibility, and political and community acceptance, of both the process and the outcomes. The use of an expert panel provides greater scrutiny of the assumptions, and a contribution from a range of appropriately selected experts can provide a more informed and democratic outcome, than one based on an individual practitioner. Most importantly, the use of a structured approach to evaluate the drivers of future urban form may provide a more objective and nuanced view of future populations.

2.2.5 The Empirical Nature of Population Projection Practice

Booth (2006) provides a comprehensive review of developments in demographic forecasting[17] between 1980 and 2005. Booth (2006, p.1) categorises three approaches to forecasting demographic processes: extrapolation, expectation and theory-based structural modelling. Extrapolative methods – which are described as "essentially atheoretical" (Booth, 2006, p.4) - use past trends to determine the future trajectories of the underlying demographic components of the population as a whole. Underlying structural changes - whether social, political, economic or technological - are not considered in these approaches and, as such, they are unlikely to achieve satisfactory results for populations that have changing or variable trends in their demographic components.

Methods based on expectation include: individual expectations about personal behaviours - particularly relating to fertility; a structured process based on the expectations of a group of experts such as the argument-based approach adopted in this study; and the less structured use of informed judgement of experts (Booth, 2006, p.5). These types of models can take account of expectations of changes in the underlying demographic trends and exogenous influences on these trends, although in a fairly informal manner. In this regard, models based on expectation can accommodate a theoretical structure and hypothesise about future events, but are not necessarily theoretically based.

Structural models explicitly take account of non-demographic variables that may affect demographic components and future populations. Exogenous factors, such as changes in underlying social attitudes toward families and child rearing; economic factors that may influence household formation; and policy initiatives, such as changes to the baby-

[17] Forecasting as used here by Booth refers to the collection of activities ranging from objective assumption-based projections through to theoretically-based structural modelling.

bonus[18], can all be embedded into a structural model to evaluate the possible impact of these factors on demographic outcomes. Booth (2006, p.7) comments that structural modelling is often regarded as the ideal in demographic forecasting but as yet has not improved the accuracy of these forecasts – particularly with regard to capturing turning points in demographic trends or underlying structural changes.

The development of demographic forecasting methods has been focused primarily on improving statistical methods for forecasting demographic components – particularly for improving model fit to the available data. Techniques such as forecasting life expectancy using univariate time series analysis and forecasting mortality using the Lee-Carter model, are common practice amongst technical demographers (Lee, 2000). These and other statistical methods for forecasting demographic components have been improved and revised over several decades; but as Booth (2006, p.28) states "… little progress has been made along the development path of forecasting …". Booth goes on to state that "… accuracy is a main goal … [of forecasting]" and that "… [i]mproving the accuracy of demographic forecasting is [still] a major challenge".

One of the major conclusions that can be drawn from Booth's review of demographic forecasting is that despite significant developmental effort in improving statistical techniques and models, an empirical approach to demographic forecasting alone – particularly one based on modelling demographic trends - is unlikely to provide more accurate demographic forecasts or population projections. To improve the accuracy of these forecasts and projections will require "… methods that … have the capacity to capture structural change …" as well as "… a greater understanding of the causal factors and processes that determine the level, sequence and timing of demographic events …" (Booth 2006, p.31).

Booth (2006, p.571) states that:

> "…it would appear that demographic behaviour, like most human behaviour, is too complex to be easily modelled and forecast; indeed, it may be inherently unpredictable"

And that progress over this period

> "… has not resulted in theory-informed forecasting; current demographic theory is too general to be of such use …"

[18] The baby-bonus is an Australian federal government initiative designed to help with the cost of having children and potentially to increase the number of births (http://www.humanservices.gov.au/customer/services/centrelink/baby-bonus).

Booth's statements resonate with the current study. This study develops a conceptual framework to evaluate the casual factors and processes that shape future urban form, and the distribution of the population within a local area population projection context.

2.3 Uncertainty

Uncertainty is at the core of all population projections. Future population magnitude, geographic distribution and demographic structure are all uncertain. But what is uncertainty and how is it addressed within current population projection practice? This Section considers uncertainty in terms of knowledge – what do we know and how do we know it? This perspective on uncertainty provides the rationale for needing an alternative approach to developing assumptions in local area population projection practice. As previously argued, traditional approaches are generally empirical and heavily reliant on past trends in the underlying demographic factors of fertility, mortality and migration. It is proposed here that these empirical methods may address measurable risks based on variability within past data and recent trends, but do not account for unmeasurable uncertainty which is beyond the scope of standard empirical methods. To address the uncertainty inherent within population futures requires a critical and reflexive approach that can look beyond the immediate and compelling opinions of experts and empirical data. Such an approach needs to compliment empirical methods – not replace them – with the aim of improving the development of assumptions and population projection outcomes.

2.3.1 An Unknown Future

> "[T]here are known knowns; there are things we know we know.
> We also know there are known unknowns; that is to say we know there are some things we do not know.
> But there are also unknown unknowns – there are things we do not know we don't know" (Rumsfeld, 2011, Author's note).

These words were famously uttered by the former United States Secretary of Defense Donald Rumsfeld in a 2002 press conference on the lack of evidence of Iraq's possession of weapons of mass destruction (Rumsfeld, 2011, Author's note). The concepts embedded in these phrases apply generally across the temporal bounds of the past, present and the future – all of which have relevance to the practice of population projection. At a metaphysical level Donald Rumsfeld encapsulates the meaning of epistemology – in essence, what is knowledge? At a more pragmatic level, Rumsfeld is addressing the issue of uncertainty.

Population projection practice generally deals with known knowns; with some consideration of known unknowns. Past and current trends provide much of what is considered knowledge for the generation of population projections at the national, regional and local levels – these are known knowns or relative certainties. The future of course is by its very nature unknowable; it is uncertain. The setting of population projection assumptions therefore deals with the known unknowns. Guided by past and current trends, future levels of fertility, mortality and migration are determined with the knowledge that actual future levels are unknown.

So what of Rumsfeld's third characterisation of knowledge – unknown unknowns? Although rarely addressed, it is this characterisation that is of most relevance to population projections; and the focus of this study. In general, the development of assumptions for population projections at any level assumes knowledge of likely future levels of fertility, mortality and migration. Although actual future levels are unknown, there is still a sense that the likely level within an upper and lower bound can be determined with some level of confidence. But this confidence cannot extend to things that "…we do not know we don't know". It is these unknown unknowns that prove to be the most uncertain and have the greatest impact on future outcomes and therefore need to be considered to capture possible future outcomes for the population. In the short term we may have reasonable confidence that the future will be similar to the past – although history tells us that major events can be both unexpected and catastrophic (See Taleb, 2007 for a discussion of the *Black Swan Theory* concerning events that are rare but have a dramatic impact). In the longer term the future becomes more uncertain and at some point the events that will change the future course of fertility, mortality and migration can no longer be known with any certainty – they become unknown unknowns.

An interesting extension to Rumsfeld's three characterisations of knowledge is the *unknown known* – things we don't know that we know (Zizek, 2006, p.137). These unknown knowns may be the intentional refusal to accept knowledge because of a belief system, political ideal or moral and ethical code. But these unknown knowns may also be unconscious beliefs, preconceptions and prejudices that determine our perception of reality. In the context of population projections, these unknown knowns may include a belief that the benefits of population growth far outweigh the economic, social or environmental costs – which are relegated to a lesser importance – and therefore assumptions are developed with an optimistic bias toward population growth. Similarly, an unquestionable acceptance of current government policy with a disregard for the dramatic policy changes that may have occurred in recent times may lead to a view of future population growth and distribution that differs fundamentally from likely future realities[19].

It is within the context of the unknown unknowns and the unknown knowns that this study frames the rethinking of population projection practice. This study questions the reliance on known knowns and known unknowns in the setting of assumptions in the projection process. Framing the question of what is knowledge in terms of what can be observed – both past and present – and what can be gleaned from these observations limits the scope of any possible future. To fully appreciate the breadth of possible and even likely futures requires an investigation of issues and forces that are generally considered to be external to the projection process. Through this investigation elements of the unknown unknowns may emerge that are not apparent through the analysis of past and present trends or from more direct expert opinion. In addition, the underlying beliefs, ideals, preconceptions and prejudices that may lead to unknown knowns can also be addressed. By replacing expert opinion with a more objective, argument-based method of investigation provides a mechanism by which a more reasoned and critically-based set of possible futures can be derived.

2.3.2 Risk versus Uncertainty

To expand on Donald Rumsfeld's and Zizek's characterisations of knowledge, it is worth considering to what extent can knowledge – and in this case uncertainty – be measured? The measurement and metric of knowledge and uncertainty is paramount for the quantitative practice of population projections.

Chicago economist Frank Knight's (1921) seminal work "Risk, Uncertainty, and Profit" distinguishes between risk and uncertainty in terms of their measurability:

---

[19] As an example of rapidly changing government policy, in 2002 the City of Melbourne released its 30 year plan *Melbourne 2030 – Planning for sustainable growth* with an emphasis on a more compact city with metropolitan growth concentrated on activity centres and transport nodes and contained within an urban growth boundary (Department of Sustainability and the Environment, 2002). In 2008, *Melbourne 2030: a planning update - Melbourne @ 5 million* was released by the Victorian government. This update included a major policy shift towards major Growth Investigation Areas in the northern and western regions of Greater Metropolitan Melbourne to accommodate faster than projected population growth (Department of Planning and Community Services, 2008). In 2011 the Victorian government announced preparation for a new Melbourne Metropolitan Planning Strategy to accommodate Melbourne's population growth (Department of Planning and Community Services, 2011).

> “Uncertainty must be taken in a sense radically distinct from the familiar notion of Risk, from which it has never been properly separated. The term “risk,” as loosely used in everyday speech … really covers two things which, functionally at least … are categorically different. … The essential fact is that “risk” means in some cases a quantity susceptible of measurement, while at other times it is something distinctly not of this character; and there are far-reaching and crucial differences in the bearings of the phenomenon depending on which of the two is really present and operating … It will appear that a *measurable* uncertainty, or “risk” proper, as we shall use the term, is so far different from an *unmeasurable* one that it is not in effect an uncertainty at all. We shall accordingly restrict the term “uncertainty” to cases of the non-quantitive (sic) type.” (Knight, 1921, I.I.26)

This distinction between risk and uncertainty gives rise to two issues relating to population projections. The first is to what degree and in what circumstances are risk and uncertainty “present and operating” within population projections? The second is how risk and uncertainty are dealt with within the population projection process.

Knight (1921) further distinguishes between risk and uncertainty by introducing the notion that uncertainty requires some form of change:

> “Change of some kind is prerequisite to the existence of uncertainty; in an absolutely unchanging world the future would be accurately foreknown, since it would be exactly like the past … We live in a world full of contradiction and paradox, a fact of which perhaps the most fundamental illustration is this: that the existence of a problem of knowledge depends on the future being different from the past, while the possibility of the solution of the problem depends on the future being like the past.” (Knight, 1921, III.XI.1)

The concept of change is fundamental to the practice of population projections. Over a short-time period of months or several years the demographic, economic, social, political and environmental conditions that underpin demographic factors and demographic outcomes may remain relatively stable. In this context, the future may be similar to the past and the demographic factors of fertility, mortality and migration may be – within reason – predictable; that is, they are known knowns or relatively certain. Given this relative stability it is reasonable to expect that these factors will fall within some measurable band with some mid-point representing the most likely level and an upper and lower band representing less probable but still possible levels. But as Knight (1921, III.XI.1) states “… the existence of the problem … depends on the future being different from the past …”. If populations remain stable or predictable then the practice of population projection becomes trivial and essentially unnecessary. The reality is of course that the future will be different from the past establishing the need for some foresight of future populations.

Knight (1921, III.XI.1) also states that "… the solution … depends on the future being like the past" setting up a logical postulation without a solution. If Knight's twin suppositions are adopted, how does population projection practice reconcile the need for relative stability in order to project future populations, and the knowledge that the future will indeed differ from the present and the past?

As touched on above, one common approach to addressing the uncertainty of the future is to identify the three variants of the "most likely" level and the upper and lower bounds for each demographic factor by evaluating past trends (see Rowland, 2003, p.448; Shryock et al., 1976, p.440). Although requiring judgement, this trend analysis approach assumes that the future is likely to be similar to the past within some upper and lower bound. By combining the most likely, the upper and the lower bounds for each demographic factor, variants of future populations can be derived. By combining all upper bounds and all lower bounds, an envelope of possible future populations can be determined. It is relatively common that three variants are produced: a high, medium and low variant representing the extent of "likely" futures - but official statistical offices may produce many more variants (See ABS, 2011b; Office for National Statistics (ONS), 2010; and Statistics NZ, 2009 for examples). This *deterministic* approach requires that specific magnitudes are chosen for future levels of each demographic factor. The likelihood or probability of each of these levels actually eventuating is not considered directly. But it is implicitly understood that the upper and lower bounds are less likely – and therefore have a lower probability – than the central value.

An alternative method to this deterministic approach that is being evaluated within some official population projection circles, is the use of probability theory in stochastic population forecasting (See Dunstan, 2011; Lutz et al., 1996b; Rowan and Wright, 2010; Wilson and Rees, 2005 for examples). In this approach, probability distributions for the possible future levels of fertility, mortality and migration are derived using statistical trend techniques. From these probability distributions upper and lower bounds for each demographic factor can be determined for specific levels of confidence. These probability distributions may also be the result of expert opinion on the likely level and upper and lower bounds representing the lesser likelihood for each demographic factor (Bell et al., 2011; Dunstan, 2011; Lutz, 2009; Rowan and Wright, 2010).

In general, both the deterministic and stochastic approaches accept that the likely future levels and upper and lower bounds of each demographic factor can be both identified and measured. In terms of Knight's distinction between risk and uncertainty, both of these approaches deal with risk – not uncertainty[20]. This issue is fundamental to this study in that it is argued that in the main, current population practice – both variant and stochastic approaches - addresses risk but does not address uncertainty. As Knight (1921, III.XI.1) puts it: "We live in a world full of contradictions and paradox …" [t]hese contradictions and paradoxes ultimately make the future different from the past in immeasurable ways; and it is this immeasurability that makes the future uncertain. The question is then how to understand and address this uncertainty.

To emphasise the importance of uncertainty Tversky and Fox (1995, p.269) state that:

> "Decision theory distinguishes between risky prospects, where the probabilities associated with the possible outcomes are assumed to be known, and uncertain prospects, where these probabilities are not assumed to be known … An event has greater impact when it turns impossibility into possibility, or possibility into certainty, than when it merely makes a possibility more or less likely." (Tversky and Fox, 1995, p.269)

This statement is at the heart of current methods of developing assumptions for population projections in that the probabilities associated with possible outcomes is assumed to be known – implicitly in variant projections and explicitly in stochastic forecasting (See Lutz and Goldstein, 2004 for a discussion on uncertainty in population forecasting). If these probabilities are not known – as is the premise of this study – then there is a prospect that impossibility may become possibility and possibility may become relative certainty. In these circumstances, the impact of an event that is outside of what is considered possible may be far greater than the impact of events that are considered more or less likely. Such events may include rapid policy change and social changes that may present as weak signals but are only identified in retrospect; or rapid changes, such as closure of a major employer and changes internationally, that may be excluded from conventional approaches to local area assumption setting.

[20] One key exception to this statement is the work currently being undertaken by the International Institute for Applied Systems Analysis in Austria (IIASA) (Lutz and Goldstein, 2004 and Lutz, 2009). As will become apparent in the next Chapter, the argument-based approach developed at IIASA is central to this study and provides the foundation for addressing the concept of Knightian uncertainty in local area population practice in this study.

2.3.3 Expert Bias

One method used to address uncertainty is ‘reference class forecasting’ which won Daniel Kahneman the Nobel Prize in economics (Flyvberg, B., 2006). Reference class forecasting addresses uncertainty by taking an *outside* view rather than an *inside* view of the problem or issue being considered (Kahneman and Tversky, 1979; Lovallo and Kahneman, 2003). An inside view focuses on the specific issue being considered - in the case of population projections this may involve analysing past and present trends in migration for the population of interest; and the development of projection assumptions based on these trends. An outside view would instead focus on alternative but similar populations that may be able to inform the future of migration for the population of interest. As an example, for stochastic population forecasts the probability distributions used for the future level of migration may be drawn from the populations of other regions that are similar – belonging to the same class of populations – but which display greater variability in past migration. This information regarding the possible variability in migration levels for similar populations may provide a broader view of the possible outcomes for the population of interest.

Kahneman and Lovallo (1993) compare the inside and outside views to the narrow and broad framing of a problem:

> “The distinction between inside and outside views in forecasting is closely related to the distinction … between narrow and broad framing of decision problems. The critical question in both contexts is whether a particular problem of forecast or decision is treated as unique, or as an instance of an ensemble of similar problems (Kahneman and Lovallo, 1993, p.25).

Reference class forecasting requires that the problem – or in this study the population – is treated as an instance within an ensemble of populations. The broad framing of the problem allows the dynamics of other populations to be considered in the population projection process. It is also argued in this study that this broad framing includes the fundamental forces that drive population outcomes, but which may not be readily apparent to the practitioner or the expert providing an opinion. These fundamental forces are a major source of the unknown unknown’s or uncertainty and may provide an “outside view” of the problem.

Kahneman and Lovallo (1993) demonstrate that errors of judgement in forecasting are not random but are often consistent and predictable and based on the biases of the forecaster. This is similar to Zizek’s (2006) unknown knowns. As a result of intentional or unconscious refusal to accept knowledge due to beliefs, ideals, preconceptions or prejudices the forecaster may introduce persistent and predictable biases which in turn lead to persistent and predictable outcomes.

Furthermore, Kahneman and Tversky (1979, p.314) found that an awareness of this bias does not change the forecaster's perception of reality and these errors of judgement can persist even with an understanding of their existence. This does not, however, obviate the need to include a correction to this systematic and persistent bias in the forecasting process. Flyvbjerg (2006, p.7) makes the observation that:

> "Awareness may, however, enable one to identify situations in which the normal faith in one's impressions must be suspended and in which judgement should be controlled by a more critical evaluation of the evidence".

Flyvbjerg (2006, p.7) goes on to say that "[h]uman judgement, including forecasts, is biased. Reference class forecasting is a method for unbiasing forecasts".

Kahnenan and Tversky (1977, p.i) address the need to correct for biases in "intuitive predictions". Although acknowledging the critical role of expert, intuitive judgement in decision making, they state the importance of assessing the factors that limit the accuracy of judgement. Kahnenan and Tversky (1977, p.i) summarise "… the deficiencies of unaided, intuitive judgements of probabilities for uncertain events" as follows:

> "(1) Errors of judgement are often systematic rather than random, manifesting bias rather than confusion. People suffer from mental astigmatism as well as from myopia, and any corrective prescription should deal appropriately with this diagnosis.
>
> (2) There are no significant differences between the judgemental processes of experts, intelligence analysts, and physicians, to cite but a few, confirm the presence of common biases in the professional judgements of experts.
>
> (3) Erroneous intuitions resemble visual illusions in a crucial respect: both types of error remain compellingly attractive even when the person is fully aware of their nature. In situations to produce illusions of sight or intuition, we must let our beliefs and actions be guided by a critical and reflective assessment of reality, rather than by our immediate impressions, however compelling these may be." (Kahneman and Tversky, 1977, Summary)

Kahnenan and Tversky (1977) include in their reasons for these deficiencies: a tendency to underweight or ignore distributional information (Kahnenan and Tversky, 1977, p.4); to see patterns in data that do not exist and ignore evidence that does not fit these patterns leading to an overestimation of consistency (Kahnenan and Tversky, 1977, p.45); to assume "normal conditions" and ignore potential extremes leading to assumptions that only partly reflect actual uncertainty (Kahnenan and Tversky, 1977, p.46); and *anchoring* the initial value to a "best guess". The upper and lower probability distributions are then determined from this best guess. This leads to possible ranges that are overly narrow (Kahnenan and Tversky, 1977, p.46).

Reference class forecasting is discussed here as a vehicle for discussing bias in judgement that impacts population projection outcomes. Its relevance is in its consideration of bias and the need to correct for this bias; through both an awareness of its existence and "… controlled by a more critical evaluation of the evidence". As Kahneman and Tversky (1977, p.i) state:

> "…we must let our beliefs and actions be guided by a critical and reflective assessment of reality, rather than by our immediate impressions, however compelling these may be."

This critical and reflective assessment of reality forms the basis of this study.

2.3.4 Uncertainty in Local Area Population Projections

So far this discussion has considered at a general level, the uncertainty surrounding the development of assumptions for fertility, mortality and migration at a regional level. This study is concerned with local area population projections and therefore the future geographic distribution of the population. The geographic distribution of the population differs fundamentally from fertility, mortality and migration at a regional level in that assumptions cannot be independently constrained by a most likely and possible upper and lower bounds. Geographic distribution at the local level is effectively a trade-off between areas that receive or lose population and those that remain relatively stable. Population distribution outcomes are driven by many factors including: government policy regarding zoning and the release of land; developer decisions to provide appropriate dwelling stock; consumer preference for location and dwelling type; and the location of employment. Uncertainty in this context is multi-faceted and encompasses economic uncertainty, policy uncertainty, consumer preference uncertainty, and – ever increasingly – environmental uncertainty. These drivers and their associated uncertainty are addressed in detail in the literature review in Chapter four.

Knightian risk and uncertainty are "present and operating" within the complexity of possible future population distributions at the local area level. Possibly more importantly, Zizek's (2006) unknown knowns are likely to be present in both individual and institutional opinions of the likely future geographic distribution of the population. Current government policy – particularly planning strategies – are likely to strongly influence the collective view of how a city is likely to grow within the stated life of the plan. This is an example of Kahneman and Tversky's (1977, p.45) assumption of "normal conditions", ignoring the possibility of major changes to policy with changing political will or a change in government at some stage in the life of any plan. Equally, current and past consumer preferences, government policy and economic influences have produced the current shape and structure of the city which provides an "anchor" – as described by Kahneman and Tversky's (1977, p.46) – from which to view possible futures. This anchor may limit what is considered possible and therefore limit the view of future population distributions. In turn, this "inside view" limits the setting of population distribution assumptions in the projection process.

There are a range of urban simulation models that address uncertainty in future urban population distribution. Epstein and Axtell (1996) take a bottom-up approach to growing artificial societies; Waddell (2000) describes the UrbanSim model used to model metropolitan policy and planning in Washington State in the United States; and Torrens (2006) describe a model for simulating urban sprawl in the United States. All of these models are effectively stochastic in nature using agent-based and behavioural models to create scenarios of potential futures or to evaluate the likely impact of policy change. However, without a method to explore Knightian uncertainty in the underlying assumptions that guide possible future outcomes, these outcomes remain constrained by an "inside view".

2.3.5 The Need for a Critical and Reflexive Approach

This discussion has focused on the issue of what is knowledge in population projection practice and how is uncertainty incorporated in this knowledge? The use of Rumsfeld's (2011) unknown unknowns and Zizek's (2006) unknown knowns is informative as these concepts delineate what is generally accepted as knowledge in population projection practice – knowledge of past and present events and knowledge of the risk or probability of likely future events – from uncertainty. The concept of Knightian uncertainty (Knight, 1921) provides a context for refocusing population projection practice on those issues, forces and events that are generally not included in the development of assumptions for population projections. This refocusing requires a critical and reflexive methodology that can look beyond the immediate, compelling and possibly biased opinions of practitioners and subject-based experts; a methodology that evaluates the building blocks of arguments and opinion and objectively illuminates possible futures based on this evaluation.

Chapter three introduces the argument-based approach - the methodology modified for this study for evaluating the building blocks of the arguments and forces that impact on future urban form and population outcomes. This approach offers a broad, "outside view" for the setting of projection assumptions but requires the expert and the practitioner to suspend their "… normal faith in one's impressions …" and allow "… a more critical evaluation of the evidence" (Flyvbjerg, 2006, p.7). To re-emphasise:

> "… we must let our beliefs and actions be guided by a critical and reflective assessment of reality, rather than by our immediate impressions, however compelling these may be" (Kahneman and Tversky, 1977, p.i).

2.4 The Research Method

It is argued here, that population projection practice is traditionally empirical and positivist in approach and would benefit from both a more theoretical and conceptual perspective. A mixed methods approach that combines both quantitative and qualitative research methods may provide this theoretical and conceptual perspective.

The following Section discusses the application of mixed methods research in the social sciences. Various approaches to developing mixed-method frameworks are considered along with recent applications of mixed-methods design in geography. The use and typology of the mixed-methods approach used in this study is then discussed.

2.4.1 Mixed Methods Research

Traditional quantitative and qualitative research paradigms can be characterised by their differences in the type of data used, the methods of data collection and analysis, their philosophical foundations, such as their epistemology and ontology, the types of research questions of interest and the purpose and interpretation of research results (Bergman, 2011, p.272). The quantitative paradigm has its philosophical foundations in positivism – or more correctly post-positivism. The quantitative approach is deterministic, reductionist and empirical. The qualitative paradigm rejects positivism in favour of philosophies such as constructionism, advocacy, humanism and pragmatism. These philosophies relate to understanding, theory generation, politics and power, and the consequences of actions (Creswell, 2009, p.6; Johnson and Onwuegbuzie, 2004, p.14). But within this dichotomy of ideas a third research paradigm has emerged -

mixed methods research - which positions itself between what Johnson et al. (2007, p.113) describe as the extremes of Plato's singular and universal truths to knowing the world, and the multiple and relative truths of the Sophists. Tashakkori and Teddlie (2003) describe the slow adoption of mixed methods approaches as the third methodological movement following the first quantitative and second qualitative movements.

Over the past few decades the use of mixed methods approaches to address research questions in the social sciences has been evolving, with both quantitative and qualitative researchers beginning to recognise the strengths of each methodology (Creswell, 2009; Crooks et al., 2011; Lawson, 1995; Tashakkori and Teddlie, 2003). Crooks et al. (2011, p.79) consider that the application of mixed methods approaches that employ multiple methods of data collection and analysis is particularly beneficial in understanding complex research problems – particularly those involving human behaviour and decision making.

Johnson et al. (2007, p.118) believe that the mixed methods research paradigm – like the quantitative and qualitative paradigms – includes its own assumptions, principles and values about the methodological and practice of research. This includes methods of data collection such as questionnaires, interviews and observations; methods of research such as experimental or ethnographic approaches; and philosophical foundations, including ontology, epistemology and axiology.

Greene et al. (1989) develop a mixed-method framework from the then theoretical literature and identify five purposes for mixed method research: triangulation, complementarity, development, initiation and expansion. Paraphrasing Greene et al. (1989) these purposes are defined as follows:

- Triangulation is described as the design of multiple methods to investigate the same phenomenon to strengthen the validity of the research results. The principle of triangulation is to offset the inherent biases and limitations of any single method (Greene et al., 1989, p.256). An example of triangulation in mixed-method research is the use of a qualitative interview and a quantitative questionnaire to evaluate a single phenomenon such as educational aspiration (Greene et al., 1989, p.258).
- Complementarity within a mixed-method design uses qualitative and quantitative methods to measure overlapping phenomena and different aspects of a phenomenon. The key difference between complementarity and triangulation is that triangulation is focused on the same aspects of a single phenomenon (Greene et al., 1989, p.258).

- Development uses the results from one method to inform another method in a sequential manner. Within a mixed-method design this involves the sequential use of qualitative and quantitative methods whereby the results of the first method are used to develop the second method (Greene et al., 1989, p.260).
- Initiation is either the intended or emergent discovery of paradoxes, discrepancies and contradictions that may lead to fresh insights or a reframing of the research question (Greene et al., 1989, p.260; Johnson et al., 2007, p.116).
- Expansion seeks to expand the scope and breadth of study by using different methods for different aspects of the research. For example, for program evaluation purposes, expansion may use qualitative methods to assess processes and quantitative methods to assess outcomes (Greene et al., 1989, p.260).

Greene et al. (1989, p.261) report that expansion is the most stated purpose for using a mixed-method approach, followed by triangulation and then complementarity.

Creswell (2009, p.5) suggests that the larger philosophical ideas that underpin a research study should be made explicit to help explain why a quantitative, qualitative or mixed-methods approach was chosen. These larger philosophical ideas would include:

- The philosophical worldview proposed by the study
- A definition of basic considerations of that worldview
- How the worldview shaped [the] approach to research (Creswell, 2009, p.6).

Following Guba (1990, p.17), Creswell uses the term “worldview” to encompass “a basic set of beliefs that guide action”. The four worldviews considered by Creswell (2009, p.6) are postpositivism, constructivism, advocacy/participatory and pragmatism.

Creswell (2009, p.6-11) defines each worldview as follows:

- Postpositivism – also referred to as the scientific method – implies a quantitative approach to research which is deterministic, reductionist, empirically based and is aimed at verifying theory. Postpositivism differs from positivism in that it challenges the idea that there is an absolute truth that can be known; particularly when studying human behaviour.
- Social constructivism implies a qualitative approach to research that assumes that individuals seek an understanding of their world. Truth is subjective and an individual constructs meaning from their experiences – specifically through interaction with others – and their personal, cultural and historical perspectives.
- Advocacy/participatory is associated with qualitative research but can also be the basis for quantitative research. This worldview addresses a perceived gap in the constructivist approach in that marginalised groups are not explicitly considered. Advocacy/participatory worldviews have a political agenda to help marginalised people by addressing issues such as empowerment and inequality.

- The pragmatic worldview is concerned with actions, situations and consequences and is focused on solutions to the research problem. All methods and approaches are available from this worldview which may include both qualitative and quantitative approaches.

Of these worldviews Creswell (2009, p.11) believes that it is pragmatism with its multiple methods, different assumptions and different forms of data collection and analysis that "…opens the door…" to mixed methods research. Johnson et al. (2007, p.113) agree with Creswell that the primary philosophy of mixed methods is pragmatism.

Although a proponent of mixed methods research, Bergman (2011, p.272) asks the question how the quantitative approach which "… subscribes to objectivity, unbiased and value-free research, and the separation between the researcher and the researched" can be combined with a qualitative approach that "… emphasises subjectivity, researcher context, value-laden research, and the inseparability between the researcher and the researched." Bergman (2011, p.274) states that the justifications for using a mixed methods approach are problematic; suggesting that:

- It is often argued that mixed methods research is beneficial as it provides a supplementary perspective beyond which the quantitative or qualitative approaches can provide alone. Whilst this is true, it is argued that any additional relevant data or additional analysis would provide an additional perspective and the use of a mixed method approach is not unique in this respect.
- Mixed methods research often concludes that the use of mixed methods leads to a holistic understanding of the phenomenon being researched. Bergman questions this view particularly the idea that using multiple perspectives leads to objective research results that are superior to research resulting from the use of only one research method.
- Mixed methods research design is sometimes used to reveal the limitations of qualitative and quantitative methods – promoting the richness or depth of interviews compared to questionnaires, or conversely, the benefits of normalised or standardised scales over personal interviews.
- It is often argued that mixed methods are better than individual methods in principle. Bergman offers several reasons why some research can benefit from limiting the research method, including "… parsimony, theoretical and methodological elegance, reduced complexity, time and cost considerations…".

A common methodological inclusion in mixed-methods research design is quantitising - the conversion of qualitative data to numerical values (Sandelowski et al., 2009, p.208). Quantitising is aimed at simplifying qualitative data (Mol and Law, 2002, p.4) and clarifying and extracting meaning from that qualitative data (Sandelowski, 2009, p.218). The major drawback of quantitising is that it relies on an appropriate method to convert the qualitative data to meaningful numerical values. Once converted, the method of conversion and the subjective reasoning and judgement behind the conversion is usually lost (Mol, 2002, p.236).

For quantitising to be useful it must add value to the research in a substantive way whilst retaining the meaning and complexity of the original qualitative data (Sandelowski et al., 2009, p.208). Sandelowski et al. (2009, p.219) comment that:

> "Questions about quantitizing go to the heart of the mixed methods research enterprise and some of the assumptions on which it is based".

Without strong justification for the application of quantitising the use of mixed-methods over qualitative or quantitative methods may be questionable. But Sandelowski et al. (2009, p.218-220) also question the separation of the qualitative/quantitative paradigms in that quantitative approaches rely on qualitative research to define the research question, to interpret the results, and to provide the complexity and narrative to the research. Alternatively, quantitising can support qualitative data by converting it to nominal, ordinal and interval data which can both add value and allow for statistical hypothesis testing not available using traditional qualitative approaches.

2.4.1.1 Mixed Methods Typologies

In developing a mixed methods approach Creswell (2009, p.206-209) suggests considering four aspects that influence the design of mixed methods study – timing, weighting, mixing and theorising. Timing relates to when qualitative and quantitative methods will be introduced - either sequentially (phased) or concurrently. Weighting is the priority given to the quantitative and qualitative methods within the study. Weighting may be equal or may emphasise one approach over the other. Mixing refers to the integration, connecting and embedding of data, research questions, philosophy and interpretations. Mixing may occur at various stages in the research and may involve a phased approach where the analysis from the initial phase informs the latter phase; a merging of qualitative and quantitative data; or the embedding of secondary data into a primary dataset as support for the study. Creswell (2009, p.208) describes theorising – or alternatively referred to as a transforming perspective – as adopting a "… larger, theoretical perspective [that] guides the entire design". This theoretical perspective may be derived from the social sciences or may be a "… broad theoretical lens …". Mertens (2010) discusses how a transforming lens shapes all aspects of mixed methods research. Mertens (2010, p.470) describes this transformative paradigm as a framework of belief systems that engages culturally diverse groups with a focus on social justice and human rights.

Using these four aspects, Creswell (2009, p.206) and Creswell et al. (2003) advance six types of mixed methods approaches: sequential explanatory; sequential exploratory; sequential transformative; concurrent triangulation; concurrent nested; and concurrent transformative.

Creswell et al. (2003; 2009) consider each of these types of approaches by the four criteria of implementation, priority, stage of integration and theoretical perspective (see Table 2.1). These four criteria align with Creswell's (2009) four aspects of timing, weighting, mixing and theorising.

Creswell's (2003) six design types are either sequential or concurrent in their implementation. In a sequential research method, either the quantitative stage or the qualitative stage of data collection and analysis will be undertaken followed by the alternative approach. Priority can be given to either the quantitative or qualitative approach, or equally to both. Integration is always in the interpretation phase and a theoretical perspective may be present in the explanatory and exploratory designs and is always present in the transformative design.

In Creswell's (2003) concurrent design the quantitative and qualitative approaches are implemented at the same time. Although the priority of approach can potentially differ between triangulation, nested and transformative designs, concurrent design is less prescriptive with quantitative and qualitative approaches given equal priority or used with equally frequency. In contrast to sequential design, concurrent designs are generally integrated during the analysis phase. A theoretical approach may be present in the concurrent triangulation and nested designs, but similar to sequential designs it is integral to the transformative design.

2.4.1.2 Mixed Methods Research in Geography

For some time geographers have recognised the benefits of mixed methods research (Cope and Elwood, 2009; Crooks et al., 2011; Lawson, 1995; Madsen and Adriansen, 2004; Rocheleau, 1995; Sporton, 1999; Yeung, 2003).

Table 2.1: Types of Designs by Four Criteria

Design Type	Implementation	Priority	Stage of Integration	Theoretical Perspective
Sequential explanatory	Quantitative followed by qualitative	Usually quantitative; can be qualitative or equal	Interpretation phase	May be present
Sequential exploratory	Qualitative followed by quantitative	Usually qualitative; can be quantitative or equal	Interpretation phase	May be present
Sequential transformative	Either quantitative followed by qualitative or quantitative followed by qualitative	Quantitative, qualitative, or equal	Interpretation phase	Definitely present (i.e. conceptual framework, advocacy, empowerment)
Concurrent triangulation	Concurrent collection of quantitative and qualitative data	Preferably equal; can be quantitative or qualitative	Interpretation phase or analysis phase	May be present
Concurrent nested	Concurrent collection of quantitative and qualitative data	Quantitative or qualitative	Analysis phase	May be present
Concurrent transformative	Concurrent collection of quantitative and qualitative data	Quantitative, qualitative, or equal	Usually analysis phase; can be during interpretation phase	Definitely present (i.e. conceptual framework, advocacy, empowerment)

Source: Creswell et al., 2003, p.224

Lawson (1995) discusses the usefulness of using quantitative research methods in feminist geography research. Winchester (1999), using a classic triangulation approach of individual interviews and aggregated quantitative questionnaire data, uses a mixed-method approach in a population geography context to study the experiences of lone fathers in Newcastle, Australia. Sporton (1999) questioning the mainstream, data-led research culture to fertility research in population geography favours the use of qualitative methodologies in combination or in a multi-level framework. Sporton (1999, p.74) concludes that the increasing use of mixed-methods in fertility research is due to the greater understanding that qualitative methods can provide of the complexities and contradictions in reproductive behaviour. Cope and Elwood (2009) provide a profile of the various ways that researchers are integrating Geographic Information Systems (GIS) and qualitative research. The term qualitative GIS is used to describe a mixed-method approach that combines spatial analysis with qualitative methods, such as focus groups, ethnography, interviewing, or participatory action.

2.4.1.3 Mixed Methods Approach in this Study

This study adheres to the definition of Creswell et al. (2003, p.212) that:

> "A mixed methods study involves the collection or analysis of both quantitative and/or qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of the data at one or more stages in the process of research."

The next Chapter introduces the argument-based approach developed at the International Institute for Applied Systems Analysis (IIASA), which is modified for this study. In terms of Creswell's (2003; 2009) design criteria in Table 2.1, the modified argument-based approach developed in Chapter three is characterised as a structured qualitative approach followed by quantitative analysis – including the quantitising of the qualitative results; an approach that prioritises quantitative data and analysis; integrates data in the analytical and interpretation phases; and makes explicit a conceptual/theoretical framework – but one that does not deal with advocacy or empowerment. Given this characterisation, it is considered that the research design used here is fundamentally sequential exploratory in nature.

Chapter 3 An Argument-Based Approach to Developing Assumptions

This Chapter introduces the argument-based approach to aid in the development of assumptions for population projections. The distinction is initially made between projections and forecasting. It is suggested that this distinction is determined by the level of judgement used in developing assumptions. Following this reasoning, an argument is mounted that the development of assumptions needs to move from analysing patterns in data to considering the underlying processes that drive the demographic factors for which assumptions are developed.

With the aid of a hypothetical example, the argument-based approach is discussed in detail. The application of this approach to local area population projections is then considered; and a modified argument-based approach developed for this study is then discussed. One of the primary elements of this modified approach is the mapping of arguments to forces and to urban form scenarios. This argument mapping exercise facilitates the comparison of the likelihood of a particular urban form eventuating based on the responses of an expert panel.

3.1 Projections or Forecasts?

Practitioners in the world of population futures have for many years differentiated the production of population projections from the less objective pursuit of forecasting. An excerpt from the Australian Bureau of Statistics' projections for Australia emphasises this point:

> "The projections are not intended as predictions or forecasts, but are illustrations of growth and change in the population that would occur if assumptions made about future demographic trends were to prevail over the projection period … While the assumptions for the projections are formulated on the basis of an assessment of past demographic trends, both in Australia and overseas, there is no certainty that any of the assumptions will be realised. In addition, no assessment has been made of changes in non-demographic conditions." (ABS, 2008a, p.2)

It is argued that population projections are the product of a mathematically precise algorithm that advances the population from one period to the next based on specific assumptions (Smith et al., 2001, p.3) – in terms of the cohort component model these assumptions relate to fertility, mortality and migration (Smith et al., 2001, p.28). If these assumptions were to eventuate then the projected population would also eventuate.

Smith et al. (2001, p.16) define projections as “[t]he numerical outcome of a particular set of assumptions regarding future values of a variable” and forecasting as “[t]he projection selected as the one most likely to provide an accurate prediction of the future value of a variable”. In other words, projections are conditional on assumptions holding true; but do not imply that these assumption will hold true – they are non-judgemental. Forecasts on the other hand are explicitly judgemental and reflect the practitioner’s view of likely future populations (Smith et al., 2001, p.3).

Generally, population projections produced by government agencies are presented with a number of variants – commonly based on high, medium and low demographic assumptions (for examples of variants, see ABS, 2008a; Office for National Statistics, 2004; also see Prommer and Wilson, 2006, for the results of a survey of national statistics offices in the European Union that indicates the extent of variants used in Europe). Forecasts have an elevated level of responsibility for the assumptions made, and the validity of the population outcome – particularly after the projection interval has been reached and the actual population outcome can be assessed against the projected outcome. A population projection can always be defended as there is little or no assertion that the assumptions made *will* eventuate; only that *if* they did eventuate the projected population would result. In a nutshell, population projections are never wrong; but population forecasts are rarely right!

The issue facing many practitioners of population futures at this time is the realisation that reliance on time-series and statistical modelling is not sufficient in setting assumptions for population models (Booth, 2006). What is required is a level of judgement and subjective assumption setting more akin to forecasting than to strict population projection. The challenge is how this judgement can be formally incorporated into the projection process.

3.2 Rethinking Assumption Setting – Moving from Patterns to Processes

Willekens (1990, p.11) comments that “[t]he transition of forecasting from pattern-oriented to process-oriented will have important implications for research, since much of the current knowledge in the field of population is not directly usable in forecasting” (attributed to Keyfitz, 1982, p.747). This statement is as true today as it was in 1982 (see Booth, 2006).

The traditional – and still most common - approach to developing assumptions within population projection practice is to assess past trends in fertility, mortality and migration in the search for patterns within data that may identify either a continuation of past trends or a change in the direction or magnitude of these demographic factors (see Wilson and Rees, 2005, for a comprehensive review of recent developments in population projection methodology). In a comprehensive review of demographic forecasting at the time, Willekens (1990) contrasted this extrapolative approach to population projections with explanatory models that attempt to explain the underlying drivers of population change. Of particular relevance to this study, Willekens argues that in periods of change, extrapolative models do poorly and explanatory models perform better. More strongly, Willekens (1990, p.10) states:

> "I firmly believe that a breakthrough in our ability to foresee the future can only be expected if we come to grasp with the causal factors *and processes* that determine the level, sequence and timing of demographic events as we observe them. It requires not only to *identify* the factors and processes as well as their interrelatedness, but to *understand* the mechanisms by which they produce the picture of demographic change that we are able to witness" (emphasis in original).

Willekens (1990, p.11) comments that "[i]nstead of focusing on the quantitative relations between variables, we should focus on the underlying causal mechanisms that produce the relations between variables" and "[t]*he ultimate goal of forecasting-oriented demographic research should be a demographic forecasting model rooted in an understanding of the causal processes at work*" (emphasis in original).

Willeken's (1990, p.12) further emphasises the importance of process in population dynamics stating:

> "Events are themselves outcomes of ongoing processes, most of which remain latent until their existence is discovered in a diagnosis or manifested in the event occurring. Having identified the existence of a process does not mean that it is understood. The understanding implies knowledge of (i) the factors that determine the onset of the process and (ii) the factors determining its dynamics …"

Similarly Keyfitz (1972, p.361) concluded that:

> "The weakness of population forecasts is due to our ignorance of the mechanisms by which populations grow and decline. We know much about birth rates and their differentials among statistically recognizable population groups, as well as about changes over time as shown in past records, but this great volume of statistical information has contributed disappointingly little to the discernment of the comprehensive causal system underlying the differentials and changes"

As discussed in Chapter two, the search for patterns has taken demography down the statistical and empirical path with ever increasing sophistication and finesse. Also highlighted in that Chapter is the relatively slow advance made in the understanding of these demographic factors compared with the intellectual effort made (Booth, 2006).

This study supports the argument of others, that there is a need to move beyond the empirical, statistical time-series approach to developing population projection assumptions, toward an evaluation of the underlying processes that influence and may determine the demographic factors of fertility, mortality and migration (Booth, 2006; Lutz 2009; ONS, 2009). Past trends and sophisticated statistical techniques may assist in the understanding of underlying processes; particularly if the demographic processes within a particular region appear to be stable through time – that is, they have structural inertia (Willekens, 1990, p.16). But stability rarely lasts and at any point in time it is not certain whether a trend will continue or more fundamentally whether a trend truly exists. To better understand the past and present characteristics of fertility, mortality and migration requires a deconstruction of each demographic factor to try to understand what underlying forces are driving these broader demographic factors; how these underlying forces influence the outcomes of the demographic factors; and how these forces interrelate. Lutz (2009, p.7) encapsulates these ideas stating that:

> "…the direction into which to move on from the current practice [of assumption setting is to] … [h]ave a more systematic review of the substantive arguments behind the assumptions in the form of a structured interaction with the demographic research community which also facilitates the involvement of more experts".

He continues by saying:

> "… it is surprising to see how little systematic attention the scientific community has given to the evaluation of arguments underlying the assumptions of future fertility, mortality and migration trends"

It is the more systematic review of the arguments behind the development of assumptions and the involvement of a range of experts that provides the focus for this Chapter.

Population projection practice has an air of respectability shared by other forecasting pursuits, such as weather forecasting and economic modelling. Indeed, the application of statistical techniques underpins and legitimises the projection or forecasting of the population, the weather and future economic trajectories (Willekens, 1990, p.10). Yet the reality for all these futurist pursuits is that the future is unknown. Recent or long-term trends may provide some insight into near-term conditions and long-term cycles. But in the main forecasting is at one extreme trivial – tomorrow's weather is likely to be the same as today's – and at the other, futile – the next economic boom will be followed by a bust; but the magnitude and timing of this bust is unknown.

Similarly in population projection practice it is likely that recent trends in fertility, mortality and migration will continue in the short-term. At some stage it is likely that these trends will shift, either slowly or abruptly – the direction of the shift being less certain. Equally these insights may provide some comfort (or distress depending on the desired future) for the short-term but provide little guidance to policy planners on the longer-term future pathways of the population and their future needs. What is certain is that social, economic and environmental systems are complex and possibly less predictable and more volatile than in the past (Bengston et al., 2012). With this in mind what may be required to better understand and "predict" future events and outcomes is "strategic foresight". Strategic foresight, as defined by Slaughter (2002, p.1) is:

> "…the ability to create and maintain a high-quality, coherent and functional forward view, and to use the insights arising in useful organisational ways. For example to detect adverse conditions, guide policy, shape strategy, and to explore new markets, products and services."

Although Slaughter (2002) discusses strategic foresight within an organisational context, the principles of creating and maintaining a high-quality, coherent and functional forward view and the use of insights to detect adverse conditions, guide policy and shape strategy, apply equally to the projection of future populations.

For practitioners and academic demographers alike, the suggestion that the respectable field of population projection should adopt a non-rigorous and highly stylised approach, such as strategic foresight, an approach being led by organisational and management consultants, may seem an anathema to the 'scientific' and empirically-based rigour of current projection methodologies. But a search for emerging trends, thresholds and "weak signals"[21], and putting forward possible, probable, and preferable futures is precisely the task of projecting future populations. These pursuits are akin to a systems approach which challenges or at least complements the reductionist-scientific method as a primary method in the creation of knowledge and understanding; and the scenario approach which is likely to have benefits over the

[21] One definition of weak signals is "… *ideas, trends, technologies or behaviour changes that are as yet unrecognised by mainstream society. They might have a big impact or they might disappear."* Source: *Forum for the Future,* <http://www.forumforthefuture.org/futures/weak-signals> (emphasis in original), viewed 29 July 2010.

currently accepted norm in population projections of producing potentially inconsistent variants of future populations[22] (Willekens, 1990, p.12).

3.3 Expert Elicitation

One of the key propositions of this study is that population projection methodologies are fundamentally empirical in nature, and that recent developments have focused primarily on improving statistical methods for forecasting demographic components. An alternative to the use of empirical data is the use of expert expectations (Booth, 2006, p.5). Although there are informal methods for obtaining expert opinion or judgement, more structured methods have been developed that enhance the scientific and technical credibility of the use of experts; and the acceptability of results (U.S. EPA, 2011, p.8).

Expert elicitation is a methodology designed to address issues that are highly uncertain and have a range of possible futures (Usher and Strachan, 2013, p.812). It is a formal and systematic process to obtain quantitative judgment on scientific questions, such as the probability of different events occurring, or identifying relationships (U.S. EPA 2011, p.24). Expert elicitation differs from expert opinion in that it requires a formal process by which expert judgment is obtained to quantify uncertainty (U.S. EPA 2011, p.7) This approach is highly suited to the evaluation of likely future urban form. The empirical evidence for future urban form – or any other futurist pursuit – can only be based on past and present knowledge and data; and future urban form outcomes are associated with high levels of uncertainty and a range of possible futures. Although empirical evidence is critical to the projection process, it is limited in assessing Knightian uncertainty, as described in Chapter two (Knight, 1921, I.I.26). The development of assumptions for likely future urban form must therefore be based on judgement - in this study, this judgement is derived from an expert panel and facilitated by the modified argument-based approach.

[22] Assumption setting for population projections generally seeks to identify a ‘middle’ projection with high and low ranges. These high and low ranges (and possibly even middle projections) may be based on logically inconsistent assumptions, such as high net overseas migration and low interstate losses. It could be rationally posited that high levels of net overseas migration would result in an increase in interstate losses as this highly mobile group engages in a broader search for settlement than their original place of arrival.

3.4 The 'Delphi' Method

The concept of strategic foresight is based on sound – although non-mainstream - principles for considering future events and outcomes (see Wilkinson, 2011 for an application of strategic foresight to operationalise a more adaptive approach to strategic spatial planning in Melbourne, Australia). However, to operationalise these principles within a population projection framework requires a process or method that can draw from expert demographic knowledge relating to current demographic trends and current and likely future demographic contexts; but a method that also confronts the uncertainty, complexity and ambiguity of possible futures. Given the nature of this task, the opinions and judgements of experts in demography and associated fields can contribute to this knowledge.

One process or technique that has been used to address future uncertainties and complexities is the Delphi technique (Rowe and Wright, 2001). The Delphi technique seeks to elicit the opinions and judgements of a group of experts rather than relying on any one individual expert. The Delphi technique was developed by the RAND Corporation[23] in the 1950s to improve on more traditional group forecasts and decisions by adding structure to the group process (Rowe and Wright, 2001). As an alternative to group meetings with the associated issues of individual dominance, group dynamics and potentially limited dissent, the Delphi technique is designed to reveal an expert panel's opinion on a particular forecast by eliciting opinions and views from disparate domain knowledge with the goal of obtaining the overall judgement of the group. The exchange of information and data within the group is anonymous and occurs over several rounds or iterations of group interaction. Following two or three rounds of opinions and feedback with associated justification from the experts involved, the average of final round estimates is taken to be the group judgement. Rowe and Wright (2001, p.141) distilled the following principles for using a structured approach to combining expert opinion – including the Delphi technique:

- Use experts with appropriate domain knowledge
- Use heterogeneous experts
- Use between five and 20 experts
- For Delphi feedback, provide the mean or median estimate of the panel plus the rationales from all panellists for their estimates

[23] The RAND Corporation is a nonprofit research and development institution formed in the United States in 1948 to improve policy and decision making.

- Continue Delphi polling until the responses show stability. Generally, three structured rounds are enough
- Obtain the final forecast by weighting all the experts' estimates equally and aggregating them
- In phrasing questions, use clear and succinct definitions and avoid emotive terms
- Frame questions in a balanced manner
- Avoid incorporating irrelevant information into questions
- When possible, give estimates of uncertainty as frequencies rather than probabilities or odds
- Use coherence checks when eliciting estimates of probabilities.

Rowe and Wright (2001, p.137) conclude that Delphi groups make more accurate judgements and forecasts than traditional unstructured groups.

Green et al. (2007, p.2) found that the Delphi technique had been used in many business and technology forecasts as well as for broader social issues, such as urban futures. Green et al. (2007, p.3) state that "Delphi can be used for nearly any problem involving forecasting, estimation, or decision making – as long as complexity and ignorance do not preclude the use of expert judgement". The issue of complexity and ignorance is an important one as the opinions and judgement of individuals on the expert panel need to contribute in a meaningful way to the final judgement – requiring individual panel members to understand the issues and the context of the debate.

This brief discussion of alternative approaches to forecasting highlights the notion that using past trends and statistical analysis may be insufficient to understand the range of possible and even probable population futures. An alternative approach is required that can explore the underlying forces that influence and shape future demographic outcomes. Such an approach requires conjecture and creativity but must also stand up to objective scrutiny within a structured and organised framework. Such a framework is offered in the "argument-based approach" to developing population projection assumptions developed by the International Institute of Applied Systems Analysis in Austria (Lutz et al., 1996a; Lutz et al., 1996b; Lutz et al., 2000; Lutz, 2009).

3.5 The 'Argument-Based' Approach

3.5.1 Overview of the Method

The modern world is becoming increasingly more complex. Makowski and Wierzbicki, (2003, p.3-4) identify three "commonly known observations" supporting the notion of increased complexity and difficulty in both the clarification and understanding of both problems and solutions:

- The complexity of problems is growing faster
- The amount of knowledge available to decision makers is growing rapidly although in diversified and dispersed forms
- Knowledge and experience are developing rapidly but in diverse directions making integration of various methodologies and tools practically impossible.

Makowski and Wierzbicki (2003) conclude that these complex problems cannot be represented by one precisely defined mathematical model. Actual decision making is and will remain a human task with intuition playing a key role; but this intuition requires appropriate model-based decision support.

Makowski and Wierzbicki's (2003) comments are relevant from a population projection perspective. The complexity of society both on a local and a global scale has increased rapidly over the past half century with changing social norms and rapidly growing mobility (Ostrom, 2000; Hugo, 2008a). The inadequacy of precisely defined mathematical models resonates with the increasing availability of socio-demographic data and information and the increasing complexity of the forces driving demographic outcomes. Decisions on fertility, mortality and migration assumptions that drive demographic models cannot be adequately addressed by complex and precise mathematical models alone (Booth, 2006; Willekens, 1990). Human decision making aided by model-based decision support must play a key role in the development of appropriate demographic assumptions. This assertion is not new. In their discussion on alternative approaches to population projection, Lutz et al. (1996a, p.38) comment that:

> "… there can never be a population projection without personal judgement. Even models largely based on past time series are subject to a serious judgemental issue of whether to assume structural continuity or any alternative structure."

One of the key reasons why judgement is so critical to population projection methodologies generally, and the development of assumptions in particular, is that structural changes and shifts - whether demographic, geographic, social, environmental or economic – cannot be identified through the analysis of historical time-series alone. Lutz et al. (1996a, p.38) in a discussion on the use of experts in probabilistic population projection approaches comment that "…alternative expert-based assumptions [are] the only meaningful way to capture future uncertainty." Lutz et al. (1996b, p.427) qualify the use of expert-opinion stating that expert-opinion "…can be wrong and often is wrong. But there is no better alternative." Lutz et al. (1996b) argue that the strength of expert opinion is that it captures relevant knowledge that has accumulated over years of experience and study. However, possibly more importantly they highlight the fact that expert-opinion can incorporate intuition and judgement; neither of which can be *directly* incorporated into a formal model.

Building on the premise that judgement and expert opinion is necessary to address the ever increasing complexities and uncertainties of the modern world, the International Institute for Applied Systems Analysis (IIASA) has developed a method to formally incorporate judgement and expert opinion in the development of population projection assumptions known as the argument-based approach (Lutz, 2009). This approach focuses on the underlying forces that shape the future trends in the demographic factors of fertility, mortality and migration. The methodology is based on a broad discussion and argumentation exercise that critically assesses the substantive arguments relating to these underlying forces. As discussed above, there is a view that reliance on statistical modelling of past trends is insufficient to adequately model likely future trends and major changes in direction of the demographic assumptions used in population projections. IIASA's argumentation exercise offers an alternative to the strict empirical modelling of past trends or formal structural modelling.

Although the argument-based approach was developed for national – and indeed world - population projections, this study takes this approach to the development of assumptions and applies it to local area population projections. Some assumptions, such as net overseas migration, impact nationally as well as locally. But other assumptions such as the residential location decisions of households, and future urban form, are more specific to local area population projections. The application of the argument-based approach to local area population projections is a major element of the conceptual framework developed in this study and is discussed later in this Chapter.

The essence of the argument-based approach is that judgement is required to aid in the projection process and that this judgement must be justified through argument and evidence. Judgement could be made by an individual expert or the individual undertaking the projection. But there is an underlying assumption in the argument-based approach that the judgement and decisions of a group are generally superior to the judgement of the individual; with individual bias and singular domain knowledge likely to result in judgement that is based within too narrow a scope. A disparate group of experts from a variety of subject matters and methodological domains is likely to result in a more informed and less biased outcome (Lutz, 2009; Lutz et al., 2000).

The argument-based approach draws many parallels to the Delphi technique. They are both designed to elicit the opinions and judgement of a group rather than individual experts; they are both structured approaches compared with more traditional face-to-face meetings; and they both aim to ascertain the “average” opinion and judgement of the group. One key advantage of the argument-based approach over the Delphi technique involves the specific and rigorous preparation and critical thought required in the early stages of the argument-based approach. The forecaster must clearly identify the major forces influencing the projection outcomes, and define the substantive arguments that may support or negate these forces prior to the panel involvement. This preliminary work along with a comprehensive evaluation process removes the need for multiple iterations of ‘panel response – estimation - panel response’ required of the Delphi technique. As Lutz (2009) states, one of the major difficulties with using a panel of experts is getting them together in one place – let alone getting a commitment to contribute to on-going rounds of debate and comment. A key advantage of the argument-based approach is the highly structured evaluation process that takes subjective responses and produces objective scores for each expert and for the group as a whole. This evaluation process is dealt with in detail below.

3.5.1.1 The use of an expert panel

Prommer and Wilson (2006, p.2) conducted a survey of the national statistical offices of the European Union countries:

> “... to assess the [then] current status of expert involvement and methodology in making population forecasts ... [and] to evaluate what future improvements could be made in the process by which experts contribute to the definition of assumptions in population projections”.

The majority of national offices (76 per cent) used experts in the assumption setting process; many involving more than ten outside experts. Most external experts had a background in demography, the remaining experts coming from government agencies, other social sciences or health related fields. In almost all cases, national offices responded that there was a need for improvement in defining demographic assumptions; the majority relating to “... interactions among agencies, experts, or the involvement of more experts”.

Armstrong (2001) identifies 139 principles to summarise knowledge about forecasting. With reference to implementing judgemental methods, Armstrong (2001, p.697) makes the obvious but profound comment that “[i]n general, you need to ask the right people the right questions at the right time.”

Amongst Armstrong’s principles, several relate directly to the use of expert knowledge. In summary, these include:

- Experts should justify their forecasts by providing written support showing reasons supporting their forecasts
- Obtain forecasts from heterogeneous experts who vary in their information and in the way they approach the problem
- Rely on theory and domain expertise when specifying directions of relationships
- Use structured procedures to integrate judgement and quantitative methods
- Use structured judgement as inputs to quantitative models
- Use pre-specified domain knowledge in selecting, weighting and modifying quantitative methods.

Lutz et al. (2000, p.4) conclude that “[v]ery few of [Armstrong’s] ... [p]rinciples are applied in population forecasting”. These principles do however resonate with the argument-based approach developed by IIASA.

Given the breadth of the forces and influences that potentially impact on population and demographic outcomes, it is reasonable to expect that experts with a range of domain knowledge could contribute productively to the development of assumptions for population projections. Within these domains it is also necessary to include a cross-section of mainstream and non-mainstream experts. If only mainstream – or proponents of current paradigms and common-understandings – are included, then potentially useful and insightful information which may be considered of limited relevance, may be excluded from the process. This is particularly relevant to the projection process as many future events, thresholds or tipping points are likely to be only within the peripheral vision of mainstream experts; and potentially discounted for this reason. Identification and selection of relevant experts is of particular relevance to local area population projection. The forces and arguments that relate to the geographic and spatial outcomes at the local level are likely to be regional in nature. Expert input will need to reflect this regional dimension and include contributions from demographic, urban geography and urban planning disciplines. The choice of an expert panel for this study is discussed later in this Chapter.

3.5.2 Major Forces Influencing Demographic Factors

A critical element of the argument-based approach is the identification of the major forces that affect the demographic factors of fertility, mortality and migration. The level and age-sex structure of these demographic factors is determined by a complex array of actual and perceived economic, social and environmental factors that differ across space and over time. A key underlying premise of this study is that analysis of past trends alone is insufficient to identify possible or likely changes in future levels and structure of these demographic factors. It is necessary to delve beneath the observable outcomes of fertility, mortality and migration and grapple with the complexities of the underlying forces. The method adopted in the argument-based approach is to identify broad classes of forces within which arguments supporting and negating changes in population and demographics can be developed. An example of the forces developed for the United Kingdom office for National Statistics follows.

3.5.3 An Argument-Based Questionnaire

Given the difficulties of getting a group of disparate experts in one place and the assumed benefits of removing the face-to-face element from group interaction, the argument-based approach lends itself to internet-based application. As part of the argument-based approach the IIASA (in collaboration with the United Kingdom Office for National Statistics) has developed an interactive questionnaire designed to facilitate responses from demographic experts asked to evaluate more than 100 arguments relating the forces that impact on future assumptions about fertility, mortality and migration (Lutz, 2006). This questionnaire is designed to be delivered over the internet and is therefore necessarily both comprehensive and self-explanatory. The interactive questionnaire has been used by the UK Office for National Statistics to contribute to recent rounds of official population projections for the UK (ONS, 2009). One of the primary strengths of the argument-based approach is the structured approach that it adopts to both presenting key forces and associated arguments to the panel and eliciting relative responses with regard to the validity and the likely impact of each argument and force on demographic factors; and ultimately on population and demographic outcomes. One of the requirements of the methodology is to transform what are initially *subjective* responses into an *objective* evaluation of the forces that are likely to influence demographic and population outcomes in the future. In terms of the mixed-methods approach adopted in this study, this objective evaluation is akin to quantitising – the conversion of qualitative data to numerical values - as discussed in

Chapter two (Sandelowski et al., 2009, p.208). An electronic questionnaire facilitates this process.

The electronic questionnaire is sent to each panel member. On completion, the questionnaire is returned to the forecaster for evaluation – this evaluation process is discussed below.

3.5.4 An Example of the Argument-Based Approach

To illustrate the use of the argument-based approach, the following major forces relating to future fertility, life expectancy and migration were used to operationalise the interactive questionnaire used by the UK Office for National Statistics (ONS) for their 2008 national population projections (Lutz, 2009, p.13):

Major forces on which future fertility will depend:

1. The trend in ideal family size and the strength of individual desires for children as compared to other joys in life
2. The trend in the patterns of education and work, including the proportion of time to be dedicated to the professional side of life (life – work balance)
3. Changing macro-level conditions (government policies, child care facilities, housing, etc.) that influence the cost of children in a broader sense
4. Changes in the nature and stability of partnerships
5. Changing bio-medical conditions (sperm quality and counts, female fecundability, new methods for assisted conception)
6. Changes in population composition and differential trends in population subgroups.

Major forces on which future life expectancy will depend:

1. Changes in biomedical technology
2. Effectiveness of health care systems
3. Behavioural changes related to health
4. Possible new infectious diseases
5. Environmental change, disasters and wars
6. Changes in population composition and differential trends in population subgroups.

Major forces influencing net migration gains:

1. Trends in the main motives for international migration

2. Trend in migration pressure resulting from changes in countries of origin
3. Trend in the attractiveness of the UK as a country of destination
4. Costs of migration in the broader sense
5. Effectiveness of barriers to unregulated migration flows.

Following the identification of the major forces that may impact on the future of fertility, mortality and migration, specific arguments were developed regarding the factors that will influence these major forces. In effect, the goal of this stage of the argument-based approach is to construct three tiers of influence on population outcomes comprising the demographic factors of fertility, mortality and migration; flowing on to the major forces influencing these demographic factors; and at the finer scale the substantive arguments that affect these major forces.

To illustrate the type of arguments developed for the Office for National Statistics UK population projections, the following are the arguments that were applied to one of the major forces influencing net migration gains – “Trends in the main motives for international migration”, from the major forces listed above (Lutz, 2006[24]):

Force 1: Trends in the main motives for international migration

Argument 1.1: There will be an increase in the total number of people wishing to migrate to and from the United Kingdom for work related reasons.

Argument 1.2: There will be an increase in the total number of people wishing to migrate to and from the United Kingdom for family reunification reasons.

Argument 1.3: There will be an increase in the total number of people wishing to migrate to and from the United Kingdom for education or study reasons.

Argument 1.4: There will be an increase in the total number of people wishing to migrate to and from the United Kingdom for the purposes of claiming asylum.

Argument 1.5: There will be an increase in the total number of people wishing to migrate to and from the United Kingdom at the time of retirement.

A complete list of all arguments used by the UK Office for National Statistics for their recent population projections is at Appendix A1.

3.5.5 The Structure of the Argument-Based Approach

The argument-based approach can be broken down into a sequence of steps that seek to evaluate the major forces that are likely to determine future population and

[24] These arguments are sourced from the interactive questionnaire associated with the IIASA MicMac Deliverable D16 report.

demographic outcomes; to evaluate supporting or negating arguments around these forces; and to process the expert responses to these arguments in a systematic manner to better understand possible future outcomes resulting from these responses. With regard to the demographic factors that drive the cohort-component model these steps can be summarised as follows:

Step 1: Identify the major forces that may shape the current and future population and demography

Step 2: Define the arguments that support or negate these forces

Step 3: Determine the validity of the arguments[25]

Step 4: Determine the impact of the argument on the force

Step 5: Combine the validity and impact scores

Step 6: Calculate the weighted average scores for each force

Step 7: Determine the relative importance of each force as stated by each expert

Step 8: Combine the relative importance and weighted average scores

Step 9: Calculate the overall assessment for the sum of forces for each expert and the panel average for each force and for the overall assessment

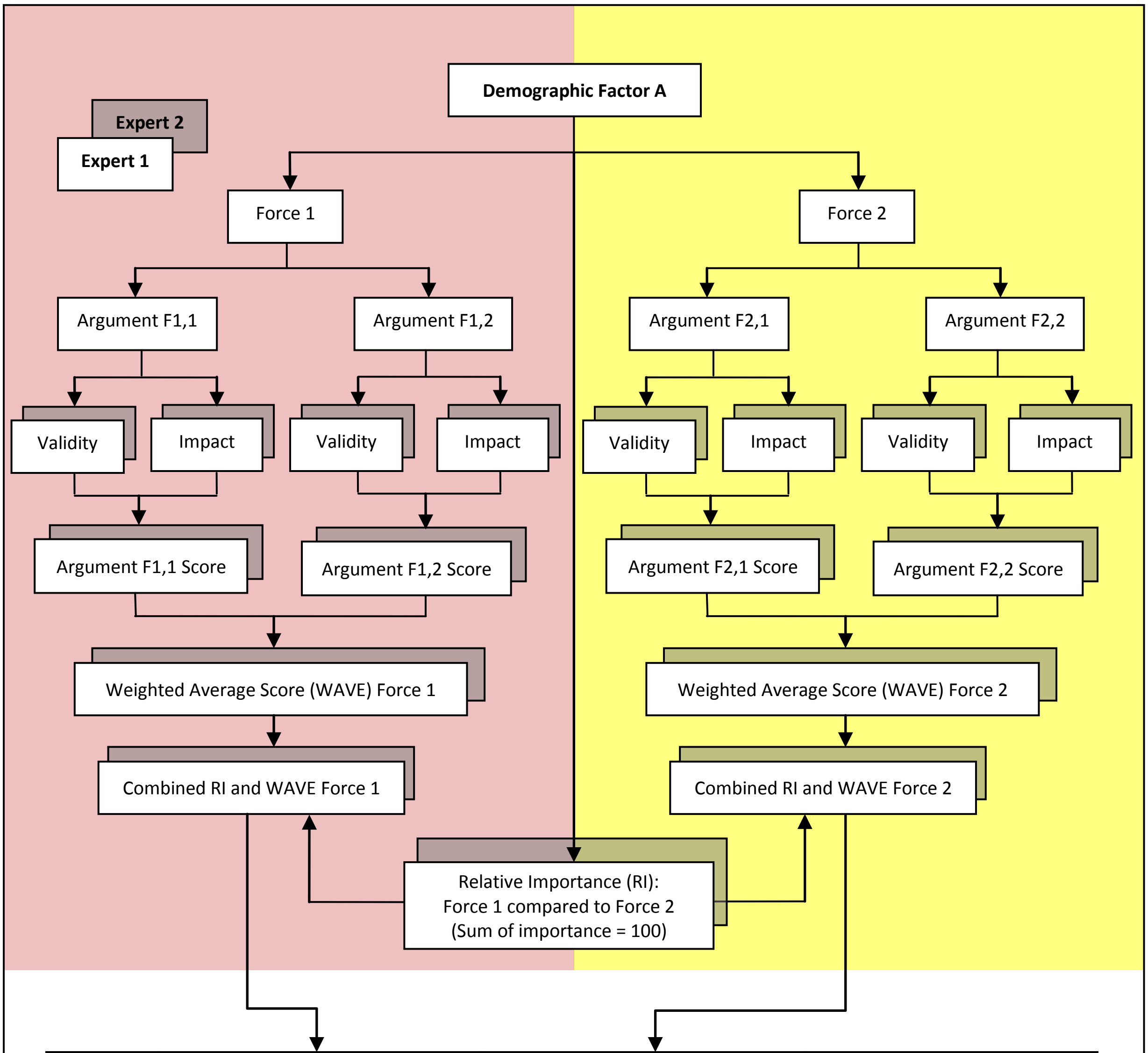
Step 10: Determine the expert's and the group's "best guess" for the most likely value; the range of values; and the societal changes required to achieve the most likely value or the extreme ranges, for the demographic factor of concern

Step 11: Interpret the overall assessment in terms of relative scores and against the experts' best guesses and ranges; and the group's best guess and ranges. Figure 3.1 provides a graphical overview of the argument-based approach for a single demographic factor and assumes that there are two experts, two forces and two

[25] Two Likert scales are used to convert the panel responses to the validity and impact questions to scores. A Likert scale is commonly used in questionnaires to elicit a respondent's level of agreement to a statement. The scale measures both positive and negative responses with responses either evaluated individually or summed over a group of questions to determine an overall rating. The Likert scale can be either ordinal (respondents perceiving the difference between choices to be non-equidistant) or interval (respondents perceiving the difference between choices to be equidistant). These scores facilitate the 'quantitising' of responses in the evaluation of arguments, forces and the overall assessment of panel responses. This is discussed further in Appendix A2.

arguments per force. Each of the above steps is considered in detail in a hypothetical example in Appendix A2.

Figure 3.1: Structure of the Argument-Based Approach



Group	Force 1	Force 2	Overall Assessment
Expert 1	Combined RI and WAVE (Expert 1, Force 1)	Combined RI and WAVE (Expert 1, Force 2)	Sum (Combined RI and WAVE; Expert 1, All Forces)
Expert 2	Combined RI and WAVE (Expert 2, Force 1)	Combined RI and WAVE (Expert 2, Force 2)	Sum (Combined RI and WAVE; Expert 2, All Forces)
Average	Average (Combined RI and WAVE, All experts, Force 1)	Average (Combined RI and WAVE, All experts, Force 2)	Average (Combined RI and WAVE; All experts, All Forces)

Source: Author's interpretation derived from Lutz (2006; 2009)

3.5.6 The Benefits of the Argument-Based Approach

The aim of the argument-based approach is to provide "… a more scientific basis for defining assumptions for population projections …" (Lutz, 2009, p.21).

The overall assessment that results from the evaluation process provides an objective outcome for each panel member and for the panel as a whole regarding the possible direction and magnitude of change for each demographic factor being considered.

The overall assessment scores provide a systematic review of the substantive arguments behind projection assumptions; and help to understand the link between the underlying forces and the likely direction and strength of future demographic change (Lutz, 2009, p.21-22).

3.6 A Modified Argument-Based Approach

In its original form, the argument-based approach produces an overall assessment for each demographic factor that provides a quantitative assessment of the panel's view of the likely future direction and magnitude of change for each factor. Applying the quantitative assessment requires judgement in the interpretation of the meaning of this metric.

To evaluate the likelihood of future urban form outcomes it is necessary to modify the structured evaluation method as used by Lutz (2009) and Shaw (2008). The key requirement of a modified approach is to enable a comparison of potential urban form outcomes to determine the most likely outcome based on the responses of an expert panel. An argument mapping process is developed for this purpose which relates each argument to relevant forces and urban form scenarios – developed in Chapter six. This step is necessary to enable a comparison of urban form scenarios and – although a departure from the argument-based approach discussed previously – provides a comparative evaluation of the panel members' responses, whilst embracing the structured philosophy of the method. Evaluating the arguments and the overall assessment calibrates the conceptual framework illustrated in Figure 1.1. This is a fundamental departure from the original form in that an explicit interpretation of the quantitative results is not required. The overall assessments for each urban form scenario can be compared and interpreted in terms of the panel's views of the comparative likelihood of each scenario eventuating.

3.6.1 The Modified Argument-Based Approach

The three key elements to the modified approach are the argument mapping to both forces and to scenarios; the weighting of each argument; and the evaluation of weighted validity by impact scores that either support or negate particular urban form outcomes. The modified structure of the approach developed in this study is outlined in Figure 3.2.

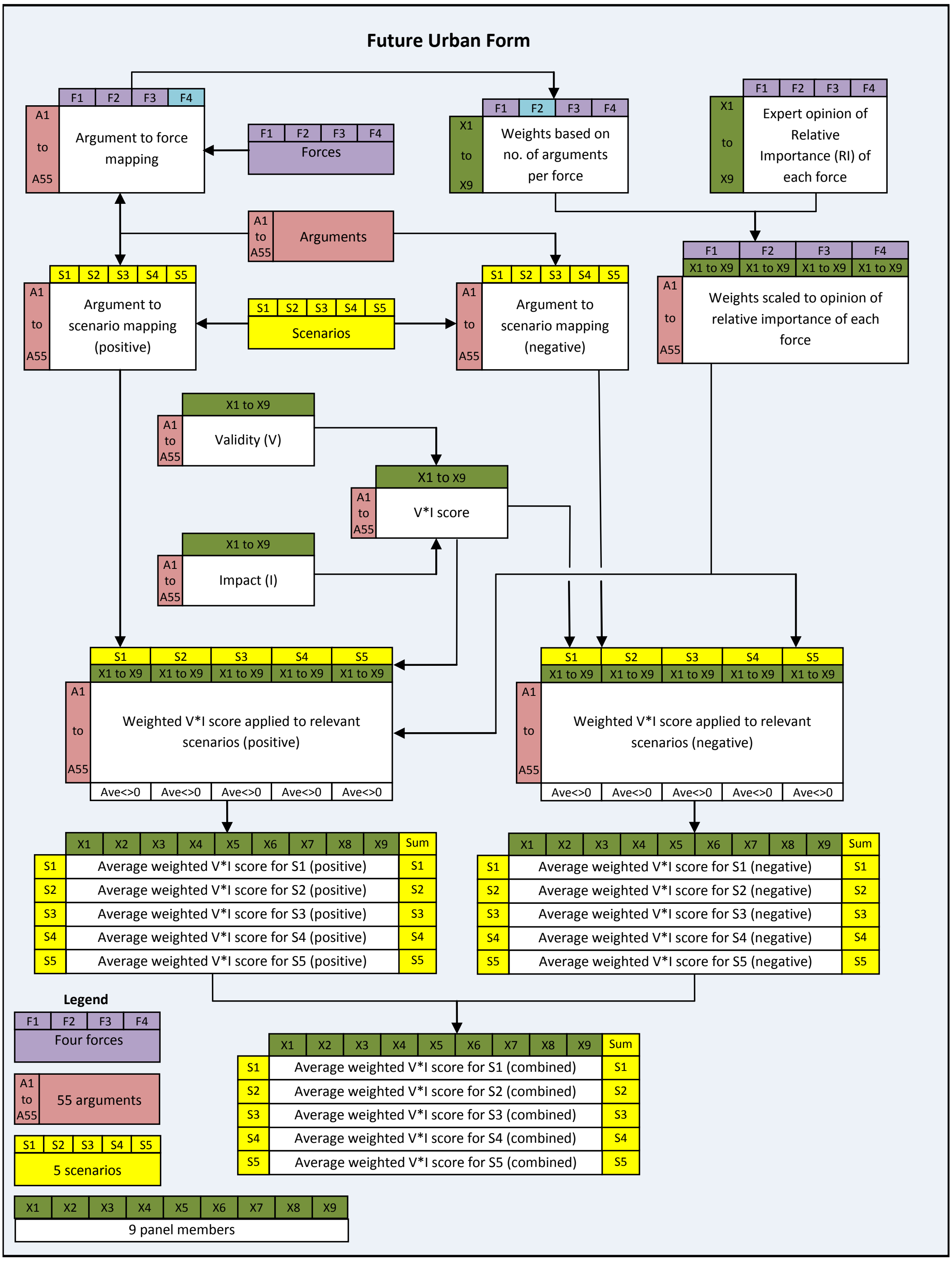
The argument-based approach developed by IIASA considers the three demographic components of fertility, mortality and international migration (Lutz, 2009; Shaw; 2008). Although there are multiple dimensions to each of these components, the argument-based approach aids in the judgement of the likely level of each component – the evaluation fundamentally occurring along a continuous scale. Urban form on the other hand is considered in this study as categorical in nature and not as a continuous variable. The characterisation of urban form is somewhat subjective and the reality of urban form is far more complex than these characterisations. Urban form in this study is treated as a categorical variable with five classes – each described by an urban form scenario – discussed in Chapter six. Urban form, therefore, does not exist along a spectrum; it exists as discrete characterisations of an urban development pathway.

The approach developed for the evaluation of urban form in this study is to generate comparative overall assessment scores – one for each scenario. This is achieved by determining the likely impact of each of a series of arguments on each urban form scenario. The premise of this approach is that each argument can support, negate or have no impact on each urban form scenario. This differential impact can then be used to leverage arguments across each of the urban form scenarios.

The argument mapping process has been designed to expand on a list of unique arguments, such that each individual scenario has sufficient arguments that may either support or negate the likely realisation of this urban form. This step is necessary so that the limited number of arguments that can be included in a panel-based questionnaire can be leveraged across the five scenarios of urban form and across the four major forces developed later in this study.

The argument mapping process is likely to result in differences in the number of arguments that apply to each force and to each scenario. This may bias the overall result by placing excessive weight on those forces and scenarios with the greatest number of arguments either for or against a particular outcome. Although the structured evaluation method used in the argument-based approach is based on averaging of validity by impact scores which addresses the issue of different numbers of arguments, the approach developed here also weights each argument based on the number of arguments that apply to each force. This addresses the potentially different number of arguments associated with each force directly in the evaluation process. In addition, the opinion of each panel member on the relative importance of each force is used to scale each argument at this weighting stage of the method. This results in a scaled weighting for each argument that adjusts for any bias due to the different number of arguments applying to each force and incorporates the panel member's opinion on the relevance of each force to future urban form – consistent with the original argument-based approach.

Figure 3.2: Structure of the Modified Argument-Based Approach



The third element of the modified approach is to evaluate the arguments that potentially support each scenario separately from those arguments that potentially negate each scenario. The results from the evaluation of the positive and negative arguments are then combined to produce the overall assessment of the likelihood of each urban form scenario.

Each of these elements is included in Figure 3.2 along with the direction of information flow. Each box refers to either input data such as arguments or urban form scenarios; or to the result of an evaluation process. The dimension of each matrix can be derived from the margins of each box which contain the number of arguments, forces, scenarios and panel members – developed later in this study.

3.6.2 Argument Mapping

The arguments supporting or negating each of the scenarios of future urban form need to provide the expert panel with sufficient coverage of the main issues such that a balanced overall panel view of the likely future of urban form can be elicited. The argument-based approach does not require a deep discussion of all the relevant issues. What is required is that the topic of interest has been sufficiently considered such that the potential key issues are included in the range of arguments. This is not an exact science.

With regard to urban form the assumptions to be developed concern the general patterns of future urban form as described by the five urban form scenarios developed in Chapter six. The issue to be addressed is whether the overall forces that will influence future urban form are likely to favour the continuation of the current trajectory of urban growth or shift it to an alternative urban form outcome?

To begin the process, a table is generated that identifies both supporting and negating arguments for each of the five urban form scenarios. These arguments could be generated using a workshop approach, with the practitioner ultimately making a decision on which arguments to include and exclude from the process. Alternatively, given that this study contends that face-to-face meetings have their limitations - which would include workshops – and that the workshop participants would likely include some of the expert panel used in the argument-based approach, the workshop approach has not been adopted. Alternatively, these arguments could have been derived from a preliminary questionnaire to the expert panel. But this may have preempted panel responses to the expert questionnaire. Fundamentally, the arguments relevant to urban form are derived from the cross-disciplinary literature review for this study in Chapter four. It is not practical to involve the expert panel in this process for this study.

The principle adopted in generating arguments is that the number of arguments in the questionnaire needs to be sufficient to be able to generate a robust overall assessment score for each scenario, but not too great that the respondents would not participate in the questionnaire. This process is aided by the leveraging of arguments across both scenarios and forces resulting in less arguments than would otherwise be required if arguments were specific to a particular scenario or force. Because some arguments apply to more than one scenario and can be supporting or negating for different scenarios, the table of relevant arguments can be reduced to a list of unique arguments, developed in Chapter seven.

Each unique argument is then assigned to each of the forces to which it is relevant – with some arguments applying to more than one force. This step is necessary to enable the incorporation of the panel member's opinions on the relevance of each force to future urban form. Once again, a judgement must be made as to which forces are relevant to each argument. For most arguments their assignment to a force or forces is reasonably clear; for others this judgement is more subjective.

The next step of the process is an assignment of arguments to each scenario – some arguments supporting particular scenarios and some negating particular scenarios. This process is based on the findings of the cross-disciplinary literature review. A judgement must be made as to which scenario the argument applies, and whether the argument supports or negates that scenario. Once again, for the majority of arguments it is reasonably clear to which scenario or scenarios the argument is related.

The current implementation of the argument mapping exercise relies on the judgement of the projection practitioner. Returning to Chapter one, this study is founded on the need for a more reflexive approach to the development of assumptions for population projections. Rittel and Webber (1973, p.162) call for an argumentative approach, incessant judgement and critical argument; O'Neill (2011, p.238) suggests that "[p]erhaps good judgement is the thing most lacking ..." and that mature judgement is needed "... to assess the possible consequences of things not yet happened ..." (O'Neill, p. 241). Makowski and Wierbecki (2003, p.3) conclude that decisions relating to complex problems will remain a human task, and Lutz et al. (1996a, p.38) comment that "... there can never be a population projection without personal judgement." These arguments lend weight to the use of expert judgement – including the judgement of practitioners.

This approach to evaluating responses in the modified argument-based approach has an impact on the structure of the expert questionnaire. The IIASA approach discussed previously and expanded on in Appendix A2 groups arguments under a specific force. Given that arguments for comparative evaluations, as developed in this study for urban form, can apply across scenarios and across forces, it is not appropriate to group arguments by individual forces. It is unnecessary that respondents know to which scenario or force each argument is applied. Indeed, the anonymity of each argument avoids any preconceived notion of the respondent on which force is most relevant and which urban form is likely to eventuate based on the arguments provided.

Consistent with IIASA's argument-based approach, two Likert scales are used to obtain responses from each expert relating to the validity and impact of each argument. As an alternative to the term validity, the first Likert scale uses the terms true and false to differentiate between whether the respondent believes the statement to have veracity, regardless of whether it has any impact on urban form. For each of the arguments the panel is asked, without considering the possible impact of this argument on urban form, do you think it is:

1. Certainly true
2. More true than false
3. Don't know / ambivalent
4. More false than true
5. Certainly false.

For example, for the argument that "Property developers control where and what is built", a panel member may believe that this statement is true and therefore would respond "1. Certainly True"; but may also believe that this truism has little or no bearing on the future of urban form. This may come about if the expert believes that developers are pragmatically flexible and will ultimately build what and where the market demands.

The second Likert scale relates to the likely impact of the statement on future urban form. For each argument the panel is asked to respond to the statement that, assuming that the argument is true, it would have a MAJOR impact on the general character of Greater Metropolitan Adelaide's urban form over the next 15 years. The choices offered are:

1. Strongly agree
2. Tend to agree
3. Neither agree nor disagree

4. Tend to disagree
5. Strongly disagree
6. Don't know.

3.6.3 Evaluation of Panel Responses

An overall assessment is determined for each scenario consistent with the argument-based approach. As an overall assessment is calculated for each scenario, these overall assessments can be compared to evaluate the panel's views on which of the urban form scenarios is most likely to eventuate based on the responses to the substantive arguments.

Due to the differences between comparing a number of urban form scenarios and considering net fertility, mortality and overseas migration, the approach to the two Likert scales has been modified to better reflect the comparative nature of urban form.

As referred to earlier in this Chapter, the two Likert scales referred to above form the basis to the evaluation of arguments, forces and the overall assessment of the panel's responses to arguments relating to the future of the demographic factor of concern. The first Likert scale used in the argument-based approach used for evaluating fertility, mortality and net overseas migration, determines the validity of the argument and the scale of 1 to 5 is converted to a weight of 1.00, 0.75, 050, 0.25 or 0.00 – from 1.00 for certainly true to 0.00 for certainly false. The second Likert scale of 1 to 6 is converted to a weight of 1.00, 0.5, 0.0, -0.5 or -1.0 – from 1.0 for strongly agree to -1.0 for strongly disagree and 0.0 for don't know. The two scores are then combined resulting in a score ranging potentially from +1.00 to -1.00. For each respondent, the combined validity and impact scores are then averaged to determine the weighted average score over all arguments.

This approach is appropriate for fertility, mortality or migration that may move in either a positive or negative direction depending on the responses of the panel. Urban form, on the other hand, is considered in this study to be categorical, and as such it is more appropriate to use a comparative scale, generating a weighted average score for each scenario. For this reason, for the evaluation of urban form the second Likert scale of 1 to 6 is converted to a score of 1.00, 0.75, 0.50, 0.25 or 0.00 – from 1.00 strongly agree to 0.00 strongly disagree – similar to the first Likert scale – and 0.00 for don't know. Combining the two scores results in a score ranging from 1.00 to 0.00.

Figure 3.2 illustrates the structure of the modified argument-based approach. Following the mapping of arguments to forces and arguments to scenarios, the validity and impact scores are combined to produce validity by impact scores similar to the original argument-based approach. These scores are then applied to relevant scenarios – arguments supporting each scenario evaluated separately from arguments negating each scenario – based on the results of the argument mapping exercise discussed in Chapter seven.

At this point, the weights derived from the number of arguments per force, and the panel members' opinions of the relative importance of each force are applied to produce weighted validity by impact scores for each scenario. Each panel member's scores are then averaged (excluding scores of zero[26]) to produce an average weighted validity by impact score for each scenario for each panel member.

The positive (supporting arguments) and negative (negating arguments) are then combined, resulting in an overall score for each scenario. Overall scores for each panel member can be reviewed to determine which scenario each individual member considers most likely to eventuate.

More importantly, however, the sum of all panel members' results represents the panel's objective judgement of the most likely future urban form outcome.

3.6.4 Choice of an Expert Panel

In its original form, the argument-based approach uses a panel of experts who are adequately qualified and experienced to provide their expert views on fertility, mortality or migration. Lutz (2006, 2009) and Shaw (2008), focusing on national level population projections, used expert panels to evaluate the demographic factors of fertility, mortality and overseas migration for world and United Kingdom population projections. An alternative approach to selecting an expert panel that draws on a much larger group to provide input into the development of projection assumptions has also been used (IIASA, 2011). Bell et al. (2011) also sought input from a wide range of population expertise to provide input into the likely levels of net overseas migration and its components for Australia. In all of these cases, the factors of concern directly related to population and demographic factors. For this reason, these studies chose expert panels that were comprised predominantly of demographic and population experts – with the likelihood that some members of the panel would have specialised knowledge on fertility, mortality or migration.

[26] The logic for excluding scores of zero is explained in Appendix A2.

This study is concerned with local area population projections with a focus on future urban form as a determinant of future population distribution. Although the distribution of the population is demographic in nature, urban form is predominantly within the domain of urban geography and urban planning. The choice of an expert panel to address urban form is therefore fundamentally different to the demographic factors of fertility, mortality and migration. As discussed later in Chapter six, urban form is complex and is influenced by many factors; but urban form is fundamentally geographic in nature. For these reasons, the expert panel developed for this study is drawn from three subject areas – demography; urban planning and urban geography.

3.6.4.1 Non-probability Sampling and the Size of the Expert Panel

A sample is a subset of the population, selected by either probability or non-probability methods (Uprichard, 2013). Probability sampling in statistics is intended to produce unbiased estimates of population totals by weighting each sample by their probability of selection (Morgan, p.682). The use of probability samples for inference is well understood (Cassel, 1977; Yates, 1946). Non-probability sampling, on the other hand, requires criteria for selection, resulting in some of the population having no chance of selection – that is, the goal is not to create a random sample.

Non-probability sampling is a group of sampling techniques used in qualitative and mixed-methods research (Saumure and Given, p.563). These techniques include quota sampling, convenience sampling and purposive sampling. Purposive sampling in research design is not new (Neyman, 1934, p. 559). Purposive sampling relies on the judgement of the researcher in the selection of sample members. The purposive sampling method used in this study is expert elicitation. Expert elicitation is used in research that requires a focus on individuals with particular expert knowledge. This approach is useful where there is a lack of empirical evidence, high levels of uncertainty and where the research takes account of a range of possible futures (Usher and Strachan, 2013, p. 812). Expert elicitation methodologies have been used for many decades and in disciplines as diverse as psychology, energy use and climate change (Usher and Strachan, 2013, p. 812)

Purposive sampling methods are designed to better understand a phenomenon or issue by seeing the world through the eyes of others. What is being sought is not representation or generalisation (Teddlie and Yu, 2007, p.77); but “saturation” – when the collection of new data does not add to the issue under investigation (Glaser and Strauss, 1967; Strauss and Corbin, 1998). Using these methods, there is a trade-off between sample size and saturation (Mason, 2010). Sample size in qualitative and mixed-methods research is therefore determined by the saturation point; which is in turn determined by the purpose of the study (Charmaz, 2006). Although, determining when saturation has been reached is debated (Bowen, 2008; Morse, 1995).

The U.S. Environmental Protection Agency (2011, p.75), reporting on the use of expert elicitation in their agency, reference a survey of 38 studies by Walker (2004), that found almost 90 per cent used eleven or fewer experts. Almost 60 per cent of these studies used six to eight experts. Guest et al. (2006, p. 74) posit that, in the main, saturation is reached after twelve interviews. Guest et al. (2006, p. 78) also report on the work of Nielsen and Landauer (1993), who demonstrated that six participants uncover 80 per cent of the "... major usability problems within a system ...". Libby and Blashfield (1978, p.127) reporting on the improvements in accuracy relating to additional experts, conclude that the majority of improvements are achieved with the first two or three experts.

It has been shown that there are decreasing marginal returns to increasing the number of experts on a panel (Makridakis and Winkler, 1983; Clemen and Winkler, 1985); and that the use of expert knowledge can reduce the number of participants needed in a study (Jette, Grover and Keck, 2003). Clement and Winkler (1999) also assert that experts who adopt a similar modelling style, have a similar philosophy, and have access to the same data, tend to provide redundant information.

One of the more common uses of expert panels is in the setting of national monetary policy (Maurin and Vidal, 2012). Berger and Nitsch (2008) looking at the size of Monetary Policy Committees over 30 countries from 1960 to 2000, found that a U-shaped relationship exists between the size of the expert panel and the goal of the panel – to minimise inflation. They concluded that the best outcomes are achieved with between seven and ten members. Ferell (1985), discussing the size of expert panels, recommends using between three and five members.

With regard to the number of experts that is appropriate to use in this study, Rowe and Wright (2001, p.141), distilling the principles for using a structured approach to combining expert opinion, recommend using between five and 20 experts. The Office for National Statistics in the United Kingdom used a panel of six experts for their 2004 and 2006 rebased population projections for the United Kingdom (Shaw, 2008), and a panel of ten experts for their 2010 projections (ONS, 2011). Lutz (2009, p.5) reporting on a survey of the use of expert opinion in national statistical agencies in the European Union, states that of 16 institutes that reported using expert opinion, 11 used 10 or more external experts; two institutes used between five and nine experts; and two offices used one to four external experts. A recent expert questionnaire used by IIASA and Oxford University to ascertain expert opinion for world population projections engaged many more experts (IIASA, 2011). Bell et al. (2011) also using an expert survey to assist in assumption setting for probabilistic forecasting, received 24 responses out of 38 approaches to experts.

A panel of nine members comprise the expert panel for this study. This group of experts - drawn from academia and relevant government bodies - is consistent with the above discussion; and, as such, is sufficient to illustrate the benefits of the conceptual framework developed in this study.

3.7 The Expert Panel for Urban Form

Following on from the above discussion on the appropriate size of an expert panel, Bowen (2008, p.140) comments that sampling in qualitative research is less focused on sample size, and more on sample adequacy. Bowen (2008, p.140) considers an 'appropriate' sample to be composed of participants who best represent or have knowledge of the research topic. Given the mixed-methods approach adopted in this study, sampling adequacy equally applies to the selection of an expert panel.

The expert panel for urban form is drawn from key Australian academics in the field of urban planning and urban geography, along with current and past State Demographers. The nine contributing members of the expert panel for urban form comprised:

- Dr Andrew Allan, Senior Lecturer (Transport, Urban and Regional Planning), School of Natural and Built Environments, Barbara Hardy Institute, University of South Australia
- Professor Andrew Beer, Professor of Geography; Director, Centre for Housing, Urban and Regional Planning, University of Adelaide, South Australia
- Dr Neil Coffee, Senior Research Fellow, University of South Australia, (previously State Demographer, Planning SA, South Australia)
- Emeritus Professor Stephen Hamnett, Adjunct Professor, School of Natural and Built Environments, University of South Australia
- Professor Pauline McGuirk, Professor of Human Geography / Director, Centre for Urban and Regional Studies, Discipline of Geography and Environmental Studies, School of Environmental and Life Sciences, University of Newcastle, NSW, Australia

- Mr Ian McQueen, Manager (retired), Spatial Planning, Analysis and Research, Planning SA, South Australia (previously responsible for land and housing forecasting for South Australia)
- Mr Jeremy Reynolds, Manager, Demographic Research, Department of Planning and Community Development, Victoria, Australia (responsible for state government population and land forecasting in Victoria, Australia)
- Dr Ross Steele, Principal Demographer, Department of Planning and Local Government, South Australia (responsible for state government population projections for South Australia and its regions)
- Emeritus Professor Patrick Troy, Visiting Fellow, Fenner School of Environment and Society, Australian National University; Adjunct Professor, Urban Research Program, Griffith University, Queensland; Visiting Professor City Futures Research Centre, Faculty of Built Environment, University of New South Wales.

3.8 The Elemental Nature of the Argument-Based Approach

This Chapter has described the modifications made to the argument-based approach to facilitate a comparative application to urban form scenarios. An argument mapping exercise is discussed which considers each argument and applies the argument to multiple forces and multiple urban form outcomes. To achieve this requires that each argument is adaptable and can potentially be applied to any force or any urban form outcome.

The argument-based approach can be viewed as having two quite separate components: the argument-based component; and the expert opinion component. The argument-based component consists of stand-alone arguments that are specific and generally without context. Although these statements require a response from the panel member, they are conceptually different to the requirements of the expert opinion component. The structure of each argument has been deliberately minimised and not associated with any particular force or urban form outcome within the expert panel questionnaire. In this study, this requires that the respondent provides a general view about the statement, without considering the complexities of the statement and its potential context. An “expert opinion” is not being sought at this stage. Although this may appear to be a subtle distinction, it is critical for the argument-based approach to be of value.

The expert opinion component on the other hand, requires that the expert provides an opinion on broader outcomes and issues. These opinions are likely to be informed by many years of considering both the complexities and the context of these broader outcomes and issues.

“Experts” by definition have had considerable experience in their chosen field and have considered the issues relevant to their field in some depth. Over time “knowledge” is both developed and undone – we learn, re-examine, re-learn and so on (Kolb, 1984). Ultimately, over time a seasoned professional will have formed views and opinions on the key fundamentals of their craft; and would have adopted various methods to aid in pursuing and evaluating further knowledge. At a fundamental level, the argument-based approach has the goal of transcending these expert opinions to draw out and unravel the arguments and forces that have led the expert to their current views and opinions.

At its essence an individual argument is rudimentary in nature. In the context of the argument-based approach these rudimentary arguments are elemental. Arguments are the elements that form the building blocks of the forces that ultimately determine the outcomes for the issue of concern – in this case, urban form.

Each argument may have little meaning in and of itself; but combined in various ways with other arguments, these building blocks can provide valuable insight into the underlying forces that influence and determine demographic outcomes, including urban form. The mechanism by which these elemental arguments are combined is the modified argument-based approach. Combining validity and impact scores; averaging expert and force outcomes; applying relevance scores to each force; and mapping arguments to forces and urban form scenarios, provides the logic and structure to combine these elemental arguments in a meaningful way.

It is interesting to note that the Office for National Statistics included some compound arguments – which provided context and consequences to the argument - in an expert questionnaire used for the 2006 rebased population projections for the United Kingdom (Shaw, 2011). One example of a compound argument used is “Global climate change will lead to a decline in food production in certain parts of the world and, as a result, uncontrolled mass migration and conflicts will increase mortality in this country” (Shaw, 2011, p.134). These compound arguments caused disagreement in the panel’s responses. Disagreement amongst the panel of experts is not an issue, as individual experts will likely have different views on some issues. The problem is that the acceptance or rejection of such an argument by panel members could have occurred for any of the four components of the compound argument: the existence of climate change; the relationship between climate change and a decline in food production; the relationship between mass migration and conflict; or the relationship between conflict and mortality in the UK. This then makes interpreting responses difficult, if not impossible. This issue gives weight to the principle of elemental arguments as they can be interpreted and applied more easily than more complex arguments – particularly compound arguments that attempt to contextualise the argument.

At this elemental level, arguments must also be dimensionless. This can be interpreted as each argument having no temporal or spatial context – the argument is not intended to be considered in terms of a particular period of time or a particular place. As previously stated, this is required so that each argument can potentially apply to any or all of the underlying forces and urban form scenarios. It is also required because the relationships and issues being considered are fundamental in nature. For example, the future preferences of households for detached dwellings or apartments are unknown. It is not a well developed preference or relationship that can be observed, but one that will emerge over time; becoming more apparent and measurable as trends change or remain the same, and only truly known some time after the present has passed.

Considering this example further, a fundamental question is how might preferences change within the study area – if indeed they change at all. For example, if the expert panel considers that household preferences will be difficult to change from current preferences – regardless of when or where - then higher density apartment dwellings in infill locations is less likely and fringe growth is likely to continue. This conclusion would then inform the setting of projection assumptions with a projection scenario potentially displaying continued urban sprawl. But the future housing preferences of households is only one element that may contribute to future urban form outcomes; with other elements potentially negating this influence or adding to it. The combination of the arguments resulting from the argument-based evaluation process attempts to rationalise the complexity of the underlying and competing forces to enable a usable and useful understanding of the panel’s overall views. More complex issues such as which type of households will change their preferences, over what period of time and in which locations are of course critical to future population distributions and to local area population projection outcomes. At this stage however, the broader parameters of the issues are unknown. This study aims to provide a conceptual framework within which these broad parameters can be considered.

As may be apparent from this discussion, the results of the argument-based approach regarding the views of the overall panel may differ from the expert opinion provided for the most likely or preferable urban form outcome. Indeed, the results for each individual respondent may also differ from their response regarding their opinion on overall outcomes. This may seem contradictory as the responses to arguments that underpin the overall outcomes should be consistent and comparable and, therefore, should provide the same results in terms of individual and panel outcomes. However, this apparent contradiction underpins the purpose and benefit of the argument-based approach. It is precisely because individual experts are likely to have formed views on key issues, such as urban form that the approach has value. The approach attempts to identify the underlying forces and arguments that have led to an individual's current views. These underlying forces and arguments may reveal emerging views or inconsistencies that are not directly accessible through the expert's opinion on the broader issues. Evaluating the panel's responses to these underlying forces and arguments can provide a panel outcome that is vastly different than would have been uncovered through more direct methods. It is here that the potentially emergent and contradictory views within and across the panel can be accessed and assessed.

Unfortunately this approach uncovers a paradox in that experts by their nature are highly developed in their field and it is the complexity and depth of argument that sets them apart from those that are not "expert". When presented with elemental statements it is reasonable to expect that one response will be the need to provide greater context to the arguments, which is contrary to the elemental nature of the statements.

3.9 Conclusion

This Chapter introduced the argument-based approach in its original form, and described the benefits of the approach. It then discussed the need for a modified approach to enable a comparison between scenarios of possible future urban form. The key modification to the approach – mapping substantive arguments to both forces and scenarios – is described in detail. This modification, along with the elemental nature of the substantive arguments, is the mechanism by which urban form scenarios are evaluated.

This Chapter makes a clear distinction between probability sampling and non-probability sampling – particularly as it applies to purposive sampling and expert elicitation. The argument is made that the size of the expert panel is less important than the adequacy of the panel. Adequacy relates to the participants who best represent or have knowledge of the research topic, and the concept of saturation. Saturation is taken up again in Chapter eight, in terms of the need to capture sufficient variability in the expert panel's responses.

Chapter 4 The Forces that Shape Future Urban Form

4.1 Introduction

This Chapter forms the major literature review for this study. The conceptual framework outlined in Chapter one, and the modified argument-based approach developed in Chapter three, require that the forces that shape urban form are defined, and considered in terms of arguments that both support and negate future urban form outcomes. Given the breadth of the issues that are relevant to urban form, this literature review covers a range of disciplines and approaches to understanding urban form. To facilitate a discussion of the forces that shape future urban form requires an ontology – what is considered “knowledge” and a classification scheme – of the broad classes of forces.

Firstly, this Chapter discusses the complexity of the urban system and the need to develop a simplified view of the system. To facilitate the conceptual framework, an ontology of four pillars that shape future urban form is developed; namely, the influence of economic, government policy, environmental and lifestyle factors. This ontology is deliberately broad to ensure a comprehensive coverage of the literature. The literature relevant to the relationship between each of these factors and urban form is explored, both through its historical development and its current academic and practical application. Each Section is concluded with a summary of the possible influences of each pillar on future urban form.

4.2 Major Forces Shaping Future Urban Form

The city is a complex system. It has many constituent parts that interact in a myriad of ways which can be considered at various scales. In order to grapple with this complexity the constituent parts of relevance need to be identified and the important relationships that connect these parts need to be understood - as well as they can in an uncertain world. But more fundamental than understanding structures and relationships is identifying the problem that is being considered, as well as the dynamic forces and processes that impact on that problem.

The problem posed in this study is how to improve the judgement required in developing the assumptions that underpin local area population projections. In this context, future urban form is identified as a key determinant of future population distribution; and therefore assumptions about future urban form are critical to the population projection process. To address this issue the major forces that influence future urban form need to be identified and evaluated. This Section formulates an ontology that is used to consider the key forces and processes that influence urban form.

The complexity of the city is firstly discussed in terms of metaphor, and as a 'wicked problem'. Given the complexity of urban systems, an argument is mounted that the view of the problem needs to be reduced to its fundamental form to facilitate understanding and analysis. The drivers of urban change are then introduced which leads into a discussion of the triple bottom line as a way of looking at the world. The concept of four pillars is then developed to simplify the view of the urban system.

4.2.1 The Complexity of the City

> "Cities do not exist in benign environments and cannot be easily closed from the wider world, they do not automatically return to equilibrium for they are forever changing, indeed they are far-from-equilibrium. Nor are they centrally ordered but evolve mainly from the bottom up as the products of millions of individual and group decisions with only occasional top down centralised action. In short, cities are more like biological than mechanical systems …" (Batty, 2012, s9).

The metaphor of a city as a machine emerged in the mid 1900s as a way of understanding society, social structures and behaviours. The view that cities are like machines suggests that cities can be designed and controlled and emphasises the physical nature of structure and form. But the complexity of the city cannot be understood solely by a mechanistic and deterministic view that ignores the complexity of a city's constituent parts and the self-determination of human behaviour (Batty, 2007, p.3).

A more contemporary metaphor describes cities as complex biological systems[27] that evolve, grow and change from the bottom up – not designed from the top down (Batty, 2012). An early characterisation of a complex system is a system that is self-organizing, non-linear and exhibits feedback and emergent behaviours (Bertalanffy, 1972). Baynes (2009, p.215) considers cities to be "…emergent entities existing near a critical point of self organisation, far from equilibrium and qualitatively different from their constituent residents and subsystems". In her classic book *The Death and Life of*

[27] This view can be traced back to the invasion and succession ideas of the urban ecologists of the 1920s, particularly Park and Burgess (Braude, 1970).

Great American Cities, Jane Jacobs (1961) made an early observation of the city as a complex, self-organising system. Jacobs' observations are a reference to even earlier work by Weaver (1948) who classified problems of science as either simple, disorganised complexity or organised complexity.

The systems view of a city shifts the emphasis from structure and form, to behaviour and process (Batty, 2007, p.3). This view has significant implications for the planning of cities in that it shifts the focus from the physical form which currently dominates the practice of urban planning towards what Batty calls:

> "… a serious concern for social process … [whereby] … the concerted action of millions of individuals and agencies … generate structures of complexity that are virtually impossible to manage, control or redesign from the top down" (Batty, 2007, p.3).

Batty (2007, p.26) concludes that the planning, design, control and management of cities is both difficult and potentially dangerous.

Jane Jacobs' (1961, p.428) makes the fundamental statement that "one of the main things to know is what kind of problem cities pose, for all problems cannot be thought about in the same way". Given the organised complexity of the city and Batty's concerns about the difficulties of intervening in city development, Rittel and Webber (1973, p.160) provide some insights into what kind of problem the city poses commenting that:

> "[t]he kinds of problems that planners deal with - societal problems - are inherently different from the problems that scientists and perhaps some classes of engineers deal with. Planning problems are inherently wicked."

The Australian Public Service Commission (2007) characterises wicked problems as:

- Wicked problems are difficult to clearly define
- Wicked problems have many interdependencies and are often multi-causal
- Attempts to address wicked problems often lead to unforeseen consequences
- Wicked problems are often not stable
- Wicked problems usually have no clear solution
- Wicked problems are socially complex
- Wicked problems hardly ever sit conveniently within the responsibility of any one organisation

- Wicked problems involve changing behaviour
- Some wicked problems are characterised by chronic policy failure.

If the city is indeed a wicked problem, the question must be asked: how can the city be understood? In the context of this study, Jacobs provides some guidance in that not all problems can be thought of in the same way. This study is concerned with local area population projections primarily focusing on future urban form. The question then becomes how can urban form be better understood in the context of population projections for the city?

4.2.2 The Need for Simplicity

Jacobs (1961, p.435) considers that conventional city planners have mistakenly considered cities as simple problems. In her discussion of the city as organised complexity, Jacobs (1961, p.434) comments that "…there is no use wishing it were a simpler problem or trying to make it a simpler problem, because in real life it is not a simpler problem".

In the context of planning and governing a city system, Rittel and Weber (1973, p.160) state that "[a] great many barriers keep us from perfecting such a … system: theory is inadequate for decent forecasting; our intelligence is insufficient to our tasks; [and the] plurality of objectives held by pluralities of politics makes it impossible to pursue unitary aims …"

If it is accepted that there is no benefit in simplifying a complex problem and that current theory is still inadequate for forecasting, our intelligence is insufficient and multiple objectives diminish the achievement of any particular goal, how can future urban form be understood – let alone forecasted - given that it is an outcome of city processes – including individual and household location decisions – within the complex city system?

One approach to this quandary is to accept the complexity and even the wickedness of the problem, but to reduce the problem to its fundamental form and to simplify the way the problem is viewed. The art of population projection practice requires judgements to be made about the parameters of future populations – for local area projections one of these parameters is space; considered in this study as urban form. The judgements made about likely future urban form must be made at a point in time following a process of analysis and reflexion. The "problem" – as asked by Jacobs – for the purposes of population projection practice, is setting plausible assumptions about future population growth and distribution based on knowledge, judgement and – as Rittel and Weber (1973, p.160) state – inadequate theory. This is the projection practitioner's wicked problem.

As an approach to viewing cities, Jacobs (1961, p.440) poses three "habits of thought":

1. To think about processes
2. To work inductively, reasoning from particulars to the general, rather than the reverse
3. To seek for "unaverage" clues involving very small quantities, which reveal the way larger and more "average" quantities are operating.

Rittel and Webber (1973, p.162) state that the city system:

> "… should be based on a model of planning as an argumentative process in the course of which an image of the problem and of the solution emerges gradually among the participants, as a product of incessant judgement, subjected to critical argument".

The *image* of the problem and the solution does not imply that the problem has been simplified, but offers a means of reducing the problem to its fundamental form or simplifying the way the problem is viewed.

If Jacobs' "habits of thought" and Rittel and Weber's argumentative process seem familiar, this is because they strongly align with the principles of the argument-based approach developed by Lutz (2006; 2009) and modified for this study. The argument-based approach considers the underlying forces – or processes – that influence population growth and change; it is grounded in the arguments that drive these forces; it reasons from these particular arguments to the general; and the *image* of the problem and the *image* of the likely outcomes emerges from the judgement of the expert participants and the critical judgement of the projection practitioner.

So what are the fundamental processes and forces that influence urban change and future urban form?

4.2.3 What Drives Urban Change?

One of the fundamental drivers of change in cities around the world is growth in population - more specifically, pressures arising from family formation and family dissolution and the demand for new dwellings (Government of Australia, 2011). All major capital cities in Australia – including Adelaide in South Australia - have experienced rapid population and household growth over recent years due mainly to increases in overseas migration[28]. In addition to population growth, Randolph (2004, p.481) lists the following pressures that are impacting on Australian cities:

- changing scale and function of Australia's cities within a global system of cities
- changing role of Australian cities in their regional economies
- changing household structures
- employment restructuring and differential regional economic development
- land release pressures
- ageing of housing stock and infrastructure
- changing impact of information technology, electronic media and communications
- environmental constraints
- urban policy pressures (consolidation)
- public policy changes, particularly in terms of the spatial impacts of fiscal and welfare policy change
- changes in transport policy and infrastructure provision
- social and economic infrastructure developments
- cultural and lifestyle changes
- changing housing market dynamics and financing.

Randolph (2004) considers that these forces are pulling and pushing the Australian city system in a range of directions with some forces working together and others working in opposition.

Residential location choice is an issue that has been considered by many disciplines including geography, economics, planning, sociology and psychology (Montgomery and Curtis, 2006, p.4). In their literature review of housing mobility and location choice Montgomery and Curtis (2006, p.4) encapsulate the cross disciplinary nature of location choice stating that:

> "The decision to buy or rent a home is a large financial commitment that, in most cases, will continue to influence the quality of life, access to opportunities and transportation patterns of families and individuals long after the event. Residential location choices shape our cities in important ways."

[28] Positive Net Overseas Migration to Australia peaked in 2008/2009 and has fallen sharply since; although current levels are still substantially above the long-term average (Australian Bureau of Statistics, June 2012a, cat. No. 3101.0 – Australian Demographic Statistics).

Of particular relevance to this study is the connection between residential location choice and the shape of cities – that is, the nature of urban form. This connection is also made by Wu (2004) and Kim et al. (2005) who attribute changes in urban form largely to aggregate outcomes of residential mobility and residential location choice.

Referring specifically to fertility and migration, McDonald (2012, p.54) states that population forecasts would be more useful if they were based not only on recent demographic trends but also on predicted behavioural change. This view can be extrapolated to residential location choice and the provision of dwellings, as future location decisions and dwelling opportunities will be an outcome of current trends and changes in future behaviour – of individuals, households, institutions, government agencies and the market.

To understand current trends and possible future changes in behaviour requires an ontology – a classification of reality – based on the complexity of the city system but one that provides a simplified view of this reality. This ontology needs to encompass the main processes and forces that influence residential location choice and future urban form, but needs to be manageable in terms of the argument-based approach adopted in this study.

4.2.4 The Three Pillars

> "Future demography is not determined by statisticians, economists or demographers sitting in their offices and exogenously dreaming of the future, stochastically or otherwise. Future demography will be endogenously determined by social, economic and environmental factors." (McDonald, 2012, p.54)

McDonald's comments encapsulate both the uncertainty of future populations and provide the basis for an ontology to describe and understand the main forces that influence population outcomes.

The triple bottom line of society, economics and the environment is a phrase coined by John Elkington (1998) in *Cannibals with Forks: the Triple Bottom Line of 21st Century Business.* Although designed as an accounting framework to guide sustainable business activities, the principles of the triple bottom line have their origins in the three pillars of sustainability popularised at the first United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. The three pillars of economic development, social development and environmental protection, are intended to provide the guiding principles for long-term sustainable development (United Nations, 2012).

The principles of the three pillars, or the triple bottom line, have been widely adopted as the basis for capturing the broad values of sustainability, principally because they provide a framework of understanding that is potentially comprehensive and inclusive of the main processes that impact on sustainability (see the report Foran et al. (2005), *Balancing Act*, as an example of a triple bottom line approach to evaluating the sustainability performance of the Australian economy in the mid-1990s). Given the complexity of the city and urban change, this comprehensive and process-driven framework provides a starting point for an ontology that describes population distribution, residential location and urban form outcomes.

4.2.5 The Four Pillars

The principles of the three pillars may provide a basis for considering population distribution and urban form, but the three pillars themselves are intentionally broad and can be interpreted in many ways. For the purposes of this study it is necessary to define and refine these three pillars to make them relevant to the forces and processes that influence future urban form.

Baynes (2009, p.215) comments that studies in urban complexity have traditionally focussed on population, land-use change and transport and although these are still relevant the field could be expanded by the inclusion of other factors such as urban management which includes food and water security, energy supply and climate-changing emissions. In terms of the three pillars, these additional factors could be considered in the context of the environment, society or economics. However categorised, they are all factors that may influence future urban form and can contribute to a relevant ontology for this study.

The terms of reference for the recently released sustainable population strategy (Hugo, 2010) for Australia included amongst others:

- the likely trajectory of Australia's population
- the sustainable provision of the social and economic infrastructure needed to support a growing population, including the urban environment, transport, housing and service delivery networks

- consideration of the environment, water resources and water use, urban amenity and liveability, social policy issues and social inclusion. (Hugo, 2010, p.ii)

These terms of reference identify several important issues that may influence future urban form. The provision of social and economic infrastructure will clearly impact both market and household location decisions in terms of employment and residential location. At the broader level, decisions on the provision of transport infrastructure and housing are either determined or heavily influenced by policy and the market. These decisions will have a major influence on population distribution and urban form. Urban amenity and lifestyle preferences are also issues that may have a strong influence on residential location decisions and are one of the foci of this study.

Montgomery and Curtis (2006, p.4) highlight the bundled nature of housing as a major consumption good. It provides not only shelter but due to its intrinsic location attributes, it is also a major contributor to quality of life through access to services, amenities and employment and the transport costs associated with this access. Given the spatial dimension of urban form, accessibility is likely to be a pivotal consideration in the decision where to live.

Roberts (2007, p.721) comments that the relationship between urban density and the sustainability of urban development is complex and embraces many physical, environmental, social and behavioural factors. To address these complex and poorly understood relationships, Roberts (2007, p.726) suggests that these factors need to be linked to “the five principal elements of urban systems” – the built, economic, governance, natural and social environments.

Roberts’ contribution to a possible ontology for this study is the inclusion of governance as a principal element of the urban system. A discussion of the influences on future urban form would not be complete without the inclusion of urban policy – particularly the consideration of urban planning strategies in the Australian context.

Drawing from the above, the four pillars that constitute the ontology for this study are the influences of economics, government policy, environment constraints, and lifestyle, on future urban form. This Chapter deals with each of these pillars separately, identifying key issues and critically evaluating their relevance and possible contribution to future urban form.

4.3 The Economics of Urban Form

This Section focuses on the relevance of economic theory and the contribution of economic geographies to the understanding of urban systems, and touches on housing affordability and accessibility to employment as specific factors influencing future urban form. The concept of underdetermination is discussed in relation to the failure of traditional population projection practice to address theory and the underlying forces that determine population outcomes.

4.3.1 Overview

"Economic factors have an impact on how the built environment is shaped …" (Frank 2004, p.146). Frank's statement succinctly captures the essence of why economics is included as one of the four fundamental pillars of knowledge defined in the ontology for this study. But the relationship between economic factors and the shape of the built environment – urban form as it is described in this study – is complex. In their literature review on housing mobility and location choice, Montgomery and Curtis (2006, p.4) comment that "[t]he literature on this topic is not only vast but spread across various fields" – economic theory being an important aspect of their review.

Blais (1996, p.4) in a Canadian report prepared for the Greater Toronto Area on the economics of urban form, suggests there are three main approaches to addressing issues related to the economics of urban form: "… truly economic; statistical; and cost assessment approaches." Blais (1996, p.4) considers statistical approaches - which test for statistical relationships between aspects of urban form and costs or expenditure – to be of limited value as they do not address the real causes or factors behind these statistical relationships. "Truly economic" approaches are considered by Blais (1996, p.4) to be highly theoretical, deal with market equilibrium conditions and adopt "necessarily" simplified assumptions. Because the purpose of Blais's work was to assess the cost and revenue implications of alternative urban forms, Blais (1996, p.4) adopts a cost assessment approach, which attempts to estimate the dollar value of the actual cost of infrastructure and other costs associated with different urban forms.

Given that the focus of this study is future urban form, with the location decisions of households and the market forming a major part, the cost assessment approach to the economic implications of urban form may have an impact depending on who bears the infrastructure and other costs (see Urbis JHD 2006, for a survey of infrastructure charges in Australia's major cities at that time; and Lyndall and Eves 2011, for an international comparison of the impact of infrastructure charges on the cost of new housing). However, the cost assessment approach is not directly considered in this study, as infrastructure and other associated costs of different urban forms are assumed to be capitalised in the cost of housing.

Primarily, this study considers the theoretical approaches to the economic aspects of household location decisions in terms of the potential trade-off between housing costs and the location and accessibility of employment and local amenity. This theme is considered extensively in the theoretical approaches taken by economists in the residential location choice literature (Dieleman 2001; Kay and Marsh 2007; Montgomery and Curtis 2006).

For the purpose of this study a perspective is required that captures the aggregate outcomes of housing location choice. This Chapter discusses various economic theories that relate to household location choice, along with the specific issues of housing affordability and the location of employment.

4.3.2 The Economics of Geography

Economic geography is a sub-discipline of geography that considers the location, distribution and spatial organisation of economic activity. It does not consider the distribution of population explicitly, but is foundational to the evolution of economic theory concerning residential location choice. Early approaches to the economic aspects of geography include the Germanic tradition of equilibrium location theory (Krumme 1999), and later, Johann von Thunen's *The Isolated State (1826)*, Alfred Weber's *Theory of the Location of Industries* (1929) and Walter Christaller's *Central Places* (1933) (Martin 1999, p.66). Following these seminal works, Losch (1954) published *The Economics of Location,* which led to the development of the disciplines of regional science - a highly mathematical and theoretically abstract discipline - and economic geography which has evolved into an "… eclectic and empirically-orientated subject …" which rejects formal neoclassical location theory in favour of more traditional approaches such as Keynesian-interventionist economics (Martin 1999, p.66).

4.3.3 The Geography of Economics

The location theories of von Thunen, Weber, Christaller and Losch provided the foundation to many contemporary geographic disciplines. These location theories also played a pivotal role in the development of the economic sub-discipline of urban economics (Capella and Nijkamp 2004, p.3). Burnell (2010, p.665) defines the field of urban economics as "… the study of the spatial relationships between individuals, households, and firms from an economic perspective." O'Sullivan (2003, p.13-14) considers urban economics in terms of six related themes: market forces in the development of cities, land use within cities, urban transportation, urban problems and public policy, housing and public policy, and local government expenditures and taxes. Unlike the economic sub-disciplines of geography that primarily focus on the location of firms and economic activity, urban economics has an urban focus on issues such as crime, education and housing. Urban economics is relevant to this study in that it considers the spatial location of households and firms and the role of government policy in housing issues. An important element of household location is the concept of durability of housing which impacts directly on residential location and urban form. This durability implies that history plays an important part in the structure and form of urban areas (Quigley, 2008).

Urban economics is currently developing in two directions: conventional urban economic approaches, that develop ever more sophisticated formal models based on either traditional macroeconomic growth assumptions or neoclassical microeconomic locational behaviour; and the less conventional, qualitative and applied approach which is "… characterised by the undeniable advantage of grasping the tangible and intangible aspects of city growth and dynamics …" (Capello and Nijkamp, 2004, p.20). The focus on the intangible aspects of urban development resonates with this study in that the consideration of future urban growth is assumed to extend beyond conventional urban modelling, and requires a more qualitative and intuitive approach to urban dynamics and future urban form.

McMaster and Watkins (2006, p.902) also criticise contemporary urban economics for its predominantly modelling and mainstream economic approach. In particular they emphasise the construction of models of land and housing markets that are overly precise, definitive and generalisable;

> "[y]et, by mainstream urban land and housing economists' own admissions, the analysis of property markets is complicated by the peculiar characteristics of urban land and housing that present 'measurement difficulties' and pose extensive problems for prediction."

McMaster and Watkins (2006, p.902) comment that this formal modelling approach has led to accusations that mainstream urban economics is "… preoccupied with technique at the expense of institutional considerations". This lack of institutional context and the more general criticism of underdetermination of economic models are taken up later in this Section.

4.3.4 Economic Theories of Housing Location Choice

Underpinning many of the economic perspectives of location are more general economic principles and methods such as utility maximisation, the Tiebout hypothesis and the hedonic price method. These more general topics are discussed here in the context of housing location.

4.3.4.1 Utility maximisation

Utility maximisation measured by revealed preferences is a general economic principle that underpins much of neoclassical thought in economic theory (see Alfred Marshall (1920) for a seminal discussion of utility and the willingness to pay; and Gilboa (2009) for a contemporary and cross-disciplinary approach to consumer choice and decision making). Fundamentally, individuals are assumed to maximise their overall benefit by trading off between available goods and services. In terms of location choice this trade off is between commuting and housing costs (Hoang and Wakely 2000; Krizek and Waddell, 2002). In its early form this transport and land cost trade off is attributed to Alonso (1964).

The utility maximisation theory is still influential, but has been widely criticised because of the relatively simple yet demanding assumptions that underpin the theory. Hoang and Wakely (2000, p.9) discussing what they describe as the market-based theory to residential housing location, suggest that:

> "… the biggest obstacle that prevents it from achieving not only a close description, but also a satisfactory explanation of residential location, is the excessive reliance on physical, measurable variables, the meanings of which could undergo fundamental changes during different historical times".

Hoang and Wakely (2000) point to the declining relevance of the monocentric city assumption that underpins traditional location theory as one of these variables – the meaning and measurability of which has changed fundamentally over time.

In terms of this study, one of the more relevant criticisms of utility maximisation in the literature is its "rigid economic determinism" (Hoang and Wakely 2000, p.33), in that the housing location trade-off is considered only in an economic perspective ignoring other social and quality of life issues. In their literature review, Montgomery and Curtis (2006) include references to a wide range of non-economic factors including racial and religious segregation (Stringer et al., 1991; Guo and Bhat 2006, Toussaint-Comeau and Rhine 2004), self image and social status (Sirgy et al., 2005; Kenyon and Heath 2001; Lindstrom 1997), access to open space and natural features (Myers and Gearin, 2001; Kaplan and Austin, 2004; Vogt and Marans, 2004;), and other lifestyle factors (Krizek and Waddell, 2002).

Richardson (1977, p.252) proposes an alternative theory of residential location, incorporating both market and non-market factors. Purely market approaches are criticised in their overly rigid assumptions such as: households have freedom to move wherever they decide when in reality households have considerable constraints on where to move due to the limited number of dwellings available at any point in time; the specific location of these dwellings; and the time constraints of households in their search for a new dwelling potentially resulting in a second best outcome for the household. As reported by Montgomery and Curtis (2006, p.9), housing choice is always based on limited knowledge, and from a subset of the overall alternative dwellings available, which is conditioned by the household's perception of utility based on their experience in the housing market. In a more broadly defined theory, Richardson (1977, p.254) suggests that the location decisions of households would involve market variables, such as land prices and travel costs, but also non-market variables such as neighbourhood and environmental characteristics, public services, air quality, the quality of schools and social or ethnic mix.

4.3.4.2 Tiebout Hypothesis

Another influential economic theory concerning residential location choice is the Tiebout hypothesis (Tiebout, 1956). Tiebout (1956, p.423) established the relationship between the provision of local amenities, and local public goods and residential location decisions in his seminal work "A Pure Theory of Local Expenditures". In summary, Tiebout concludes that consumers vote with their feet by moving to communities that provide amenity and public goods that fit their preferences. There is a trade-off between the availability of amenities and public goods, and the cost of residing in a location that has access to these amenities and public goods. Dowding and Mergoupis (2003, p.1195) include public services such as libraries, health services, education, refuse collection and street cleaning, leisure services (including parks, sports facilities and swimming pools), social services and law enforcement in the types of services considered by households in their residential location choice.

Tiebout states that:

> "The consumer-voter may be viewed as picking that community which best satisfies his preference pattern for public goods. At the central level the preferences of the consumer-voter are given, and the government tries to adjust to the pattern of those preferences, whereas at the local level various governments have their revenue and expenditure more or less fixed. Given these revenue and expenditure patterns, the consumer-voter moves to that community whose local government best satisfies his set of preferences." (Tiebout, 1956, p.418)

The Tiebout hypothesis has had mixed support in the literature. Overall, the Tiebout hypothesis has been critiqued, tested, supported and refuted over the past 50 years (Dowding, John and Biggs, 1994).

Within a similarly rigid economic construct to utility maximisation, the Tiebout hypothesis assumes a theoretically perfect world in which all households achieve their residential location preferences. As with utility maximisation, however, households do not have perfect knowledge about the housing market or the availability of local amenities and public goods. Nor do they have fixed or consistent preferences, with different members of a household likely to have different and changing preferences (John et al., 1995).

While acknowledging the potential limitations of the theory, Tiebout considers that the approach provides the best solution available stating that:

> "If consumer-voters are fully mobile, the appropriate local governments, whose revenue-expenditure patterns are set, are adopted by the consumer-voters. While the solution may not be perfect because of institutional rigidities, this does not invalidate its importance. The solution, like a general equilibrium solution for a private spatial economy, is the best that can be obtained given preferences and resource endowments." (Tiebout, 1956, p.424)

As Kay and Marsh (2007, p.169) comment, "Tiebout is clear that the model he presents is offering a solution at a conceptual level and was well aware that the simplifications underpinning the model are radical. Indeed, he refers to the model as 'extreme'. Most evidently, by labelling the model a 'pure' theory, the implication is that this is a highly stylised version of reality."

Looking at household movement data Reschovsky (1979) found that the housing location decisions of households are affected by the provision of local government services. Reschovsky (1979, p.518) concludes that local government expenditure and taxes can influence the type of households choosing to locate within the local government area. Munley (1982, p.216) strongly supports Tiebout stating that "… individuals 'vote with their feet' to secure their desired output level of a publicly provided service if institutional arrangements among local jurisdictions are such that a choice of output levels is available …". School quality is of particular importance in a household's location decisions (Bayoh, et al., 2006; Kim et al., 2005; Morrow-Jones et al., 2004). Using survey data, Thorsnes (2007, p.693) shows that Tiebout sorting – households migrating to their optimum neighbourhood based on the level of local services and local taxation - results in households locating to areas that provide alternatives to suburban public schools.

Banzhaf and Walsh (2008, p.843) consider that "…[m]ore recently, a new and growing empirical literature has leveraged the equilibrium properties of the Tiebout model to identify general equilibrium models of household sorting". Using a locational equilibrium model, Banzhaf and Walsh's (2008, p.861) results are consistent with the Tiebout hypotheses that households' location decisions are influenced by changes in the public amenities provided, and support Tiebout's hypothesis that households vote with their feet in response to the provision of public services and amenities. Banzhaf and Walsh (2008, p.862) state that their results are also consistent with recent findings on the potential gentrification of areas, which experience improvements in local amenities (Sieg et al., 2004; Vigdor, 2002).

Dowding et al. (1994, p.790) provide additional support for Tiebout, stating that:

> "It has been suggested that Tiebout's assumptions are so unrealistic that the model is empirically irrelevant …But the assumptions are no less realistic than ones used to describe perfectly competitive markets for private goods .These attacks are thus not upon Tiebout as such but rather upon the economic method."

Bewley (1981) on the other hand presents what is considered to be an evaluation of the more rigorous version of Tiebout's theory and concludes that "… Tiebout's idea does not lead to a satisfactory general theory of local public goods."

4.3.4.3 The Hedonic Price Method and the Quality of Life

One of the mainstays of economic practice is the hedonic price method which uses revealed preferences to value the constituent characteristics of a good – both intrinsic and environmental characteristics (Favero, 2011; Huang, 2010; Pope, 2008).

As discussed by Krupka (2007) the hedonic price method is commonly used in housing market studies. The characteristics of the dwelling – which includes location and accessibility to employment, services and amenities, such as schools, shops and health services - are assumed to be capitalised in the price of the dwelling. More generally, the hedonic price method assumes that the value of local amenity is capitalised into the price of land, local rents and local wages and that the market will reach an equilibrium in which the potential migrant will be indifferent between all locations (Krupka, 2007). Clearly this theoretical equilibrium does not apply in the real world and people do have preferences for certain locations and act on those preferences. In reality then, the provision of amenities not only affects the relative price of land, rents and wages but also directly impacts on migration decisions (Berger and Blomquist, 1992; Graves and Linddeman, 1979; Krupka, 2007).

The hedonic price method as applied to the implicit price of location and amenities has been well researched (Blomquist et al., 1988; Cheshire and Sheppard, 1995; Douglas, 1997; Lambiri et al., 2007; Power, 1996; Roback, 1982; Wall, 2001). One of the primary measures adopted by the hedonic price method as applied to housing markets is the quality-of-life indices for urban areas (Gyourko et al., 1999). Krupka (2007, p.1) states that:

> "[p]eople consider many factors when deciding where to live … [t]he subjective quality of life … [is an] … all-encompassing factor. These local characteristics, or amenities, affect the quality of life because people have preferences for certain types of areas …"

Variables considered in quality of life - including climate and environmental and urban amenities - have been widely used to account for regional wage and rent differentials, and for the construction of quality of life indices which rank quality of life across and within urban areas (Moro et al., 2008, p.448; also see Blomquist et al., 1988; Roback, 1982; and Rosen, 1974 for seminal contributions). Berger and Blomquist (1992) considered wages, housing costs and quality of life in the decision of whether to move and the location of the potential move. Wages and moving costs were found to be the most important factors in deciding whether to move; but quality of life, wages, and housing prices were important in the choice of destination.

Lambiri et al. (2007, p.1) comment that quality of life is a concept that is being increasingly researched both empirically and theoretically in the economic literature – particularly in urban economics where quality of life affects urban competitiveness and urban growth. Lambiri et al. (2007, p.1) state that "… research shows that when households and businesses decide where to locate, [quality of life] considerations can play a very important role". Lambiri et al. (2007) attempt to capture the multidimensional nature of quality of life and highlight the issues associated with measurement particularly related to the complexity of the concept.

Moro et al. (2008, p.449) report that "[i]n recent years, economists have started employing subjective well-being … scores from self-reported happiness and life satisfaction data as a direct proxy for quality of life …". This is an interesting development for the current study given the highly quantitative nature of traditional economic practice and population projection practice – both pursuits potentially gaining from the inclusion of a qualitative dimension in their methodologies; particularly a mixed methods approach as adopted in this study.

4.3.5 Housing Affordability and Location Choice

There is little doubt that one of the major determinants of a household's decision to move and residential location choice is the cost of housing (Montgomery and Curtis, 2006, p.14). Burgess and Skeltys (1992) undertook a major Australian study that found that housing affordability is an important determinant of household residential location – particularly the availability of affordable home ownership on the metropolitan fringe.

There is a clear view within the literature and within government publications, that urban consolidation has economic benefits that arise from reduced lot sizes, greater choice in type of dwelling, and more efficient use of infrastructure leading to improvements in housing affordability (Buxton and Tieman, 2005; Government of South Australia, 2010a; New South Wales Government, 2010; State Government of Victoria, 2008; Yates, 2001). But this view is not without its critics (Dodson, 2008; Forster, 2006; Moodie et al., 2008; Troy, 1996). In Australia, due to the ageing of the population and reduction in household size, the demand for flats, units and apartments is projected to increase at a greater rate than the demand for single, detached dwellings (Hugo, 2010, p.130). However, this projected increase in demand may not lead to a commensurate increase in supply, in that the cost of constructing higher density apartments may result in higher priced and less affordable dwelling stock. For ageing households with either diminished or fixed incomes and for single income households, higher density apartment living may be out of reach. Kulish et al. (2001, p.2) comment that the shortage of appropriately zoned land near city centres is one of the factors driving up the development costs of medium and high density developments. The Australian government's National Housing Supply Council (Government of Australia, 2011, p.94), also found that infill developments are more expensive than an average detached dwelling in greenfield locations for all Australian cities.

4.3.6 Accessibility to Employment

Early work by Garreau (1991) describes the decline of the Central Business District and the increase in employment centres in the suburbs of the United States. Garreau refers to this polycentric urban form as an edge city, and notes that this phenomenon is fundamentally changing the shape of urban form in the United States. Button (1998, p.2) comments that "[e]dge cities are suburban employment and commercial nodes that in the 1990s are having as great an effect on suburban life as malls did just twenty or thirty years ago". One of the assumed primary benefits of a polycentric city is the notion that households commute less than in centralised cities. Hamilton (1982) and Small and Song (1992) found that polycentric cities actually generate excess commuting. Other studies show that household location decisions in polycentric cities lead to a reduction in commuting time and distance (Clark et al. 2003; Dubin 1991; Levinson, 1998). In a study of the role of polycentric cities in household residential location choice, Cho et al. (2008) conclude that access to certain employment subcentres is an important determinant of a household's residential location decisions. Employment centre specialisation was important in explaining some household location decisions, particularly for higher income households.

Kulish et al. (2011, p.2) suggest that poor transport infrastructure on the fringe of cities reduces a household's willingness to buy at more distant locations. Similarly, Hugo (2010, p.130) comments that "… [w]hile a greenfield detached dwelling may be cheaper to construct and theoretically more affordable, 'embedded' location costs such as travel time and cost due to distance from employment and services reduce true affordability".

Montgomery and Curtis (2006, p.11) argue that:

> "... [n]ow, more than ever before, household choices regarding employment and place of residence are often jointly made decisions. Changing gender roles and the increasing prevalence of dual career households mean that the interaction between household location and commuting decisions is more complex than it once was." (emphasis in original).

The relationship between dual income households and housing location decisions is widely covered in the literature (Mok, 2007; Plaut, 2006; Rouwendal and Meijer 2001; Timmermans, 2009; Timmermans et al. 1992).

Waddell (1996) refers to the changing structure of households and changing patterns of employment location and states that "suburban employment centres have overtaken central business districts in importance, a dramatic rise in female labour force participation has made dual-earner households more prevalent than single-worker households, and non-work trips now outnumber home-based work trips" (Waddell, 1996, p.1). More recent work by Lee et al. (2010, p.926) comments on the complexity of accessibility measures and the need to reconcile individual travel needs with household residential decisions and the complications of increasing trip chains, non-work activities and multi-worker households. Lee et al. (2010) conclude that accessibility to employment remains a principal determinant of residential location choice.

4.3.7 The Duhem-Quine Thesis and Underdetermination

One of the fundamental criticisms of neoclassical economics is that it is traditionally a quantitative, empirical and modelling focused discipline (Boylan and O'Gorman, 2003; Downward and Mearman, 2003; McMaster and Watkins, 2006). This criticism resonates with the premise of this study that population projection practice is also limited by its quantitative, empirical and modelling focus.

Underpinning this criticism of empiricism is the Duhem-Quine thesis that asserts that models and theories are confounded by their simplifying assumptions and the rigid rules required for statistical inferences to be made about empirical data (Sawyer et al., 1997, p.3). Sawyer et al. (1997, p.1) describe the Duhem-Quine thesis as "… any one analytical hypothesis cannot be disentangled from other supporting or auxiliary hypotheses which results in the original hypothesis being effectively untestable". In his original essay on the subject 'Two Dogmas of Empiricism', Quine (1951, p.41) states that "… hypotheses about the external world could not be tested individually but only as part of a collective set".

The Duhem-Quine thesis is directly concerned with the underdetermination of economic models – what is left out. McMaster and Watkins (2006) provide a comprehensive review of underdetermination in economics with a case study of urban land and housing economics. McMaster and Watkins (2006, p.901) state that "…

underdetermination relates exclusively to epistemology, i.e., the veracity of the grounds for knowledge claims … and [that] the deductive nature of mainstream theorising may engender susceptibility to issues of underdetermination." Epistemology and the grounds for knowledge claims is explicitly addressed in Chapter two of this study regarding uncertainty. This discussion on uncertainty – particularly in relation to what is known and what is unknown within the traditional approach to population projection practice - relates directly to the concept of underdetermination. As considered in this study, underdetermination is the result of a focus on data and modelling in population projection practice; and the failure to address theory and the broader structural influences and underlying forces encapsulated in the economic, policy, environmental and lifestyle ontology adopted in this study.

4.3.8 Economics and Urban Form Summary

To benefit this study the complexities involved in the economic approaches discussed need to be collapsed into a form that can aid in identifying the probable outcomes for future urban form and the distribution of the population. A critical theme that emerges from the discussion of both traditional and contemporary approaches to location theory - whether geographic or economic in nature – is the growing realisation that the reliance on formal empirical models to describe and understand residential location is both insufficient and misguided.

One of the more relevant concepts broached in this Section is the notion of underdetermination – the inability to disentangle any one hypothesis from alternative hypotheses (Sawyer et al., 1997, p.1) – what is left out. McMaster and Watkins (2006, p.901) statement that "… underdetermination relates exclusively to … the veracity of the grounds for knowledge claims" potentially applies to all traditional economic approaches that may relate to household location decisions. It also aligns with the premise of this study that the epistemology of traditional population projection practice needs to be extended to address the underdetermination that is embedded in this traditional practice.

4.4 Policy Factors Influencing Urban Form

This Section addresses the government policy pillar and the almost incessant adoption of urban planning strategies as a mechanism to plan and manage urban growth in Australian cities; many of which are based on the principles of Smart Growth and New

Urbanism. One of the primary questions addressed is does urban planning work or do other forces mitigate the aspirations of government strategic planning?

4.4.1 Urban Planning in Australia

Although urban planning in Australia can be traced back to the early colonial period, the initial development of cities such as Sydney was more accidental and opportunistic rather than strategic (Ashton, 1993). One of the principal examples of successful early planning in Australia was Colonel William Light's grid design for the City of Adelaide in 1837 (Sumerling and McDougall, 2006, p.2). South Australia's colonial government focused mainly on economic development and physical infrastructure, such as transport, communication and roads. In the twentieth century this physical infrastructure was supplemented by the increasing provision of social services such as health, welfare and education (Prest et al., 2002, p.230). The post-war economic boom combined with rapid population growth from both immigration and the post-war baby boom resulted in many cities implementing metropolitan spatial plans, with a particular emphasis on fringe growth facilitated by ubiquitous car ownership and the rise of the suburbs. By the early 1970s both Federal and state governments were substantially involved in the planning of Australia's cities – state and territory governments having established administrative planning agencies, and the Australian government providing strategic direction in overall urban policy through the federal Department of Urban and Regional Development (Ruming et al., 2010b, p.449).

Although urban consolidation has been a dominant force in Australia since the 1970s, recent rapid population growth in many Australian cities over recent years - due principally to very high overseas migration - along with growing concerns about vehicle emissions, road congestion, energy use and variability in rainfall, has led to an increasing focus on urban consolidation, increasing densities and sustainable urban design (Godden, 2008; Gray et al; 2010; Newman and Kenworthy, 1989). The result has been an almost zealous adoption of state-level planning strategies designed to guide urban and population growth over coming decades (Government of South Australia, 2010a; Government of Western Australia, 2010; New South Wales Government, 2010; Queensland Government, 2009; State Government of Victoria, 2008). At a broad level, planning strategies are designed to "…guide the planning and delivery of services and infrastructure such as transport, health, schools and community facilities" (Government of South Australia, 2010a, p.6). At the more practical level, however, planning strategies are criticised for focusing on residential activity including urban consolidation, increasing residential densities and reducing urban sprawl (Forster, 2006; Mees, 2003).

Randolph (2004, p.490) comments that:

> "The policy implications of evolving city structure are profound. How can policy makers … more readily understand the greater fragmentation of urban structure and the implications of change before their impacts are evident in order to better guide and manage both the leading and lagging areas of our cities and their hinterlands?"

In the context of urban planning strategies, Randolph's question can be rephrased to how do our planning strategies contribute to the understanding of urban structure and the better management of our cities?

In the context of planning strategies there are three fundamental factors that influence urban form – the design and provision of transport infrastructure; facilitation of urban density; and the provision of land and infrastructure for fringe growth (Kulish et al., 2011; Newman, Kenworthy and Vintila, 1992). But to what degree do urban planning strategies and policies determine urban form outcomes; and to what extent are transport and accessibility – and therefore transport policy - more important than planning policy in determining urban form and population distribution outcomes?

A broader issue that may undermine any strategic or policy initiatives is whether cities can be retrofitted to achieve a new urban form given the enormous inertia within their built structure (Gleeson, 2010, p.110) and the fact that the majority of Australian households "… live in some form of suburban setting (Gleeson, 2010, p.105). Gleeson does call for retrofitting – not of urban form but of suburbia, to make it more resilient against climate change and resource depletion. Gleeson, 2010, p.113 promotes a "… green suburban renovation" as "[t]he first great task of urban adaptation"; and a critical view of the 'growth fetish'[29] economy of recent neoliberalism.

4.4.2 Smart Growth and New Urbanism

Smart Growth and New Urbanism are movements that have developed in recent decades to address the perceived problems of modern city growth. Both concepts emphasise the human scale, promoting walkable neighbourhoods with high residential densities, mixed land uses and increased use of public transport (Soltani and Bosman,

[29] Attributed to Hamilton, C., 2003.

2009, p.1). The aim of these initiatives is to promote better traffic flows, increase accessibility to work, retail and recreation and to reduce vehicle kilometres travelled (Song, 2005, p.240). It is argued that this will result in a more sustainable urban form that will improve quality of life and reduce environmental impacts such as air pollution and urban encroachment on agricultural and environmental land (Song, 2005, p.240; Soltani and Bosman, 2009, p.1).

The American Planning Association (2012) guidelines on the integration of Smart Growth into urban policy state that:

> "Integrating land use and transportation planning to accommodate more than just the automobile and to provide increased transportation choices, including mass transit, bicycling, and walking is a hallmark of Smart Growth."

Although not always explicitly acknowledged, Smart Growth and New Urbanism principles have been a major influence on Australian urban planning in recent years. Soltani and Bosman (2009, p.1) identify the:

> "… on-going trend to apply New Urbanism in Australian new and existing developments … focused towards urban structuring principles at all scales - from regions to neighbourhood to street and house".

4.4.3 Planning Strategies in Australia

As identified by Forster (2006), Australia's five major cities have all embraced planning strategies as a mechanism to control and manage urban growth. In recent years, many of these cities have reviewed, revised and rewritten these strategies in response to the ever-unfolding realities of urban and population growth (NSW Government, 2010; Government of South Australia, 2010a; State Government of Victoria, 2012).

Forster (2006, p.178) states that:

> "… the approaches to shaping future growth, though by no means identical, are similar enough across the five metropolitan areas to suggest a consensus view on planning policy, built on the three principles of *containment, consolidation and centres*" (emphasis in original).

Forster identifies the adoption by State planning agencies of a consolidation approach as the key strategy to more environmentally sustainable cities.

South Australia's metropolitan planning strategy - The 30 Year Plan for Greater Adelaide - explicitly states that "… a new urban form …" will result from the implementation of the Plan (Government of South Australia, 2010a, Overview, p.3). The stated aims of the 30 Year Plan for Greater Adelaide include:

- Locating the majority of new housing in current urban lands, particularly around transport corridors
- The creation of mixed-use precincts comprising housing, jobs, transport services, recreation and leisure
- The provision of land for new growth areas based on the principles of mixed-use development and higher density housing located in transport corridors where possible
- The creation of 14 new Transit-Oriented Developments
- Strategically expand larger townships with infrastructure and services.

The Victorian government's current metropolitan planning strategy has evolved from an earlier Melbourne 2030 plan designed to "…protect the liveability of the established areas and to increasingly concentrate major change in strategic redevelopment sites such as activity centres and underdeveloped land" (State Government of Victoria, 2002, p.1). At the core of Melbourne 2030 were nine desired results including:

- Build up activity centres and locate a substantial proportion of new housing in or close to activity centres and other strategic redevelopment sites that offer good access to services and transport
- Establish an urban growth boundary to set clear limits to metropolitan Melbourne's outward development; concentrate urban expansion into growth areas that are served by high-capacity public transport; protect the green wedges of metropolitan Melbourne from inappropriate development
- Upgrade and develop the Principal Public Transport Network and local public transport services to connect activity centres and link Melbourne to the regional cities … give more priority to cycling and walking in planning urban development and in managing our road system and neighbourhoods; promote the use of sustainable personal transport options.

(State Government of Victoria, 2002, p.2-5)

In 2008 the Victorian State Government commissioned an audit of the Melbourne 2030 plan (Moodie et al., 2008). An independent expert group provided advice on strategic and implementation priorities for the Melbourne metropolitan region for the next five years. The aim of the Melbourne 2030 plan was essentially to redirect household growth from the urban fringe to the established urban areas. In this regard the expert group concluded that the implementation of the Plan had under-performed in that insufficient progress had been made in redirecting residential growth away from the fringe; there was a lack of significant residential or mixed-use development occurring in and around principal and major activity centres; and there was insufficient provision or commitment to crucial public transport investments (Moodie et al., 2008, p.22).

In 2008, as a response to this audit and due to unprecedented population growth between 2001 and 2006, the Victorian State Government released *Melbourne 2030: a planning update – Melbourne @ 5 million* which "… provides complementary policy initiatives to the directions of *Melbourne 2030"* (State Government of Victoria, 2008). The substantial policy change in the planning update was a review of the Urban Growth Boundary – a fundamental pillar of the Melbourne 2030 plan.

The Victorian State Government has recently announced that it will be preparing a new metropolitan planning strategy to manage Melbourne's growth and change (State Government of Victoria, 2012).

In anticipation of major population and household growth in the Sydney metropolitan region by 2036, in 2010 the New South Wales Government released the Metropolitan Plan for Sydney 2036. The vision in the plan is for Sydney to be "… a more compact, networked city with improved accessibility, capable of supporting more jobs, homes and lifestyle opportunities within the existing urban footprint" (New South Wales Government, 2010, p.15).

To achieve this vision the Metropolitan Plan for Sydney 2036 includes the following policy settings:

- Build at least 70 per cent of new homes in the existing urban area
- Build at least 80 per cent of all new homes within the walking catchments of existing and planned centres of all sizes with good public transport
- Increase the proportion of homes within 30 minutes by public transport of jobs in a major centre, ensuring more jobs are located closer to home
- Enable residential and employment growth in areas where there is available or planned public transport capacity
- Establish no new greenfield fronts to Sydney's existing urban footprint under the Plan.

(NSW Government, 2010, p.14)

The Metropolitan Plan has a clear focus on Sydney's network of centres with plans to locate at least 80 per cent of all new housing within the walking catchments of existing and planned centres; planning for new centres in existing urban areas and greenfield release areas; and planning for urban renewal in identified centres where public transport capacity exists or is being expanded (New South Wales Government, 2010, Overview, *Strategic Directions*).

Since the release of the Metropolitan Plan for Sydney 2036, the NSW Government has announced that it is developing a new metropolitan strategy for Sydney (New South Wales Government, 2012a). This new plan will provide an updated framework for Sydney's growth, further integrating policies on housing, employment, transport, infrastructure, the environment and open space.

In a critique of the *containment, consolidation and centres* approach adopted by metropolitan planning authorities, Forster (2006, p.180) refers to the possible existence of "parallel urban universes" with metropolitan planning strategies suggesting "… an inflexible, over-neat vision for the future" contrasted against "… the realities of the increasingly complex, dispersed, residentially differentiated suburban metropolitan areas most Australians live in."

Dodson (2008) also identifies the promotion of urban consolidation and increased urban density as a continuous theme in Australian metropolitan plans. Dodson comments that these plans all include urban structure as a critical component, aimed at reshaping Australian cities to address challenging economic, social and environmental concerns.

4.4.4 Does Planning Work?

Given the almost ubiquitous use of strategic plans to both influence urban form and to address environmental issues, it is worth considering to what extent policy does influence urban form and whether urban consolidation delivers what it promises, particularly with regard to the environmental goals of reducing transport kilometres travelled and reducing greenhouse gas emissions.

As previously discussed, Forster (2006) takes the view that strategic plans are at odds with the realities and complexities of the metropolitan region. But Forster also argues that these metropolitan planning strategies do not consider the underlying structural forces that transform urban systems and ultimately urban form. An example given by Forster (2006, p.180) is that journey to work patterns are becoming more dispersed and, therefore, more car dependent, yet metropolitan plans assume that higher densities and accessibility to public transport will reduce car dependence. Forster (2006, p.176) also argues that there is little to suggest that household preferences have moved from a detached suburban dwelling in the suburbs to higher density dwellings in centres.

Examining urban policy with regard to climate change and petroleum security, Dodson (2008, p.3) is equally critical of the effect of metropolitan plans, arguing that:

> "… current metropolitan policies fail to fully comprehend the structure of Australian housing markets and their effects on urban form and structure …" and that "… urban consolidation components of current Australian metropolitan planning schemes are acting in the wrong places and at the wrong time".

However, Bunker (2005, p.790) looking at the market for higher density housing in Sydney, identified a polarised demand for higher density living – a disadvantaged group of renters in the middle and outer city suburbs, and a higher income group of mature lifestyle aspirants around waterfront and inner-city areas. Although it has been suggested that higher density housing is only a temporary option for most people prior to purchasing a house in the suburbs (Troy, 1996), and that the strong association of strata housing with private rental only reinforces this perception (Randolph, 2006, p.488). Bunker et al. (2005) consider that the existence of a range of differential housing opportunities in socially and spatially distinctive sub-markets in Sydney, may suggest that a more sensitive approach to urban consolidation could address the housing needs of a wide range of household types; and adds that "… it is difficult to believe that this can be achieved by … blanket provisions, ball-park 'targets' and the operation of the market." (Bunker et al., 2005, p.791)

In a review of Sydney's 2005 City of Cities metropolitan strategy, Searle (2006, p.553) described the strategy as "… probably the most comprehensive planning strategy that Sydney has had since its first strategy over 50 years ago". The City of Cities strategy was a 25 year plan for Sydney to 2031 with focal points similar to the Metropolitan Plan for Sydney 2036; that is to strengthen centres and corridor development; to build 60–70 per cent of new housing in existing urban areas, concentrating on centres with good public transport; and a strong transport focus particularly the development of new rail links. Regardless of its comprehensive nature, Searle (2006) is critical of the City of Cities strategy on many fronts including its approach to air and water pollution; water supply, public transport provision; and a lack of locational access to jobs for much of the workforce.

In a damning critique of Melbourne's 2002 planning strategy *Melbourne 2030: Planning for Sustainable Growth,* Mees (2003, p.293) comments that the:

> "… rhetoric about sustainable development, public transport and diversity …is merely a smokescreen to cover the fact that the substantive proposals involve no significant change from [the previous] government's … policy"

Mees (2003, p.297) also states that claims of Clayton's[30] planning is dominant in cities like Melbourne are validated. Mees (2003) goes on to say that:

> "The bizarre and confused nature of the recommendations becomes much easier to understand when viewed as a metropolitan strategy written by people who have been taught that metropolitan strategies are pointless or even counter-productive" (Mees, 2003, p.297).

Dodson (2008) examined whether the structure of metropolitan housing markets limits the ability of metropolitan plans to reduce greenhouse gas emissions and transport energy dependence. Dodson (2008, p.9) notes that transport energy dependence is highest in middle and fringe suburban areas but the capacity of current urban planning policies to achieve consolidation objectives in middle and outer areas is limited. Dodson concludes that the urban consolidation focus of current planning policies have limited potential to reduce transport emissions.

Mindali et al. (2004, p.146) question the feasibility of approaches that promote policies designed to reduce urban environmental problems through land-use planning. It is argued that the long established practice of dispersal into the suburbs cannot be changed by policy alone, and that there is little evidence that households have a desire to live in higher densities.

Referring to the mixed signals in the Melbourne 2030 planning strategy of increased density through urban consolidation, and urban dispersal through continued low density growth on the urban fringe and beyond, Buxton and Tieman (2005, p.155) suggest that the urban consolidation objectives will be undermined. They conclude that this confusion will result in an ever-expanding commuter belt of self-contained suburban areas connected by freeways rather than a consolidated city as described in the Melbourne 2030 plan.

Evaluating the potential for urban consolidation from a local government perspective, Ruming et al. (2010a, p.367) report that from a council point of view consolidation faces serious challenges due to difficulties generating large enough lots to develop high-

[30] Originally a brand of non-alcoholic beverage packaged to resemble whiskey, Clayton's is now a term in Australian vernacular which refers to an inferior substitute. Clayton's planning is therefore referring to a poor form of planning or possibly a lack of real planning.

density dwellings, and consolidating ownership of lots and dwellings to facilitate renewal. They also report that many small-scale developers do not have the funds to purchase and hold lots for future consolidation, therefore limiting the capacity of the market to deliver on urban consolidation.

At a more fundamental level, Ruming et al. (2010a, p.367) consider that although strategic plans may provide opportunities for renewal and redevelopment, it is the wider set of economic functions, such as interest rates, land ownership and the availability of finance, that operationalises this development. Ruming et al. question the effectiveness and appropriateness of highly directive targets as planning or development instruments – particularly given the unique characteristics of urban renewal sites.

In defence of urban consolidation policies, Rickwood et al. (2008) conclude:

> "… that there is clear evidence … that … higher density, transit-oriented cities have lower per-capita transport energy use …" but go on to say that "... more detailed research is needed to examine the relationships between urban form and overall energy use."

4.4.5 Path Dependency

One of the more resistant forces acting against the directions of government policy is the notion that radical change is difficult to achieve. Nielsen (2010, p.241) reporting on housing policy in Nordic countries such as Denmark and Sweden, suggests that there is enormous resistance to attempts of new governments to change housing regimes. One of the primary drivers of this resistance is path dependency "… understood as the reproduction of the legitimacy, efficiency and power of existing housing policies …" (Nielsen, 2010, p.242). Malpass (2011, p.307) considers path dependency to be "… a perspective that tends to emphasis stability and continuity between key events".

History tells us that housing policies do change and, therefore, there must be less radical processes that can breakdown these path dependencies. One of these processes is institutional weariness, the process whereby feedback mechanisms that sustain the legitimacy, power and efficiency of housing policies breakdown over time due to neglect (Nielsen, 2010, p.243).

There has been considerable debate in urban and housing research around path dependency (Cole, 2013, p.60). Central to this debate is the idea that there are "critical junctures" in the process of policy development that "… sets I train a series of events that determine a subsequent pattern of continuity and change" (Cole, 2013, p.60).

4.4.6 Urban Planning or Transport Planning?

Land-use activities, such as residential dwellings and commercial developments, are generally provided and owned by the private sector and can be facilitated or deterred through urban planning policies. Transport infrastructure on the other hand is primarily provided and operated by the public sector transport authorities, and transport planning can therefore directly control the design and operation of publicly provided rail and road infrastructure (Anderson, 1996, p.7). Kulish et al. (2011) modelling the influences on housing demand and supply highlight the importance of long-run transport infrastructure outcomes. Kulish et al. (2011, p.32-33) conclude that it is more feasible to live further from the city centre in cities with better transport infrastructure where the demand for distant housing is stimulated by lower land and housing prices and larger dwelling sizes. In contrast, transport problems associated with poor transport infrastructure are a major issue for fringe development (Applied Economics, 2010).

The American Planning Association (2012) emphasise the need to integrate land use and transportation planning to provide increased transportation choices, including mass transit, bicycling, and walking. Newman et al. (1992) and Kulish et al. (2011) also highlight the integration of transport opportunities and infrastructure along with policies that impact on housing density and the cost of new housing – particularly on the fringe.

4.4.7 Government Policy and Urban Form Summary

All major Australian states have adopted planning strategies that prescribe Smart Growth and New Urbanism principles to address the perceived problems of low density and residentially dominated urban sprawl – what Forster (2006) describes as a policy of containment, consolidation and centres. But it is unclear to what degree these strategies actually influence future urban form outcomes; particularly the desired outcomes of urban consolidation and increased densities. It is also unclear whether the achievement of these goals would actually deliver the claimed benefits of reduced car usage and reduced environmental impacts. Although there is strong support for planning strategies that focus on urban consolidation, increasing densities and sustainable urban design (Godden, 2008; Gray et al; 2010; Newman and Kenworthy, 1989), there are also those that question the effectiveness and appropriateness of highly directive and prescriptive planning instruments (Ruming et al., 2010a).

Urban policy and planning strategies are an important issue in the context of this study. If planning strategies can strongly influence urban form outcomes by the provision of transport infrastructure, facilitation of urban density and the release of land on the metropolitan fringe, then likely future urban form, and therefore population distribution, is more certain. If strategic plans are at odds with the realities and complexities of the metropolitan region and ineffective in achieving their stated goals, then other forces and influences become dominant – these other forces being far less prescriptive making future urban form far more uncertain (Buxton and Tieman, 2005; Forster, 2006; Mees, 2003; Mindali et al., 2004).

4.5 The Environment and Urban Form

This Section focuses on the environmental pillar of this study and considers water supply and security, urban encroachment and car dependency, as three contemporary environmental issues of relevance to the city. Sustainable development and sustainable urban form are discussed before turning to a defence of the suburbs and urban sprawl. The Section concludes with the current inconclusive state of play of the urban-environment debate.

4.5.1 Environmental issues of Concern

> "Over the next decade, energy concerns may well displace climate change as a major societal preoccupation, as climate change has recently displaced sustainability. This could be a welcome development, not only because of its relevance but also because, more than many other issues, energy may be able to engage a wide spectrum of interests in serious consideration of society's possible futures" (Gilbert, 2007, p.103).

Gilbert's sentiments on the environmental debate in Canada echo those in the Australian context. The status of environmental issues – particularly those that are potentially anthropogenic in origin - are not static and at any point in time may reflect academic paradigms, government policy, commercial opportunities, media whim or societal mood (see Neimark and Rhoades Mott, 1999, for a documented account of the evolution of concern about environmental degradation, pollution, and resource conservation in the United States). At a more fundamental level even the current societal focus on the environment may be relegated to history if future energy supplies are threatened.

There is considerable debate over which environmental issues are caused by population growth, and which are attributable to external factors, such as overseas demand for goods and services or poor environmental practices (Maude, 2012, p.30).

At the urban scale, one of the primary environmental focuses in the planning and transport literature in recent years has been the relationship between the built environment and car usage, as it relates to greenhouse gas emissions (Fuller and Crawford, 2011; Newman and Kenworthy, 1999; Rickwood and Glazebrook, 2009). Two of the primary initiatives that have emerged to address the issue of car usage and associated greenhouse gas emissions are Smart Growth and New Urbanism; which promote mixed land use, Transit Oriented Development, increased public transport usage and the human scale of the city (American Planning Association, 2012; Soltani and Bosman, 2009).

Two additional environmental issues related to population and urban growth are the encroachment of the built environment on adjacent agricultural land and environmental services; and water use (Gennaio et al., 2009; Troy, 2008). Although both the encroachment of the built environment and urban water use are important issues, given its prominence in the literature the main focus of this Section is on the relationship between urban density and urban form, and car usage.

4.5.2 Water as an Urban Issue

Water is a major environmental issue for both urban and rural Australia (Hugo, 2012, p.91) and a major political issue related to population growth (Spearitt, 2008, p.32). Although Australia has very high rainfall in the northern sub-tropics, the majority of the population live along the drier southern and eastern coastlines. Major droughts in these drier regions over recent years has raised the awareness of the vulnerability of Australia’s urban centres to water supply and water security (Godden, 2008, p.168).

Head (2008, p.78) suggests that there is widespread evidence that households are willing to change their behaviour toward water usage, and that stronger action is required by government to take advantage of this potential to reduce the demand for water in Australian cities. Syme (2008, p.100) on the other hand compares water with oil and electricity in that they are commodities that are generally readily available and taken for granted by city populations. This has led to difficult policy choices between maintaining current levels of expected supply and managing demand, and the socio-political problems associated with falling security of water supply and the imposition of water restrictions. This issue is exacerbated by ever-growing demand driven by urban development (Syme, 2008, p.103).

Troy et al. (2005) found that there was little difference in water consumption per capita between households living in a house or higher density flats. Troy (2008, p.197) believes that a range of alternative water supply initiatives, including the mandatory installation of rainwater tanks, greywater-recycling systems and dry-composting toilets, along with demand-management policies are required to dramatically reduce water usage across urban areas. Davison (2008, p.38) supports the notion that water usage in Australian cities is now unsustainable, but believes that this is because the capacity of water catchments cannot cope with the level of urban population growth and the increased variability of rainfall; and not because water consumption patterns have changed.

Some of the measures available to address the competing demands for water include demand management and behavioural change through education, expanding water supply by recycling and desalination, and using water more efficiently through efficient pricing mechanisms (Gunasekera, 2012, p.100). In recent years a number of high capacity desalination plants have been constructed in urban areas of Australia – including metropolitan Adelaide – to address recent water shortages due to the extended drought conditions (Spearitt, 2008, p.32). Although water supply and use are critical issues for Australia in general, the desalination initiative in Adelaide and other centres may support population growth, without the need for major behavioural changes or new sources of water for the foreseeable future (Hugo, 2012, p.91).

4.5.3 Urban Encroachment

The concept of open space surrounding urban development provides many benefits including the protection of water catchments, preserving natural aesthetics, preserving ecosystem services and amenities, and providing natural recreational opportunities that are both affordable and healthy (Steelman and Hess, 2009, p.93-101).

Two common strategies to protect open space are urban growth boundaries and green belts; although both strategies have been found to slow urban expansion but not stop it (Gennaio et al., 2009, p.224). Greenbelts are areas of open space that separate urban development and prohibit urban growth within the greenbelt (Bengston and Youn, 2006). Urban growth boundaries are not separate physical spaces, but act as a boundary around a city beyond which urban growth cannot occur. Neither greenbelts nor urban growth boundaries are intended to be permanent and are reviewed over time to allow for - but manage - further urban growth if required (Bengston et al., 2004, p.276).

Bengston et al. (2003, p.274) identifies four broad categories of public policy that can be used for managing urban growth and protecting open space: public ownership and management; regulation; incentives; and informational or educational campaigns. Bengston describes the informational approach as attempts to influence decisions through the transfer of knowledge, reasoned argument and moral suasion. Incentives can be negative, such as developer levies to help fund the infrastructure costs of development and to discourage development in particular areas; or positive to encourage infill and redevelopment. Positive incentives can include the waiving of development fees or the reduction in taxes for infill and redevelopment sites (Bengston et al., 2003, p.276). A local example of incentives to encourage infill in the City of Adelaide in South Australia is the waiving of stamp duty fees - a substantial financial impost on the purchaser of a dwelling in South Australia - on the purchase of apartments in the City (Revenues SA, 2012). The intention of this initiative is to encourage buyers to purchase in the City rather than in the suburbs where stamp duty still applies.

A key issue surrounding urban encroachment on the urban fringe is local opposition to development (van Dijk and van der Wulp, 2010, p.19). Myers and Gearin (2001) looking at the demand for denser residential living found that many households in the United States are ambivalent about urban sprawl. Although recognising the potential issues associated with urban sprawl, they were conflicted when making personal choices where to live. One of the primary benefits that accrues to residents and developers from urban growth on the fringe of cities is more affordable housing (Kahn, 2000).

4.5.4 Car Dependency and Urban Form

Looking at per capita household energy use, Fuller and Crawford (2011, p.173) found that in absolute terms energy use in Melbourne has risen over the past half century. Although the increasing trend has slowed, all three components of household energy use – operational, embodied and travel – rose over this time. Post 2000, operational energy use – heating, cooling cooking etc - has been declining and from 2000 onward, travel energy is by far the dominant energy component. Fuller and Crawford (2011, p.175) attribute the increasing travel energy trend to increasing distances travelled and greater car usage. This finding provides support for the focus of this Section on the relationship between transport energy use and urban form.

Newman and Kenworthy in their 1989 text '*Cities and Automobile Dependence: An International Sourcebook'* may have been the first to use the term *automobile dependence* within an urban planning context (Zhang, 2006, p.313). Mindali et al. (2004, p.159) consider Newman and Kenworthy's 1989 study to be one of the main foundations of knowledge and beliefs regarding the relationship between urban density and transportation energy consumption. One of Newman and Kenworthy's major contributions to the literature in this field has been the study of the aggregate patterns of car dependency across forty-six cities in North America, Europe, Australia and Asia (Newman and Kenworthy 1989; Newman and Kenworthy 1999; Kenworthy et al. 1999).

Newman and Kenworthy's (1999, p.64) primary thesis is that over the past fifty years there has been a disconnect between land-use and transportation following the establishment of road infrastructure and dependence on the car. The result of this car dependence has been the expansion of our cities, encroachment on natural and agricultural environments and increasing air pollution and road congestion.

Kenworthy (2007, p.54) considers urban form – and urban density in particular – to be the most important factor in explaining car use. Kenworthy found a very strong correlation between private transport energy use and density, and concludes that increasing urban density is a critical factor in shifting car dependent cities towards lower car and energy use.

Newman (2006) discusses a study of Chandra (2006) which considered the relationship between transport fuel use and a combination of measures of urban form at the local government level in Sydney and Melbourne. The measures of urban form used, included residential and job density, an activity measure which combined people and jobs per hectare, the permeability of the area based on the number of intersections, the distance from the CBD and a measure of the accessibility to public transport. In summary, Chandra (2006) concluded that the distance from the CBD was the most important factor that determined transport fuel use and associated greenhouse gas emissions, but the activity measure of population and jobs and access to public transport were also important determinants of transport fuel use.

At the current time car usage is highly dependent on petroleum supply (Kenworthy, 2007, p.47). Future oil security is therefore a critical issue in any discussion on car dependency and urban form. Peak oil – the point at which world production of oil starts to decline - is a hotly debated topic with no consensus on either its timing or its likely impact (Newman, 2007, p.16). On the one hand oil is seen as a finite and nonsubstitutable source of energy that once depleted will have devastating consequences for the world economy (Ferguson et al., 2007, p.6). Alternatively, the economic argument is that, like any other good, economic pressures will result in new technologies and alternative sources of fuel that will replace the eventual demise of oil (Jaccard, 2005). Recent major developments in coal gas and shale gas appear to provide some support for the economic view point, although the technologies used to extract oil from these sources has raised some environmental concerns, such as allowing gas to escape into adjacent aquifers (Grafton, 2012, p.15; Nelson, 2012, p.29).

Kenworthy (2007) is less convinced that technological fixes will be sufficient to address the issue of peak oil and the inevitable post-petroleum age. Kenworthy (2007, p.47) believes that a paradigm shift is needed to move cities from their current car dependence through measures, such as reducing or even abandoning major road construction, using road congestion as a means of naturally reducing car use and energy consumption, providing efficient public transport and making all centres small and walkable.

4.5.5 Sustainable Development

Sustainable development is a phrase popularised in the 1987 United Nations World Commission on Environment and Development publication 'Our Common Future' – alternatively known as the Brundtland Report. The often quoted definition of sustainable development from the Brundtland Report is that "sustainable development is development that meets the needs of the present without compromising the ability of the future generations to meet their own needs" (World Commission on Environment and Development, 1989, p.43). Newman and Kenworthy (1999, p.1) describe sustainable development in more simple terms as "… any economic or social development should improve, not harm, the environment".

The United Nations conference on Environment and Development held in Rio de Janeiro, Brazil in 1992, spawned a number of sustainability initiatives including Local Agenda 21 – a non-binding agreement between local authorities to adopt a range of sustainability principles (United Nations Department of Economic and Social Affairs, 2009). The Aalborg +10 European Conference on Sustainable Cities and Towns held in Aalborg, Denmark in 2004 resulted in the Aalborg Commitments - a theoretical framework through which cities can implement Local Agenda 21. More than 650 local governments in Europe have signed the Aalborg Commitments (Aalborg plus 10, 2012). At this conference, local government signatories:

> "… committed to a strategic role for urban planning and design in addressing environmental, social, economic, health and cultural issues for the benefit of all ... [and to] ... recognise the interdependence of transport, health and environment and [the commitment] to strongly promoting sustainable mobility choices" (Aalborg plus 10, 2004, p.3).

To achieve these commitments signatories committed to:

1. re-use and regenerate derelict or disadvantaged areas
2. avoid urban sprawl by achieving appropriate urban densities and prioritising brownfield site over greenfield site development
3. ensure the mixed use of buildings and developments with a good balance of jobs, housing and services, giving priority to residential use in city centres
4. ensure appropriate conservation, renovation and use/re-use of our urban cultural heritage
5. apply requirements for sustainable design and construction and promote high quality architecture and building technologies
6. reduce the necessity for private motorised transport and promote attractive alternatives accessible to all
7. increase the share of journeys made by public transport, on foot and by bicycle
8. encourage transition to low-emission vehicles
9. develop an integrated and sustainable urban mobility plan
10. reduce the impact of transport on the environment and public health.

The Aalborg Commitments demonstrate a strong acknowledgement at the local government level in Europe of the role of both urban and transport planning in addressing environmental issues associated with cities. The emphasis on reducing urban sprawl, increasing urban densities and reducing the use of the car, is aligned with the Newman and Kenworthy (1999) assessment of the role and preferred future of urban planning and urban form.

Newman and Kenworthy (1999, p.185) suggest that four steps are required to transform a city from a car dependent city to a sustainable city: the revitalisation of the inner city, focusing development around the existing rail system, discouragement of further urban sprawl, and the extension of rail into poorly serviced suburbs, and the building of new urban villages around the rail system. As a strategy to promote urban change Newman and Kenworthy (1999, p.285) consider the market, government and civil society – including the media, educational bodies, churches and community associations – to all have a role in facilitating change within the context of the core values of environmental protection, social justice, heritage, the public realm, the local urban economy and the local community (Newman and Kenworthy, 1999, p. 294).

In the context of this study, Newman and Kenworthy (1999, p.27-37) draw the link between sustainability of cities and the forces that physically shape our cities. Although acknowledging the complexity of these forces, three factors are offered as dominant in shaping the city: the extent of road infrastructure compared to tram and train infrastructure; economic priorities especially the provision of suburban infrastructure that favours greenfield development over urban redevelopment and urban renewal; and the cultural perspective that values space leading to low density living and the segregation of land-use activities.

4.5.6 Sustainable Urban Form

A key characteristic of Australian cities is the almost ceaseless expansion of the suburbs driven by household desire for low-density detached housing (Fuller and Crawford, 2011, p.166). Hugo (2012, p.89) states that:

> "... [r]etrofitting Australia's cities and changing the behaviour of the residents of those cities in light of climate change, to achieve more sustainable outcomes, is clearly an important national priority as most of us will continue to live in large cities".

New Urbanism and Smart Growth principles are aimed at retrofitting cities and changing behaviour to improve urban sustainability (Soltani and Bosman, 2009).

The American Planning Association (2012) strongly supports Smart Growth as a means of promoting efficient and sustainable development which optimises infrastructure investment and consumes less land that would otherwise be available for agriculture, open space, natural systems, and rural lifestyles (American Planning Association, 2012).

New Urbanism with its emphasis on the human scale promotes increased population density, increased use of public transport and increased modes of walking and cycling. Soltani and Bosman (2009, p.1) suggest that there is an on-going trend to apply New Urbanism principles in Australian cities at all scales; from the regions to the neighbourhood and the street. In contrast however, in their study of two urban suburbs in Adelaide – an older, inner-city suburb developed in the mid 1880s and an outer suburb developed in the 1980s and 1990s - Soltani and Bosman (2009) found that the older suburb provided a community scale, mixed-use and pedestrian friendly environment, where the more recent suburb was car-oriented and predominantly residential in nature.

New Urbanism and Smart Growth align with the research of Newman and Kenworthy (1999) that argues that higher population density, Transit Oriented Development and mixed use development, will lead to a reduction in the use of the car and the associated environmental impacts of urban sprawl. Bhat and Guo (2007, p.524) found the built environment – which was defined as the combination of land-use, urban form, and street network attributes – had a measurable impact on residential location decisions and car ownership. But alternative views, such as those of Holloway and Bunker (2005), Mindali et al. (2004) and Troy (1996), question this association (Rickwood and Glazebrook, 2009, p.171).

Analysing small area data in Australia, Rickwood and Glazebrook (2009, p.184) conclude that in Australian cities there is a consistent increase in public transport use with increased local population density and a reduction in public transport use as distance increases from the CBD. They found that these general outcomes weaken as more complex measures of urban form and access to public transport are considered and that lower densities and areas distant from the CBD imply a reduction in accessibility to public transport. In earlier work Rickwood et al. (2008) conclude that although higher density, transit-oriented cities have lower per-capita transport energy use, more research is needed on the relationship between urban form and overall energy use.

Looking at three scenarios of future urban form - high-rise inner-city apartments; outer-suburban detached housing; and inner-suburban medium density apartments - Fuller and Crawford (2011, p.181) conclude that inner-suburban residents may be able to reduce their total energy consumption and emissions by 40–50 per cent through improved access to public transport and reduced car reliance.

4.5.7 In Support of the Suburbs

Roberts (2007), states that it is unlikely that a consensus view of an appropriate population size, population density or urban form will be reached in the short-term. Roberts (2007, p.721) makes the interesting observation that a sustainable city is

"…almost an oxymoron" as central to the idea of sustainability is the belief that future generations will continue to have access to the essential resources needed to live and that urban systems must be resilient to change – both of these beliefs imply a continuation and even the protection of cities and the way we choose to live.

Studies, including Chandra (2006), Handy et al. (2006) and Mindali et al. (2004), are critical of Newman and Kenworthy's conclusion that higher densities lead to reduced fuel use and reduced greenhouse gas emissions. Other factors including the existence of activity centres, the density of employment and neighbourhood design are all considered to be important in the level of car use. Gray et al. (2010, p.337) also question the notion of a simple relationship between urban form and fuel use pointing to household behaviours other than direct use of petrol and domestic energy. A more holistic assessment of household energy use is called for which considers the contextual and socio-economic nature of households, neighbourhoods and overall urban form. Although promoting the place of urban planning in addressing urban sustainability, Gray et al. (2010, p.343) conclude that the relationship between household greenhouse gas emissions and urban consolidation and urban form is less spatially consistent than generally assumed, and a less deterministic approach to urban form is required to address sustainability issues.

Jun (2008, p.100) evaluated the Smart Growth policies of Portland, Oregon, such as the urban growth boundary, public transit and Transit Oriented Development in achieving a reduction of car dependence. Jun concluded that urban consolidation alone has no clear relationship with the reduction of car dependence and therefore a reduction in traffic congestion and air pollution.

Anderson et al. (1996, p.12) describe urban sprawl as a fundamental transformation of urban form characterised by an outward expansion of the metropolitan boundary; a general decline in intensity of population and employment densities; high connectivity of transport networks; and segregation of residential suburbs from other land uses. Anderson et al. (1996, p.30) question whether land-use changes can make a significant difference to transport behaviour and posit that if it cannot, then policy needs to focus on technological solutions and behavioural changes, rather than on changing land-use patterns. In addition, the role of public transport is also questioned in that even under the most optimistic scenario it constitutes only a fraction of overall household trips.

Urban planners in most developed countries ascribe to the view that there is a strong relationship between urban density and transport energy use with higher densities leading to reduced vehicle use and lower energy use (Mindali et al., 2004, p.145). Critically analysing Newman and Kenworthy's data Mindali et al. (2004) looked at the specific conclusion that increased urban density through changes in land-use policy will lead to a reduction in energy consumption. Mindali et al. (2004, p.159) question the generally accepted negative correlation between urban density and energy consumption; but conclude that there is the potential for lower energy consumption and increased public transport use in inner city areas close to employment dense CBDs.

Mindali et al's (2004, p.160) main concern with Newman and Kenworthy's conclusions relates to the difficulty of increasing inner-city and CBD employment densities as a means of reducing transportation energy consumption due to market forces, supporting the outward expansion of employment. In Australian cities it is likely that the displacement of 'traditional' inner-city employment by residential and mixed-use developments is working against Newman and Kenworthy's recommendations, as is the expansion of suburban and exurban sprawl.

However, using Newman and Kenworthy's European data, Mindali et al. (2004, p.160) find a strong negative correlation between energy consumption and outer area employment. This suggests the potential to reduce transportation energy consumption in Australia by increasing suburban and outer area employment density. Conversely, Mindali et al. (2004, p.160) did not find the same correlation between energy consumption and increased residential densities in outer areas. In fact, they conclude that mixed land-use in outer areas can result in an increase in transport energy consumption due to an increase in circumferential trips around the outer areas.

Troy (1996, p.77) whilst acknowledging that cities are a major source of air, water and noise pollution, takes issue with the focus on the reduction of transport energy consumption by increasing urban density to reduce air pollution and greenhouse gas emissions. Troy (1996, p.81) argues that the only environmentally sensible urban strategy is one that minimises environmental stress both within and outside the city. To this end, he distinguishes between housing policies that should apply to existing development and those that should apply to new development. Rather than addressing major environmental issues associated with cities through a redesign of urban form, Troy (1996, p.82) argues that the current and alternative approaches and practices in regard to the water cycle, food production, waste generation, air pollution, energy consumption, transport and communication need to be reviewed. He questions the big engineering and large-scale solutions to supplying environmental services to cities, and the perceived essential nature of relationships such as the journey to work and urban form. Furthermore, Troy (1996, p.116) provides a crude estimate that less than four per cent of total carbon dioxide production can be attributed to the journey to and from work.

As stated previously, Gleeson (2010, p.113) takes a different view of the suburbs and urban sprawl. Gleeson (2008, p.2654) considers that the environmental significance of urban form has been overstated and that the "… deeper socio-cultural forces that drive the consumption of nature …" need to be taken into account. One of Gleeson's key arguments is that Australia's current urban form is dominated by the suburb and given the slow pace of change in the built environment suburbs will remain the dominant urban form in the foreseeable future (Gleeson, 2010, p.105). Gleeson (2008, p.2654) and others (Perkins et al., 2009; Wright, 2010) also argue that high density urban environments do not necessarily produce low energy outcomes, and can actually result in increased energy per capita. Suburbs are considered to be the front line of the environmental challenge and, therefore, they need to become more adaptable and resilient – especially toward climate change and resource depletion. Gleeson (2010, p.113) states:

> "The suburbs will be the main theatres in the defensive war against global warming and need to be engaged and treated fairly in the debates and actions that will address climate change and energy security".

Taking a more provocative stance Gleeson (2010, p.115) suggests that a "guardian state" needs to be established whereby resources are rationed amongst households to enable a rapid decline in resource use – or more properly a reduction in production – and in pollution.

Atkinson-Palombo (2010, p.78) questions the notion that suburbia and the distance from the city centre represent unsustainable urban form. Atkinson-Palombo found that higher density housing takes many forms and cannot be solely equated to urban infill in the inner-city. A "new suburbanism" is visible that includes higher-density developments on the fringe associated with semi-autonomous villages. Kotkin (2005) suggests that new suburbanism should be encouraged and may be a practical way of improving the sustainability of suburbs which are considered to be good places for people to live.

4.5.8 The Urban-Environment State of Play

Given the current status of 'the environment' in policy debate, media coverage and public discourse it would be reasonable to assume that there is a clear and well understood relationship between urban growth and urban form, and environmental impacts and outcomes; and that responses and initiatives to address perceived urban related environmental problems would be known and generally supported. This discussion on the relationship between the environment and urban form is by no means exhaustive but it does cover several important issues that are both widely discussed in the literature and considered by policy makers. There is no doubt that water is a major issue for urban Australia – the construction of desalination plants costing billions of dollars attests to the variability in water supply in an arid land and the potential impacts of a reduction in water security. But even with a perceived willingness to change behaviour in water usage (Head, 2008) households can still be ambivalent toward water supply (Syme, 2008) and others consider population growth to be the issue - not behaviour or water usage patterns (Davison, 2008).

Urban growth boundaries and green belts designed to hold back urban expansion are commonly used, but are designed to be transitory (Bengston et al., 2004) – albeit to manage growth – and may slow urban expansion but do not stop it (Gennaio et al., 2009). Leading Australian academics in the field differ on whether urban sprawl and suburbia are any less sustainable than high density residential living (Gleeson, 2010; Newman and Kenworthy, 1999; Troy, 1996). Even the definition of suburbia may need to be reconsidered in the light of "new suburban" densification (Atkinson-Palombo, 2010).

And what of the primary driving force behind sustainability initiatives such as New Urbanism and Smart Growth – the relationship between energy consumption and air pollution, and urban form? Even with the weight of the seminal works of Newman and Kenworthy, there remains healthy debate whether denser residential living will result in less kilometres travelled by car, notwithstanding living within or near the CBD.

So, from an environmental perspective on urban form the issues are once again complex and uncertain – and the solutions elusive.

4.6 The Increasing Importance of Lifestyle

This Section introduces the concept of lifestyle as a determinant of household residential location choice, which is posited as being of increasing importance in the decision of where to live; which in turn influences future urban form outcomes. The concept of lifestyle is defined in the context of complexity, individuality and plurality along with a discussion on lifestyle typologies as they potentially relate to residential location choice. The concepts of quality of life and amenity are then discussed in terms of their use in the housing literature. A link is then made between lifestyle choice, residential location choice and urban form.

4.6.1 Lifestyle and Urban Form

The definition and concept of lifestyle is both complex and disputed (Jansen, 2011, p.182). The concept of lifestyle is traditionally used to describe a relatively stable pattern of everyday life within the constraints of individual resources (Bogenhold, 2001, p.832). Contemporary literature on the other hand discusses lifestyle in terms of individualisation and plurality particularly within increasingly complex societies that offer multiple lifestyle choices (Bogenhold, 2001, p.833).

The relevance of lifestyle to this study is the thesis that different lifestyle choices are related to different choices in residential location – different locations offering different lifestyle opportunities. This idea is not new. Wirth, (1938, p.1) in his essay 'Urbanism as a way of life' considering the "…complicated phenomena of urbanism…" relates urban lifestyles to the size, density and degree of heterogeneity of the population. Wirth (1938, p.9) considers that the central problem for the "sociologist of the city" is to "…discover the forms of social action and organisation that typically emerge in relatively permanent, compact settlements of large numbers of heterogeneous individuals". In a more contemporary context Walker and Li (2007, p.78) consider that "…deep-rooted lifestyle differences lead to differences in considerations, criterion, and preferences for [residential] location."

Van Diepen and Musterd (2009, p.332) identify two approaches to empirically linking urbanity to lifestyles: the sociological approach which considers lifestyle to be an outcome of the characteristics of the urban environment; and the social geography approach which suggests that different household types and different lifestyle choices will ultimately determine urban outcomes; with the physical environment playing a lesser role in determining lifestyle. Counter to these approaches, Van Diepen and Musterd (2009) consider that the level of urbanity and the presence of urban orientated households are mutually related, in that households that benefit from access to local amenities and economic and social opportunities will locate near these amenities and opportunities; and the presence of these households is necessary for the provision of these amenities and opportunities. Similarly, Jansen (2011, p.178) suggests that household's choose a dwelling in pursuit of values and goals that are important to individuals and the household. Lifestyle is considered to provide a "human factor" to the analysis of residential location choice that enriches and puts "flesh on the bare statistical bones" of socio-demographic variables alone.

Consideration of lifestyle as a contributing factor in household residential location choice requires a lifestyle typology that relates lifestyle to residential location and – ultimately for this study – to urban form. Jansen (2011, p.196-199) provides an overview of lifestyle typologies in an appendix of more than 40 typologies – 20 of which are directly related to housing. Two example typologies follow – the first from a housing perspective and the second from a consumer research perspective.

Van Diepen and Musterd (2009, p.331) construct a household typology according to the type and extent of 'urban connectedness' based on a household's residential choice. Urban connectedness is described as a person's relationship with the urban society. Van Diepen and Musterd (2009, p.332) consider lifestyle to be "… behaviour related to household types, with regard to housing, use of urban facilities and orientation on the city" – a broader concept than lifestyle based on taste or preference alone.

Van Diepen and Musterd's (2009, p.338) housing-based typology consists of five urban lifestyles:

- Superurban households
- Economically urban households
- Socially urban households
- Nonurban households
- Retired households.

Due to the housing nature of van Diepen and Musterd's typology (2009, p.338), the five urban lifestyles reflect the distribution of households across the urban area. In summary, superurban households are over-represented and dominant in the centrally located districts and the city centre; economically urban households that are connected to the city usually by employment are hardly present in the centrally located parts of the city as are – by definition - nonurban households; family households are generally found at the urban outskirts; socially urban households that are connected to the city for mainly social reasons are evenly distributed over the city; and retired households are rarely present in the centrally located areas of the city and over-represented in the more peripheral districts.

From a consumer research perspective, Fournier et al. (1992) use a value-based consumption method to develop nine consumption lifestyle typologies. The basis of these typologies is the assumption that informal groups have shared needs, values and lifestyles and that this translates to common consumption patterns (Fournier et al., 1992, p.329). The nine lifestyles are: functionalists, nurturers, aspirers, experientials, succeeders, moral minority, golden years, sustainers and subsisters. These are defined as follows:

- Functionalists spend most of their money on essentials
- Nurturers expenditure patterns are governed by child-rearing
- Aspirers spend their income on status-related goods and services
- Experientials spend a disproportionate amount on entertainment
- Succeeders are educated dual-income professional households
- Moral Minorities spend on donations and are disproportionately empty-nester households
- Golden years generally aged over 65 years spend on second dwellings, remodelling their homes and entertainment
- Sustainers are mature households that spend on basic survival needs
- Subsisters are typically welfare and single-earner households whose income goes on providing housing.

Although both of these typologies relate to households, van Diepen and Musterd's typology directly relates lifestyle typologies to relative location within the urban/nonurban space where Fournier et al.'s typology does not have a locational dimension. Conversely, van Diepen and Musterd's typologies do not directly describe lifestyle or behaviour where Fournier et al.'s typologies directly describe lifestyle and behaviour. If lifestyle typologies are to be used in a locational setting a link between lifestyle, behaviour and location is required.

A discussion of typologies would not be complete without a discussion of social area analysis, particularly the work of Shevky and Bell in the 1950s (Marshall, 1998). The original form of social area analysis was descriptive and distinguished social areas in terms of social rank, degree of urbanization, and segregation. The theoretical basis later formed around the idea of scale and the number and intensity of a community's relationships (Marshall, 1998).

Rex and Moore, working in the 1960s, suggested that the system of housing allocation at the time gave rise to six housing classes: owner-occupiers, council house tenants, tenants of private landlords, owners of lodging houses, lodging house tenants and those buying a house on mortgage (later dividing council tenants into long-life accommodation and slum stock) (Saunders, 1981, p.139). Later classes were also added leading to the criticism that any group discriminated against in housing may constitute a housing class. A more fundamental criticism of housing class division is the difficulty of empirically identifying these conceptual classes (Saunders, 1981, p.139).

4.6.2 Quality of Life

Quality of life is increasingly becoming the focus of theoretical and empirical research based on the assumption that the social and physical environment can have an influence on the well-being of residents within an area. Moreover, quality of life is considered to be a key determinant in the decision of where to reside (Lambiri et al., 2007, p.1). Bukenya et al. (2003, p.204) define quality of life as "... a product of the interplay among social, health, economic, and environmental conditions which affect human and social development".

Quality of life characteristics known to influence housing location decisions include preferred lifestyles, preferences for leisure and recreation, familial connections, aesthetics of the surroundings and feelings of safety and security (Curtis and Montgomery 2006, p.16). A preference for external recreation and open space leads to a tendency to locate close to recreation locations (Colwell et al. 2002; Kaplan and Austin 2004) and familiarity and social connection provides strong inertia to remain in an area or to move short distances (Burgess and Skeltys 1992; Winstanley et al., 2002).

Florida (2002) considers quality of life to be vital in attracting 'knowledge workers' and the 'creative classes' to highly productive cities. Florida (2002 p.231) associates this quality of life with the 'quality of place' which is determined by the built and natural environments, the type of people that live in the area, the nature of the community and the amenities, leisure activities and culture that the area has to offer.

Measuring the implicit price of location and amenities has been well researched (Blomquist et al., 1988; Cheshire and Sheppard, 1995; Dellar et al., 2001; Power, 1996; Roback, 1982). Much of this research has involved the hedonic price model to compute quality-of-life indices for urban areas to rank quality of life across and within urban areas – covered in the economic section of this Chapter (Gyourko, J. et al., 1999; Moro et al., 2008, p.448). Hedonic pricing assumes that price is determined by both internal characteristics and by external factors. The hedonic pricing method is often used in the housing market. The price of a property is assumed to be determined by the characteristics of the dwelling, such as its size, condition and its location. This may include accessibility to services and amenities, such as schools, shops and health services; the physical environment, such as trees and open space; and the availability of employment.

Rappaport (2009, p.779-780) reports that residents in the United States move to locations that are perceived to provide high quality of life, including places that have nice weather, coastal locations and cities that offer high levels of consumption amenities, such as restaurants and live performances. This phenomenon is associated with individuals choosing to spend a greater share of their income and wealth on quality of life. Rappaport (2009, p.801) concludes that the demand for high-amenity places and quality of life will increase in the future and that firms and residents can be attracted to metropolitan areas by improving quality of life opportunities, such as schools, public health and safety, public and private transit, parks, museums, the arts and festivals.

4.6.3 Quality of Place and Neighbourhood

Both quality of life and quality of place are difficult to define and their meanings are contested. Quality of place may be considered in purely physical, social and economic terms although it is increasingly concerned with the complex of factors that distinguish one place from another (Llewelyn, 2006, p.3). This complex of factors includes the physical nature of the environment but also the neighbourhood – the interaction and connectivity of the people and households living within the area.

Surveys in the United Kingdom have shown that households want to live in locations that have character and in neighbourhoods that feel like they have an attractive identity. Households also value the local services and sense of community that higher density locations can offer (Commission of Architects and the Built Environment (CABE), 2005, p.1). Although the benefits of higher density living are appreciated, recent shifts in household preferences and housing design have seen a resurgence in the role of the street – including street layout, the provision of public space and the usability and size of a garden (CABE, 2005, p.10-16).

Hur and Morrow-Jones (2008, p.620) consider that the neighbourhood is still the most basic location in which social lives occur and, therefore, the neighbourhood directly affects the quality of life of its residents. Neighbourhoods that provide a high quality of life and have residents that are happy in their location will encourage residents to stay and for others to move in. Hur and Morrow-Jones (2008, p.632) conclude that neighbourhoods evolve beyond basic interaction by communication with others towards interaction through social activity with neighbouring residents; which leads to greater neighbourhood satisfaction and attachments to the neighbourhood. Blomquist (2006, p.500) also concludes that households cluster in areas that offer the bundle of amenities that they prefer within the constraint of price.

Hugo (2010, p.81) commenting on the liveability of cities suggests that cities are best understood by taking a broad view of people's needs – material, psychological, social and cultural - and considering whether cities contribute to satisfying these needs. The experiences of residents from across the urban fabric need to be considered which includes city, inner city, middle ring, outer urban and peri-urban dwellers. Similarly, consideration of quality of place and neighbourhood needs to take this broader view. Demographic, social and economic differences between households lead to differing demands and needs which emphasises the individuality and plurality of lifestyle and quality of life.

In Sydney, Australia, Easthope and Tice (2011, p.431) found that lower income families with children are choosing to live in apartments due to increasing concerns about housing affordability. Although apartment living may be more of a necessity than a choice for many families, they consider that there is "policy blindness" in the under-supply of apartments for those families with children that cannot afford to rent or buy a detached house or townhouse. Consideration of lifestyle needs rather than lifestyle aspirations may lead to different residential and urban form outcomes for some areas of the city.

Equally, the needs and desires of an ageing demographic will demand a quality of place and neighbourhoods different to the broader population. Faulkner (2007, p.154) discussing the ageing of the baby boomer cohort states that "… it is expected that they will have greater expectations about the quality of the housing they occupy, the quality of the neighbourhoods in which they live and the type of facilities associated with, or in close proximity to, that housing" (Faulkner, 2007, p.154).

4.6.4 Amenity

As discussed previously on the economics of residential location, the relationship between local amenities and public goods, and the choice of residential location is well researched (Bayoh et al., 2006; Krupka, 2009; Nowotny, 2010; Partridge, 2010; Tiebout, 1956).

Florida (2002) looks at the relationship between concentrations of cultural amenity – in particular the creative group known as bohemians. He concludes that high concentrations of bohemians reflect an underlying set of conditions which are open and attractive to talented and creative people. This bohemian presence and these conditions then attract other talented and high human capital people (Florida, 2002, p.67).

Clark et al. (2004, p.104) allude to a potential paradigm change that emphasises consumption and amenities as new drivers of urban dynamics. They comment that amenities differ by location as does the relationship between different types of people and these amenities; and – critical to this study – that distinct amenities explain different types of population growth. Clark et al. (2004, p.104) distinguish two amenity measures, *natural amenities* which include factors such as moderate temperature, hills, and water; and *constructed amenities* such as the number of research libraries, used and rare book stores, Starbucks, and bicycle events. Moreover, Clark et al. (2004, p.291) consider cities to be “entertainment machines” that leverage culture to enhance economic well-being. They also conclude that residents demand amenities to improve their quality of life “… treating their own urban location as if tourists, emphasising aesthetic concerns.” Their main goal is “… to encourage researchers and policy makers to give serious attention to amenities in future thinking” (Clark et al., 2004, p.132).

Shapiro (2006, p.333) found a relationship between college graduates and growth in quality of life which may also “… encourage the growth of consumer services, such as restaurants and bars, which then make an area more attractive to potential migrants”.

Glaeser (2001) argues that there are four critical urban amenities: the presence of a rich variety of services and consumer goods, such as restaurants and theatres; aesthetics and physical setting; good public services such as schools and low crime; and speed – the ease with which individuals can move around. Glaeser (2001, p.28) makes the point that “… edge cities and decentralisation of employment have increased commuting distances but often decreased commuting times relative to traditional downtowns".

Storper and Manville (2006, p.1247) question the dominant explanations of urban resurgence and urban growth, suggesting that theories of the knowledge or creative economies, urban amenities, diversity and tolerance, as well as urban beauty, require greater specification and even overhaul, to satisfactorily address the diversity of urban growth. In particular, Storper and Manville (2006, p.1247) believe that urban theory needs to better understand residential choice behaviours with regard to housing as a bundled good, the degree to which households are willing to substitute preferences, and the relationship between past and present preferences. Along similar lines, Storper and Scott (2009, p.147) question the prominence given to amenity in current approaches to understanding urban growth and emphasise the role of employment, the location of firms and the availability of skilled labour as drivers of urban development.

Hansen and Winther (2010) are also critical of the amenity paradigm. Using recent work from the United States and Europe, they consider that the amenity-growth paradigm does provide some explanation for urban growth for some cities and regions but it is far from universal. One of the major criticisms of the amenity approach is the disputed nature of beauty and the lack of empirical support for the relationship between amenity and urban growth.

4.6.5 Lifestyle Choice and Residential Location Decisions

A recent Australian government led report concluded that "... economic and lifestyle drivers will continue to be the key determinants of where Australians choose to live ..." (DSEWPC, 2011, p.38).

Ratcliffe and Krawcyck (2011, p.649) discussing changing societal value systems comment that the exceptional levels of wealth generated by past generations have led developed societies to take economic and social security for granted and to now focus on subjective well-being, self-expression and quality of life.

Sirgy et al. (2005) consider that housing choice is based on both practical aspects of the dwelling and location, and the more symbolic reflection of a person's view of themselves in terms of class and personality and how they want to be perceived by others. Both housing choice and location decisions are therefore made in both a practical and symbolic context. Similarly, Marcus (1995) suggests that people choose where to live based on where they feel comfortable based on their personal values, chosen lifestyle and the image that they wish to portray.

An empirical study by Walker and Li (2007, p.97) found that lifestyle preferences do exist and that these preferences are a key determinant of residential location choice. Randolph (2004, p.484) also identifies lifestyle consumerism to be related to the segregation of cities in a more complex way than the notion of class or life cycle, which reflects the more complex social and economic structures that we live in.

Montgomery and Curtis (2006) comment that the type of people living in a community can be an important factor in the choice of where to live. One of the primary drivers being the desire to locate with people who have shared values and from the same perceived class, and with households that have a similar structure to their own (Bayoh et al.2006, p.102; Gou and Bhat 2007; Lindstrom 1997).

4.6.6 Lifestyle and Urban Form

Walker and Li (2007, p.98) discuss the need to better understand the connection between demographics, lifestyle and residential location, to enable a better understanding of how urban areas develop. Randolph (2004, p.492) also identifies the need for research at the local or neighbourhood level because the neighbourhood is where "… the interaction between the multi-scaled dynamic forces of urban change are played out". Randolph considers the household to be the nexus between the many dynamic forces of urban change and calls for exploration of how cities are changing from the local level upwards to begin to understand the changing spatial structures of cities.

Scheiner and Kasper (2003, p.324) suggest that neighbourhoods provide the spatial context in which specific lifestyles create communities. They ask how the built environment – and neighbourhoods - will meet the new demands arising from less predictable ways of life and the pluralisation of lifestyles.

There are mixed results on whether particular lifestyle preferences result in actual residential location decisions. In a review of the urban sprawl and urban growth literature, Glaeser and Kahn (2003, p.2) found that despite common beliefs, higher density living was not on the rebound and that sprawl was both ubiquitous and expanding; suburbia, edge cities and sprawl are "natural" outcomes as a result of the dominance of the car; and the negative qualities associated with sprawl have been over-stated and edge-cities are actually associated with increases in measurable quality of life. Morrow-Jones et al. (2004) showed a strong preference for lower density, cul-de-sac neighbourhoods in households in Franklin County, Ohio.

There are also mixed views about the relationship between urban density and liveability. Although higher densities may provide for greater recreational and employment opportunities, they are also associated with loss of open space, over-crowding and traffic congestion (State of Environment 2011 Committee, 2011); and there is dispute whether higher urban densities are more efficient in the use of resources such as water and electricity (Troy, 1996).

There are many potential problems associated with City-centric living. Allen and Blandy (2004, p.2-4) explore a range of potential problems for city dwellers, including the inconvenience of inadequate shopping and parking; the problem of crime; housing density in terms of noise and personal and open space; poor quality dwellings; and declining housing affordability of city apartments. Although they found these potential problems did not affect all city dwellers, they found that those people who moved to the city for lifestyle reasons were affected by the lack of suburban conveniences; were unlikely to trade-down in their housing quality; but were generally accepting of noise and loss of personal space associated with higher density.

Morrow-Jones et al. (2004, p.196) found that regardless of the rhetoric of the lifestyle and environmental benefits of neotraditional and new urban developments, most households still prefer traditional housing in traditional suburban settings – although some niche lifestyle markets were viable. Myers and Gearin (2001, p.636) had similar findings in that households in the United States favour suburban location and design; detached dwellings; low-density neighbourhoods; ease of car use, and lowest cost. Notwithstanding these traditional choices, Myers and Gearin (2001, p.639) report that households held inconsistent preferences in that along with their low density living choice they also had a desire to reduce car dependence.

4.6.7 Lifestyle Summary

In relation to residential location, Walker and Li (2007, p.97) conclude that "... people's preferences seem to be more complex than are typically hypothesised". This discussion on lifestyle suggests that not only are preferences more complex, but the understanding of these preferences and their translation to residential location choice, are equally - if not more - complex. Although there is no consensus view, the literature generally supports the notion that a relationship exists between lifestyle preferences and residential location choice – whether it is a family household's preference to live in a detached dwelling in the suburbs, or the attraction of younger people to the amenities offered by city living. The complexity, individuality and plurality of this relationship, along with its yet poorly understood nature, prohibits formalising or quantifying this relationship. But the increasing importance of lifestyle in residential location choice and the potential impact that lifestyle choice may have on urban form outcomes cannot be ignored. As stated by Jansen (2011, p.194):

> "... [t]he gap between theory and practice is still wide with respect to the implementation of lifestyle variables in determining what has to be built."

This gap is possibly wider with respect to the relationship between lifestyle and urban form.

4.7 The Political Economy and Urban Form

Four broad forces are described in this Chapter to better understand the changing urban environment. However, a more overarching influence that cuts through all of these dimensions is encapsulated in the political economy. The forces that influence urban form can be looked at through the vested interests or the *positioning* of opinions and influences. Harvey (1992, p.588) suggests that the question of positioning is "… fundamental to all debates about how to create infrastructures and urban environments for living and working in the twenty-first century". In describing the various positions in the literature of the 1960s, Harvey (1992, p.592) identifies seven higher-order arguments relating to urban development:

1. Efficiency
2. Economic growth
3. Aesthetic and historical heritage
4. Social and moral order
5. Environmental/ecological
6. Distributive justice
7. Neighbourhood and communication.

These arguments are founded on a 'rational position' to bolster a case for a particular urban outcome (Harvey, 1992, p.593).

Castells' work 'The City and the Grassroots: a cross-cultural theory of urban social movements' was influential in defining urban social movements research (Castells, 1983). Mayer (2006, p.203) describes these movements as "… movements that combine struggles over collective consumption with those for community culture and political self-determination". Mayer (2006, p.203) states that since the 1960s and 1970s, "… urban movements have gone through a series of cycles that have transformed their goals, strategies, organisational structures and actions".

Since the 1970s, urban movements have increased in number and become differentiated and fragmented. Any attempt to classify these disparate groups would fail to capture "… their dynamic and their role in contemporary society (Mayer, 2006, p.203).

4.8 Conclusion

This Chapter described the four broad forces used in this study to better understand the influences on future urban form. Economic theory, including utility maximisation and the Tiebout hypothesis, partially explain household location decisions; as do housing affordability and the relative location of employment.

Government policy, in the form of urban planning strategies, is used in all of Australia's main capital cities to control and manage urban growth. The success of these policies is, however, uncertain.

Environmental concerns, such as urban encroachment and car dependence, are prominent in both the literature, and in policy and community debate. But the impact of these concerns is unclear. Urban growth constraints, such as urban growth boundaries, are impermanent and react to both policy and developer pressures. And the relationship between energy consumption and urban form is not without its critics.

Finally, lifestyle as a force driving urban change is complex, individual and multi-faceted. Unravelling these complexities, and making sense of how lifestyle ultimately influences urban form, requires critical judgement.

To grapple with the complexities and uncertainties inherent in changing urban form, requires a structured and systemic approach. The conceptual framework presented in Chapter one, and the modified argument-based approach developed in Chapter three, provide the methodology used in this study to address these complexities and uncertainties.

Chapter 5 An Australian Perspective

This Chapter focuses on the forces that shape Australia's cities within the ontology developed in Chapter four. The Australian housing context is briefly discussed within an aspirational and institutional framework; followed by a discussion of the urbanisation of Australia's population. Each force is then addressed within the nuances of the Australian context. The relevance of Australia's ageing population and international migration to future urban form is then considered.

5.1 The Australian Housing Context

An underlying aspiration for many Australian households is to own their own home – colloquially known as "the Great Australian Dream" (Forster, 2006, p.175). The proportion of home purchase and ownership has traditionally been very high in all Australian cities. In 2011 Melbourne had the highest proportion at 71.8 per cent, Hobart in Tasmania at 71.6 per cent, Perth at 71.5 per cent, Adelaide at 70.8 per cent and Sydney at 67.4 per cent[31] (ABS, 2011a). Although still high, the proportion of home owners and purchasers across Australia has declined in recent years from approximately 71 per cent in 2001 to 69 per cent in 2011 (ABS, 2011a). Reasons given for the declining home ownership rates include a reduction in housing affordability, increased divorce and separation rates leading to a reduction in the ability to attain or maintain home ownership (Flatau et al., 2004); and reduced job security (Kupke, 2000).

The reduction in home ownership is partly a reflection of the declining home ownership for younger households (Yates, 2006, p.4). Yates shows that between the mid-1970s to the early 2000s, Australian home ownership for those aged 25 to 29 declined by eleven percentage points, and ten percentage points for those 30 to 39 years of age. Notwithstanding the dramatic social changes over past decades, such as partnering and having children later, possibly the greatest impediment to home purchase has been the dramatic increase in the real price of housing, driven by historically lower interest rates, and the growing insecurity of employment (Yates, 2006, p.8).

During Australia's peak migration period following World War II, all states and territories provided public housing for newly arrived working migrants funded through the Commonwealth-State Housing Agreement (Australian Government, 2000). In South

[31] Based on Australian Bureau of Statistics Greater Capital City geographies.

Australia, the South Australian Housing Trust was established to provide housing close to industrial employment (Forster, 1974, p.32). Public housing is now generally available as welfare accommodation only (Jacobs et al., 2010).

Since the mid 1990s Commonwealth Government rental assistance to low income households has steadily replaced the function of the Commonwealth-State Housing Assistance scheme (Hulse, 2002, p.9). In addition, with the decline in federal government support for public housing, much of the public housing stock is progressively being demolished and replaced with private sector housing stock (Atkinson and Jacobs, 2008; Randolph and Judd, 2000). This in effect has transferred a substantial part of the housing affordability responsibility from the states and territories to the Commonwealth government (Yates, 1997).

5.1.1 Urbanisation of Australian cities

Australia is one of the most urbanised countries on the planet with more than two thirds of its population living in major cities on the east and southwest coasts (ABS, 2008b). There are five cities in Australia with a population of more than one million people. Adelaide is the smallest of these with a population of almost 1.3 million as at June 2012 and Sydney is the largest with a population of more than 4.6 million (ABS, 2012a).

Much of Australia's development occurred through the long-boom of the 1950s and 1960s - a time of increasing affluence and the mass production of the motor car. This confluence of events led to the opening up of suburbs beyond the inner cities (Bunker, 1985, p.310; Forster, 2006). Affordable land and access to work and services by motor vehicle resulted in the preference for many households being a detached house on a 'quarter acre block' on the urban fringe (Victorian Department of Infrastructure, 1998, p.3). Over the past six decades this has led to a generalised urban form in all of Australia's major cities that has been characterised as urban sprawl (Kellett, 2011, p.263). This low-density urban form has been criticised for its wastefulness in terms of infrastructure provision and the demand for land (Mee, 1994).

This is by no means the only characterisation of Australia's urban cities. East coast cities in particular have significant high density living in their city centres, and along coastal strips as a result of demand to live near the Central Business District (CBD) or within prime coastal beach locations. Sydney, Melbourne and Brisbane have all experienced a significant shift towards higher density living in recent decades (Randolph, 2006, p.475). In the city of Sydney, it has been projected that multi-unit dwellings will account for approximately half of all dwellings over the next ten years (Productivity Commission, 2004, p.14).

A paradox of living in a highly urbanised country with a vast land mass of approximately 7.7 million kilometres, is that Australia is running out of land. Australia's capital cities combined cover approximately 65,000 square kilometres - less than one per cent of Australia's land mass (Productivity Commission, 2011, p.98). With the likelihood that the population will continue to want to live in large cities (Hugo, 2012, p.89) physical boundaries in cities such as Sydney, and government initiatives to constrain further urban sprawl, are limiting outward growth. This in turn puts upward pressure on the price of land and housing (Productivity Commission, 2004, p.134).

5.2 The Forces Shaping Australian Cities

The ontology of forces shaping future urban form developed in Chapter four is intended to be both broad and comprehensive. As such these forces can be considered at various scales and locations. Although there is much diversity within and between Australian cities, given they have all been established over the past 200 years and have experienced similar economic, social and technological influences over this time, they are also remarkably similar (Forster, 2004).

5.2.1 Economic

Due to the generous tax concessions provided for investment property in Australia and the prospect of strong capital gains, the Australian housing market is driven by both the owner-occupier and the investor (Reserve Bank of Australia, 2003, p.17). Property prices in Australian cities have experienced strong growth since the early 1970s. A major contributor to this price increase has been the demand to purchase rental properties by household investors (Reserve Bank of Australia, 2003, p.35). Ownership of Australian rental properties is widespread amongst the general population with most investors owning only one property (ABS, 1995). One of the results of this ownership structure is the dispersed provision of rental properties across metropolitan locations, rather than a concentration of rental properties within particular suburbs or within high-density apartment blocks. Notwithstanding the differential affordability between cities, the availability of Commonwealth government rental assistance, and the spatially dispersed nature of rental properties, provides the opportunity for renters to locate in a variety of locations within Australia's cities (Melhuish et al., 2004); although recent increases in the private rental stock have been at higher rental levels, and are unlikely to be affordable to lower income households (Wulff et al., 2011, p.26). Randolph and Holloway (2007, p. 139) report that there has been a shift of low income households away from city and inner city locations, into suburban locations, with lower income households being concentrated in lower cost middle ring suburbs. This shift is a result of gentrification of the inner city and investors purchasing more affordable rental stock in the suburbs.

The mix of dwelling type varies between major Australian cities. There is an established and increasing market for apartment living in larger cities such as Sydney (Bunker et al., 2005, p.772; Productivity Commission, 2004, p.14), driven by population density, the high relative land value of inner city and amenity locations, and the well established cultural acceptance of apartment living. Australia's other major cities – including Melbourne, Perth, Darwin and the national capital of Canberra – all have established high density residential living in and around their inner cities, and amenity locations, to various degrees (ABS, 2001; Department of Lands, Planning and Environment, 1996; Environment and Sustainable Development, 2011).

Adelaide is an exception to this trend. The population of the City of Adelaide[32] is low compared to Melbourne and Sydney. The City of Adelaide's population peaked in the early 1900s, and declined steadily until the mid 1990s. Since this time the population of the City of Adelaide has increased dramatically, although it is still less than half its early peak (McDougall and Vine, 2006). The development of high-rise apartment blocks within the City has increased in recent years, with the State government adopting a policy of increasing the population of the City of Adelaide to 75,000 over the next 30 years in a campaign called "Vibrant Adelaide" (Government of South Australia, 2012b).

As discussed in Chapter six, along with inner-city development, an early implementation of the 30 Year Plan for Greater Adelaide is the promotion of Transit Oriented Development (TODs)[33] and corridor development within the adjacent suburbs of the City of Adelaide (Government of South Australia, 2012b). Currently the adjacent arterial road designated for high-rise residential development on the City's southern boundary is a major commercial strip, and to the west is a major industrial location

[32] See Chapter one for a discussion of the study area and the place of the City of Adelaide within Greater Metropolitan Adelaide.

[33] TODs refers to a form of urban growth that consists of mixed-use development around high density hubs on the transport network – usually light rail; and growth along the transport network within corridors (Government of South Australia, 2010a, p.14).

(Government of South Australia, 2009b). Policy changes are designed "… to facilitate high density mixed-use development as key components of the city edge" (Government of South Australia, 2012b, p.47). If the inner-rim policy is successful, much of this commercial and industrial employment would be displaced, resulting in a loss of local employment – a result contrary to one of the fundamental principles of most urban strategies.

5.2.1.1 Affordability

As discussed above, the Australian housing market is characterised by little public housing, tax concessions, Commonwealth rental assistance, a high level of urbanisation and a high level of home ownership and purchase. This combination of factors has resulted in a high rate of real housing price increases over many decades, by international standards (Productivity Commission, 2004, p.16). The cost of housing is therefore a major impost for most households (Yates and Milligan, 2007). Although housing prices have increased in real terms, home loan interest rates in Australia have fallen dramatically over the past three decades - from approximately 17 per cent in the late 1980s to around five per cent in 2013[34]. This has been a major contributing factor to price increases. There has also been a shift toward renting rather than buying (Hulse et al., 2011) – a trend that is likely to continue in the future (Yates and Milligan, 2007). For some, this shift is by choice, but for others it is due to lack of affordability (Randolph and Holloway, 2007, p.139; Yates and Milligan, 2007, p.12).

Housing affordability impacts on the total effective demand for housing in that sub-optimal market conditions can result in a level of unmet demand for housing - the concept of 'underlying demand'. This unmet demand may result from young adults delaying leaving home to form a household, couples staying together for economic reasons, or the establishment of multi-family households (National Housing Supply Council, 2013). Notwithstanding the issue of underlying demand, the general availability of rental properties and Commonwealth rental assistance makes accessibility to housing available to most, with the major impact being choice of dwelling, tenure and location.

Generally, housing affordability is relevant to urban form in that households are limited in their choice of residence and location, depending on where they can afford to reside.

[34] Reserve Bank Of Australia, accessed 24 October 2013 <http://www.rba.gov.au/statistics/Tables/#interest_rates>

Although the availability of rental properties in Australian cities is dispersed, a choice to live close to the city will result in a trade-off for most households, in that housing is less affordable to either buy or rent. Conversely, cheaper housing is generally available on the fringes of cities – travel time and reduced access to services and amenities reflected in the cost of housing (Hugo, 2010, p.130). This differential in housing affordability between the inner city and the middle and outer suburbs, has led to a concentration of young renters and high-income, childless households living in the higher cost city and inner-city locations (Yates et al., 2006, p.87).

A critical element of housing affordability is household income, which in turn is related to an individual's skill base and effective access to jobs (Berry, 2006). Unemployment due to access and location is frictional in nature and can be addressed by policy initiatives to relocate jobs to disadvantage areas.

Policy efforts in the United Kingdom to address the spatial mismatch of lower paid households living in house cost housing regions such as London, has focused on public sector employees – particularly for the purchase of a home (Berry, 2006, 17).

According to Berry (2006) and others, the restructuring of the urban economy is leading to the spatial restructuring of major cities like Sydney. A clustering of new-economy, high-income jobs, is occurring in central city and inner cities, resulting in a demand for highly skilled, high-income professionals, and low-income service jobs. This results in a highly segregated urban form and housing market with rising house prices and rents in cities and inner suburbs, and lower income service employees pushed to the fringe and forced to commute long distances to work.

5.2.2 Government Policy

Urban development in Australia is generally controlled by two of its three tiers of government[35] – local government controlling most individual development proposals, and State or Territory governments providing the policy and zoning framework for urban development more broadly (Thompson and Maginn, 2012).

As discussed in Chapter four, all five of Australia's major cities have adopted planning strategies in recent years to address the growth in both population and urban development. Although the concept of containment, consolidation and centres is

---

[35] Australia is a federation comprising a federal government, six states and two mainland territories, and numerous local governments within each state and the Northern Territory.

essentially a cornerstone of all of these strategies (Forster, 2006), the success of these goals has been questioned in the literature (Dodson, 2008; Forster, 2006; Mees, 2003).

Although Forster (2006) and Dodson (2008) identify consolidation and increased densities as key components of contemporary Australian planning strategies, more recent changes to some of these plans indicate a relaxation of urban containment strategies, resulting from the realities of strong population growth and the complexities of facilitating and developing alternative high-density, mixed-use developments, such as Transit Oriented Developments (Government of South Australia, 2010a; State Government of Victoria, 2008).

The experiences of both Melbourne and Sydney's planning strategies suggest that, in reality, urban development and strategic planning - as Forster (2006, p.180) states - exist in parallel universes. Melbourne's vision for containing outward development has been revised with a relaxation of its Urban Growth Boundary (State Government of Victoria, 2008). Equally, the Metropolitan Plan for Sydney 2036 is being reviewed only two years after its release (NSW Government, 2012). Given the similarity of the underlying principles contained in the 30 Year Plan for Greater Adelaide and these other plans, there is likely to be pressure for a review of this strategy in coming years.

The question whether planning works in the Australian context is complex. All states and territories have well established legislative and policy frameworks to control development which are debated by the public and developers alike. The current wave of planning strategies, with a central aim of increasing densities and mixed use, being imposed on Australia's cities, has seen a backlash from community groups (Searle, 2007; Lewis, 1999). But the public voice can be characterised as bipolar; appropriate urban development is seen as a sign of progress and prosperity by most – as long as it's "not in my backyard" (NIMBY)[36] (Sarkisian, 2013, Schively, 2007). Counter to this view, there is also a view that controls are too bureaucratic and costly, and should be streamlined to facilitate development (Government of Western Australia, 2009).

Several Australian state governments have strategic transport and infrastructure plans to guide the long-term delivery of infrastructure (Department of Infrastructure and Transport, 2013). The Victorian government has recently established the Growth Areas Authority to integrate land use and infrastructure development in its metropolitan

[36] NIMBY is an acronym widely used to describe a view that development is needed as long as it does not directly impact on the individual concerned.

growth areas (State Government of Victoria, 2013a); New South Wales has the NSW Long-term Transport Master Plan and State Infrastructure Strategy (New South Wales Government, 2012b; Infrastructure New South Wales, 2012); and South Australia has recently released an integrated transport and land use strategy for South Australia (Government of South Australia, 2013c). Although these strategies are in place or in development, there is also a perceived disconnect between urban land use planning and infrastructure planning – including transport planning - in many Australian cities (Wilmoth, 2005). A disconnect between urban and transport planning is likely to result in inefficient outcomes for infrastructure, but also a potential undermining of urban development policies aimed at achieving urban form outcomes, such as increased densification and reduced sprawl.

Government strategies such as the 30 Year Plan for Greater Adelaide reflect the views and policies of the presiding government. Any change in government has the potential to also change the strategic direction of planning. Changing political landscapes can, therefore, transform apparent certainty regarding the official position on the desired trajectory of urban development, into disjointed policy constraints through time. The reality of changing government policy and vision on urban development may lead to outcomes that are void of any of the espoused benefits of comprehensive, integrated planning, such as the efficient allocation of jobs or the development of employment or residential clusters accessible to public transport.

5.2.3 The Environment

The interface between the environment and urban growth in Australia has a physical, social and policy dimension. Australia is a vast, arid land that has temperate zones along much of its coastline and a sub-tropical climate in its north. Water has always been a driving force of settlement in Australia – river systems providing water supplies for early development, and rainfall and fertile soils fostering population growth (Napier, 1835, p.108). Like many cities around the world, as Australia's cities have grown, much of the arable soils that provided local food have been replaced with dwellings and industry. The cities food bowls have moved ever-further out from city centres (Paul and Haslam McKenzie, 2011, p.126). With the globalisation of food supplies, the necessity for food to be sourced locally has diminished; although the cultural wave to consume locally produced food may have increased (Roots et al., 2013, p.334); including a return to producing food in the suburbs (Gleeson, 2013, p.311). Notwithstanding these trends, there is still a need to retain local food bowls that are continually encroached upon by the ever-expanding demand for housing land (Budge, 2013, p.367).

Natural amenity is also an important element of Australia's city environments. Most Australian cities are bounded by coastline and mountain ranges – although these ranges are relatively small by international comparison. The Australian national park network was established in 1879 and has grown to more than 500 parks across the nation (Westcott, 1991, p.331). Sydney's Blue Mountains National Park; the Adelaide Hills incorporating its wine growing regions along with its primary water catchments; the Perth Hills National Park and its premium wine growing regions in the Leeuwin-Naturaliste National Park; and the national capital of Canberra – known as "the bush capital" – are examples of accessible natural amenity for many living in Australia's cities. A recent survey of the population of New South Wales' knowledge of, and attitudes and behaviours toward the environment showed that 32 percent of people in the State visited bushland or a natural area many times over the preceding 12 months, and that almost 80 per cent had visited these areas at least once over that period (Office of the Environment and Heritage, 2012, p.72).

Given that the provenance of the term and the notion of "car dependency" emanates from Australia, it is important to consider the extent to which the principles of Newman and Kenworthy's (Kenworthy et al., 1999; Newman and Kenworthy, 1989) work have been incorporated into government policy and the Australian psyche more generally.

As discussed previously, urban planning strategies in Australia have strong overlapping principles of consolidation, containment and centres (Forster, 2006, p.180). These principles align with Newman and Kenworthy's vision of urban development in Australia (Kenworthy, 2007). Kenworthy (2007, p.55) supports higher density residential developments as a means of reducing car dependence, concluding that urban density explains 84 percent of car passenger use.

As a measure of the direct influence of Newman and Kenworthy's work and principles in Australian strategic planning, a search of the metropolitan plans for New South Wales, South Australia, Victoria and Western Australia for the terms "Newman", "Kenworthy", "New Urbanism", "Smart Growth" and "car dependency" has been undertaken. The 30 Year Plan for Greater Adelaide does not directly reference these terms, but does refer to the use of density and Transit Oriented Developments as planning tools to reduce car use and avoid further urban sprawl (Government of South Australia, 2010b, p.43 and p.202). The recently updated Melbourne Planning Strategy (State Government of Victoria, 2013b) does not reference Newman or Kenworthy directly, but does include a reference to car dependency (State Government of Victoria, 2013b, p.100). The Metropolitan Plan for Sydney 2036 (NSW Government 2010) and the Western Australian Metropolitan Development Program 2005/2006 to 2009/2010 (Western Australian Planning Commission, 2006) do not reference the key search words. The Western Australian 'directions 2031 and beyond' contains several references to car-dependence (Western Australian Planning Commission, 2010, p.55; 62).

Overall, the connection between Newman and Kenworthy's work - and by association Smart Growth and New Urbanism – appears to be implicit in the principles of Australia's urban development strategies, rather than explicit. This suggests the application of a New Urbanism/Smart Growth "template" approach to Australian metropolitan plans, rather than consideration of the first-principles on which these movements and ideas are based. This approach may fail to address the fundamental uniqueness of individual cities. Without considering first-principles; the differences between international examples of where these principles have been applied; and the individual Australian context, the application of these strategies may lead to both unsuccessful and unintended outcomes (Sipe and Gleeson, 2004).

5.2.4 Lifestyle

For many decades the Australian lifestyle has been characterised and promoted to the world as a sun-drenched country, with boundless sand and surf; with a population that is both tolerant, but at the same time irreverent to authority and "the tall poppy"[37]. This carefree image of Australian life is of course a caricature of reality. American culture has for many decades pervaded our television screens (Bagnall, 1998) and the diaspora of Australians living and working overseas (Hugo et al., 2003) has expanded both the individual and the collective minds. Australia is as diverse as any country, and within that diversity lie a plethora of lifestyles, aspirations and life goals.

Australia's urban culture has evolved over many decades of migrant waves, world travel and the pervasive influences of modern technologies and social media. Post-war immigration from southern Europe – particularly Italy and Greece – and later waves of immigration from Vietnam and China has resulted in diversification of Australian culture (Walsh, 2001; Rubino, 2002). For many, living within walking distance of a café strip is a mark of success – both in terms of lifestyle and image (Victorian Department of Infrastructure, 1998). In turn, this has increased the demand for housing around these

[37] In Australia, the tall poppy syndrome refers to criticism of successful people who possess little humility. The concept is founded on a culture of the Australian "underdog".

urban amenity hubs with an associated premium to both rent and buy a property in these locations. This increased demand has led to higher density residential developments around these amenity locations, such as inner-city and waterfront developments (Bunker et al., 2005, p. 790). Notwithstanding these recent trends, there is still a strong desire for home ownership – particularly separate houses on a plot of land (Davison et al., 1995).

Natural amenity – particularly the beach culture – has always been a major part of the Australian lifestyle. In recent years, the demand to live near the coast has grown exponentially, due to increased populations and the limited coastline within the city boundary. With high prices being paid for city coastal properties (Healy and Birrell, 2006, p.iii) many Australian's have moved to relatively accessible coastal towns where properties are cheaper (Planning Research Centre, 2005, p.16) – the phenomenon known as a 'seachange'. The ageing of the population has added substantially to this demand, resulting in major increases in property prices within many of these coastal towns (Planning Research Centre, 2005, p.18).

5.3 Australia's Changing Demography

In calendar year 2008, Australia's population increased by more than 400,000. This was the highest recorded growth in the nation's population since 1971 (ABS, 2012a). The main contributor to this recent population growth was net overseas migration (NOM). Since its peak in 2008, NOM has fallen dramatically, resulting in national growth of around 250,000. This level of growth is still historically high (ABS, 2012a).

South Australia's population growth has followed a similar pattern to national growth, with peak growth occurring in calendar year 2009. Although growth declined following this peak, there is evidence that South Australia's population growth is rebounding (ABS, 2012a).

5.3.1 An Ageing Population

One of the major characteristics of Australia's population is the baby boomer cohort born between 1946 and 1961 (ABS, 2012b). High fertility rates during this period created an enduring bubble of population that has been flowing through the population for half a century. In 2011, the first of these baby boomers reached retirement age, and over the next 15 years the bulk of this cohort will move out of the work force, into retirement, and then old age (Pinnegar et al., 2012, p.4). This ageing has led to an increase in the number of lone person households, as the life expectancy differentials between males and females translates into more single female households in older age. In addition, a more contemporary phenomenon has also been identified where empty nesters and recent retirees separate after many years of marriage (Hugo, 2003b, p.111).

The increase in lone person households due to greater survivorship of females does not in itself increase the demand for housing. Some ageing households will move to retirement homes, and ultimately to aged care; but many will age in place, in lower density, outer and middle ring suburbs (Hugo, 2003b, p.112). The impact of this on the housing market will be the extent to which ageing households move from their family homes; to retirement living, other dwellings, or to an alternative location for lifestyle reasons; and the timing of disinvestment in residential assets owned by this cohort (Pinnegar et al., 2012, p.31).

Pinnegar et al. (2012, p.10) develop a typology of six baby boomer ‘types’ based on existing tenure, aspirations for future housing and location, and constraints on choice. These types are:

> **Age in place**: the group that wants to, and is able to, keep living in the family home
>
> **Local adapters**: the group that has recently or wants to, and is able to, move out of their current home, but keep living in the same area
>
> **Scene changers**: the group that has recently or wants to, and is able to, move out of the current home and area, to somewhere with greater amenity
>
> **Constrained retreat**: the group that wants to keep living in their current home, or even the same area, but forced to make compromises due to financial constraints
>
> **Increased dependency**: the group that wants to stay in their current home, but has to make housing or location compromises due to deteriorating health
>
> **Older renters**: the group that has reached retirement without purchasing their own home, and will need to retain or find ongoing rental accommodation.

Each of these typologies will have an influence on both the demand and the supply of dwellings; and on the future distribution of the population.

5.3.1.1 Adelaide’s Ageing Population

The population of Greater Metropolitan Adelaide aged 65 years and older is currently approximately 200,000. This number is projected to double over the next 30 years (Government of South Australia, 2010c). In 2011, 76 per cent[38] of this cohort lived in a

[38] Count of enumerated persons, excluding ‘not stated’ in total persons.

detached dwelling (ABS, 2014). One of the relationships between the ageing of the population and urban form is the extent to which retirees and the aged are 'downsizing'[39] to smaller dwellings - particularly, private apartment living[40]. Evidence in larger cities, such as Sydney, points toward the likely escalation of problems managing strata title developments, and the possibilities for social conflict and the loss of local amenity due to the deterioration of multistorey developments (Easthope and Randolph, 2009, p.255). Other research suggests that apartment living has not become more desirable and that smaller households do not necessarily prefer smaller dwellings (Easthope et al., 2009, p.19). There is also a decreasing trend for older Australians to live in flats or apartments; with the percentage of South Australians aged 65 years and older living in flats or apartments decreasing from 8.9% in 2001 to 7.5% in 2011 (Judd et al., 2014, p.42). High density developments in Sydney, Melbourne, Brisbane and Perth are economically viable, with developer profits increasing in most cities in recent years. Adelaide is the exception, with developers generally making negative profits on high density developments (Urbis, 2011, p.20).

Ultimately of course, the baby boomer cohort will either move or die. Given the number of people and households in this cohort, a major consequence will be the increased availability of existing housing stock in middle ring suburbs, to current and new households. Due to the age of the baby boomer cohort, it is likely that many of these dwellings will come onto the market over the next couple of decades. This increase in the availability of existing stock will result in a relative fall in the demand for new housing over this period – regardless of the actual increase in the number of households. In addition, much of the housing stock in the middle ring suburbs of Adelaide is on relatively large blocks of land. Many of these blocks are likely to be suitable for demolition and subdivision into two or more smaller blocks. This process will lead to increased densities of dwellings, and people, in these suburbs.

Another phenomenon of ageing in South Australia has been the 'seachange', referred to previously. This group is part of Pinnegar et al.'s (2012, p.10) 'Scene Changer' typology. A common coastal location for retirees in South Australia is the Fleurieu Peninsula on the south coast; in particular the township of Victor Harbor. Between

[39] Downsizing is a term used to describe the phenomenon of particular cohorts – generally older, empty-nesters or retirees – moving from a larger dwelling to a smaller dwelling for lifestyle or financial reasons.

[40] Private apartments are distinct from non-private dwellings, such as communal aged care facilities.

2006 and 2011, the population of the Local Government Area of Victor Harbor aged between 65 and 69 years has increased from 898 to 1,212; an increase of 35 per cent (ABS, 2014). Over this same period, the total population of the area has increased by 15 per cent (ABS, 2014). Associated with this disproportionate increase in the aged, has been an increase in the number of people employed in the 'health care and social assistance' sector; from 566 in 2006 to 712 in 2011 (ABS, 2014). This associated growth provides further impetus for further population and economic growth in the region.

In more recent years, other coastal towns have begun to attract retirement migration. The Local Government Area of the Copper Coast, north-west of Adelaide, has increased its population aged between 65 and 69 years from 769 in 2006 to 934 in 2011 (ABS, 2014). This northern coastal location has developed due to its relative location to the northern suburbs of the Adelaide metropolitan region. Hugo and Harris (2012, p. 20) report that a substantial contribution to the growth of the Copper Coast comes from these northern suburbs; as well as from adjacent regional locations. As with Victor Harbor, there has also been a substantial increase in the number of health care and social assistance jobs in the region between 2006 and 2011 (ABS, 2014), contributing further to population growth.

5.3.2 Overseas migration

Migration to Australia has been the foundation of population growth over its 200 year history (Hugo, 2011, p.246). Australia's immigration program is comprised of three streams:

- The permanent migration program, which includes skilled migrants, family reunions and a special eligibility intake
- Long-term temporary entrants, including overseas students, working holiday makers and business long stay entrants (but excluding visitors)
- Residents returning to Australia and New Zealand citizens, who have the right to enter Australia under the 'Trans-Tasman Travel Arrangement' (Department of Immigration and Border Protections, 2014).

Out-migration from Australia comprises permanent departures, long-term visitors departing, and long-term residents departing.

Until the mid 1970s, Australia's migration program focused predominantly on permanent migration from the United Kingdom and Southern Europe (Khoo et al., 2011, p.550). During the 1970s, Australia opened its borders to Asian immigrants, including a substantial refugee program following the reunification of Vietnam (Hugo, 2003a, p.251). During this period, there was little delineation between types of migrants whether skilled, family reunion or refugee (Khoo et al., 2011, p.551).

By the late 1980s, Australia had experienced a major recession which led to many new arrivals remaining unemployed for years (McDonald, 2013). This resulted in a change of government policy toward skilled migration, and the introduction of a points-based entry system (Khoo et al., 2011, p.553), which delineated skilled, family and humanitarian migration targets.

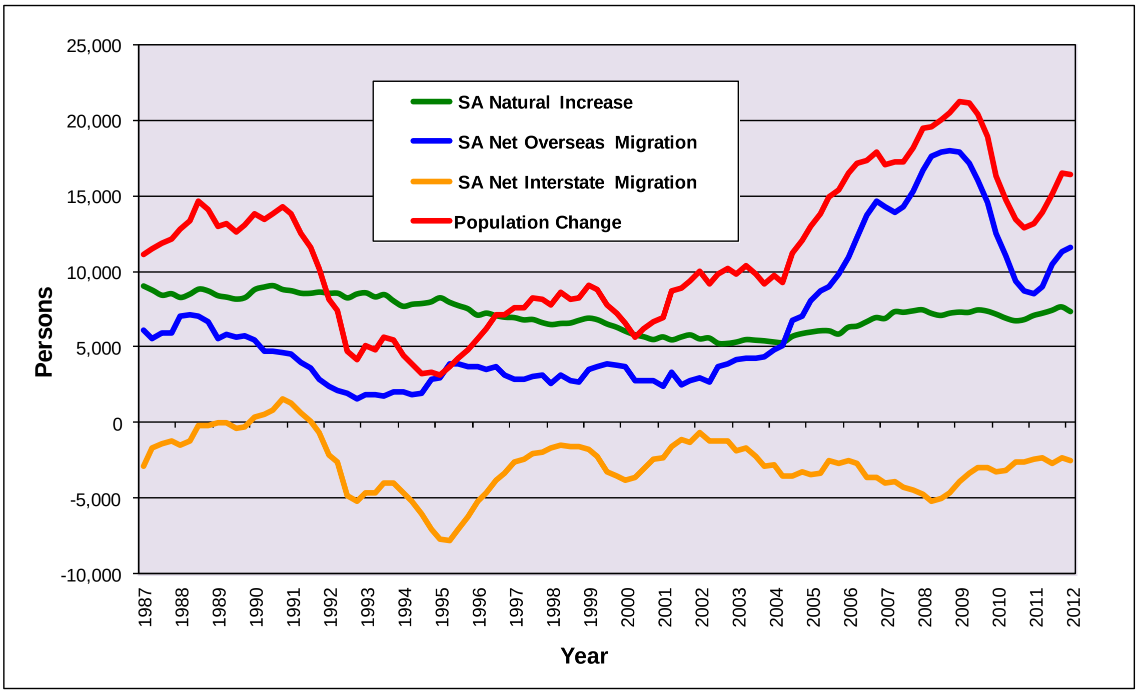
Since the mid 2000s, South Australia - and Australia more generally – has experienced major increases in the level of net overseas migration, as shown in Figure 5.1. In recent years, migration to Australia has experienced a significant shift from permanent migration controlled by government policy and target numbers, to long-term temporary migration predominantly in the form of long-stay business visas and international students (Hugo, 2008a, p.273). In the mid 1990s, the Australian government introduced a range of initiatives to boost temporary skilled immigration (Hugo, 2006). Around this time, the 'State Specific and Regional Migration Scheme' (SSRM scheme) [41] was introduced that restricted immigrants to low growth areas of Australia (Hugo, 2008a, p. 554). The result of these changes to Australia's immigration policy was that by 2009, South Australia's long-term temporary entrants were double that of settler arrivals and permanent migrants.

These recent increases in net overseas migration have contributed greatly to South Australia's population growth. South Australia's population increased by approximately 20,000 people over the 2008-09 period – an annual increase of 1.2%; the fastest growth for the State for more than 30 years (ABS, 2013). Continued high levels of long-term temporary skilled migration to South Australia have been threatened in recent years. In its original form, the SSRM scheme excluded most capital cities and other large conurbations. The capital city of Adelaide was exempted due to its low population growth (Department of Immigration and Multicultural Affairs, 2007, p.44). In 2011, the resource focussed state of Western Australia received more favourable treatment under the scheme, with the capital city of Perth obtaining regional status (Government

[41] The State Specific and Regional Migration (SSRM) scheme was introduced by the Australian Government to assist states and territories to address skills shortages and to direct skilled immigrants to low growth regions of Australia.

of Western Australia, 2014). The vulnerability of South Australia's migration intake to the SSRM scheme is evident in Figure 5.2, which shows the proportion of migrants associated with the SSRM scheme compared to other migrants. South Australia has by far the greatest exposure to changes to the SSRM scheme.

Figure 5.1: Components of South Australia's Population Growth

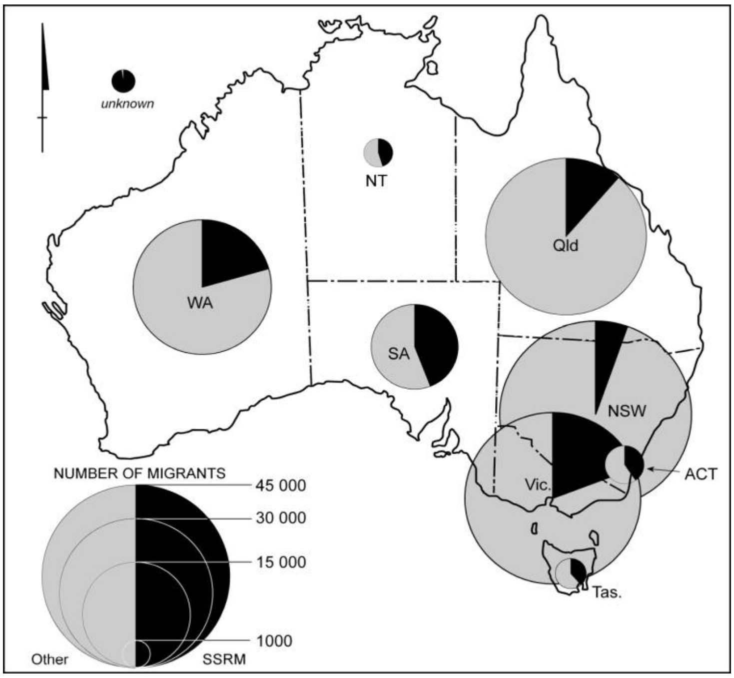


Source: Australian Bureau of Statistics, ABS, 2013

Although the United Kingdom is still a major source country for migration to Australia, Asia has now become the major region from which Australia sources migrants – excluding New Zealander citizens who have free movement between New Zealand and Australia. Countries, such as China and India, are major contributors to Australia's annual migration flows – particularly as international students (Department of Immigration and Citizenship (DIAC), 2013, p.18).

Over recent decades, there has been a change in the notion of migration to Australia from one of permanent relocation to a complex pattern of movements between Australia and donor nations (Hugo, 2008a). Hugo (2008a, p.269) identifies a number of distinct structural elements in Australia's contemporary Asian migration experience:

Figure 5.2: Australia: Permanent Arrivals by State "State Specific and Regional, Migration Scheme Migrants" compared "Other Migrants", 2008-09



Source: Hugo, 2008b, p.23

Permanent Settlement of Asians in Australia: permanent movement of Asians to Australia

Indirect Settlement Migration to Australia: movement of Asians to a third country prior to moving to Australia

Return Migration: permanent return to the homeland after a period in Australia

Third Country Migration: permanent migration to a third country after a period of residence in Australia

Reciprocal Migration: permanent relocation of Australians to Asian countries

Circular Migration: long-term but temporary migration between Australia and Asia – mainly students and long-term temporary business migrants

Circulation: shorter movements between Australia and Asia.

One of the consequences of this complex relationship between Asian migration and Australia's future urban form, is its impact on inner city property markets. Between the mid 1970s and mid 1980s, Asian investment in Australia increased from less than 15 per cent to 40 per cent of total foreign inflows – much of this investment directed to capital city property markets (Stimson and Adrian, 1987, p.48). The deregulation and internationalisation of Australia's financial system through the 1970s and 1980s, led to local and foreign capital flowing into Australia's inner city built environments, including major investment from Asia (Berry and Huxley, 1992, p.52). Much of this investment was into speculative or non-productive commercial and residential projects, based on an expectation of future profits (Berry and Huxley, 1992, p.56). One notable development at this time was Darling Harbour, which dramatically changed the urban form of a previously derelict rail yard in central Sydney.

Under current Foreign Investment Review Board regulations, temporary residents with a 12 month visa, or those holding a bridging visa to permanent residence, may purchase an existing residential dwelling as their home in Australia (FIRB, 2013). Non-residents and short-term visa holders can invest in residential real estate only if the investment adds to the housing stock of Australia (Hundley, 2014, p.2). The Foreign Investment Review Board 2012-13 Annual Report, shows that the reported purchases of existing Australian residential property increased from 647 in 2009-10 to 5,091 in 2012-13, and individual purchases of new dwellings increased from 1,937 to 4,499 (FIRB, 2013, p.29). Anecdotal evidence suggests that Australian real estate agents are marketing directly to Chinese investors through Chinese language publications – particularly in Melbourne (Hundley, 2014, p.5).

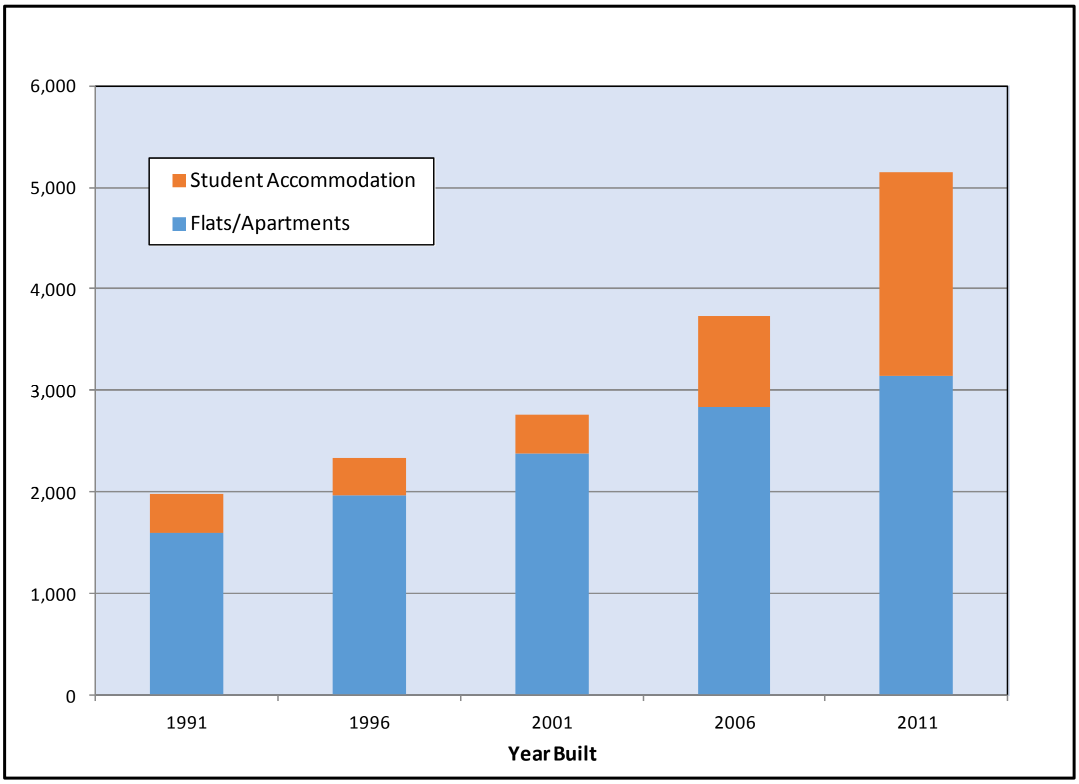
The level of foreign investment in Australian real estate is estimated to be between five and ten per cent of total dwelling turnover (RBA, 2014, p.1). However, this investment is concentrated in new rather than established dwellings, and in higher priced, higher density developments – particularly in the inner city areas of Sydney and Melbourne (RBA, 2014, p.4). The motivation for this foreign investment in residential property appears to be to provide housing for business people temporarily located in Australia, and international students; or to purchase a second residence and geographically diversify private wealth (RBA, 2014, p.5).

In early 2014, the House of Representatives Standing Committee on Economics announced an inquiry into the application of Australia's foreign investment policy on residential real estate. This inquiry is a result of community concerns that foreign investment in Australian real estate is distorting the housing market, and making housing less accessible and affordable (Parliament of Australia, 2014).

5.3.2.1 The Impact of International Students

The rising level of international students in Australia may not translate to an equivalent level of housing demand. The growing availability of student accommodation in large purpose built apartment blocks - generally in the city centre – and the propensity of students to live in shared, rental accommodation will reduce the overall demand for housing by international students (Murray et al., 2011). Figure 5.3 shows the growth in

Figure 5.3: Student Accommodation and Flats/Apartment Development, Local Government Area of Adelaide



Source: Government of South Australia, 2014

student accommodation and in flats/apartments between 1991 and 2011, in the Local Government Area of Adelaide. Although there has been substantial growth in the stock of private flats and apartments over this time, the number of student accommodation dwellings more than doubled between 2006 and 2011, compared with an 11 per cent increase in private accommodation.

5.4 Conclusion

Although unique in their own right, Australian cities share a common history in their development (Forster, 2004). Because Australia's major cities were influenced by the same world events, the same advances in technology and the same social and economic upheavals, their development pathways have been similar. Australia's urban populations are continuing to expand. International migration, and the perceived future need for labour due to retiring baby boomers, will likely see this trend continue. This will maintain the pressure on Australia's cities and on changing urban form.

The Great Australian Dream of owning a home is still entrenched, but may be faltering due to increasing real values of properties. But this trend may also be due to changing lifestyle expectations (National Housing Supply Council, 2013, p.41) that may affect the ability to save for a deposit and to service a housing loan; or may lead to a decision to remain renting in a lifestyle location that is unaffordable for purchase. The impact of this changing tenure on where people will choose to live will unfold over coming decades.

With the falling percentage of South Australia's population 65 years and over living in flats or apartments, and with future population growth in the City of Adelaide currently reliant on continued international student growth, planned increases in higher density living in metropolitan Adelaide, may be difficult to achieve.

Changes in social attitudes; changing economic conditions; and looming environmental threats will all play a part in the future development pathways of Australia's cities. The potential urban form outcomes that may result from these forces and development pathways, is the subject of Chapter six.

Chapter 6 Urban Form

One of the central aims of this study is to develop a conceptual framework to better understand urban form and its place in local area population projection practice. This Chapter considers the relevance of urban form to this study before discussing the current urban form of the study area – Greater Metropolitan Adelaide. An intrinsic element of the conceptual framework developed in this study is the characterisation of urban form – firstly as typologies of development and then as clearly defined urban form scenarios. These scenarios are used in the framework to guide the assumptions for future urban growth within the population projection model, and to ultimately guide the distribution of population projection outcomes.

6.1 What is Urban Form and why is it Relevant?

At a physical level urban form can be considered to be the physical structure of urban space. This may include the many urban patterns formed by the built environment on the ground, as well as the intensity of this built environment encompassing the density and height of urban development (Troy, 2004). But the physical structure of urban form is little more than the result of countless interactions between individuals, organisations, institutions and public bodies regarding the organisation of urban space. At a more fundamental level, urban form is the manifestation of the relationship between society and its built environment (Gleeson et al., 2004, p.2).

Troy (2004, p.1) considers the issue of relationships within the built environment by distinguishing between urban form and urban structure and defines urban structure as:

> "… the spatial relationships between cities and their services and activities … whether the activities are arranged in linear relationships and are highly centralised … or whether the city is structured as an interconnected set of nodes" Troy (2004, p.1).

Troy (2004, p.1) contrasts the spatial relationships within urban structure with urban form which is defined as "… the nature or density of development". This distinction is useful in that it introduces the concept of scale. Urban structure relates to the broader metropolitan scale and how the built environment is both structured and related over urban space. Urban form relates to the more local scale and the intensity of development at this local scale. More fundamentally however, is the idea that a relationship exists between the physical dimension of urban space and the activities and services that occur within that space.

Gleeson et al. (2004, p.2) take the concept of urban form a step further remarking that "[t]he socio-physical structure of urban space has re-emerged as key in the metropolitan response to growing infrastructure pressures manifest particularly in congestion and pollution." This comment both emphasises the relationship between society and urban form and – more importantly – identifies urban form as the primary means of addressing two community issues – congestion and pollution. This then makes the concept of urban form a planning policy instrument that can be used to proactively address relevant societal issues; and to engineer desired social, economic and environmental outcomes.

For the purposes of this study, urban form is considered in terms of Gleeson's et al. (2004) concept of the socio-physical structure of urban space, with an emphasis on the relationship between spatial form, social and economic activity and household level outcomes – particularly with regard to residential location. As previously stated, Troy's (2004) distinction between urban structure and urban form is important as it highlights the issue of scale. The local scale considers the notion of density and potentially the relationship between density and lifestyle; and the urban scale considers the relationship between a household and its broader activity space[42] which includes journeys to work, study, shopping and entertainment.

Fundamentally, the consideration of urban form in this study relates to its direct relationship with where people live. Assumptions regarding the nature of future urban form will directly impact on local area population projection outcomes. An assumption that urban form will become more centralised with increasing residential density will produce population projections that are vastly different to an assumption of ever increasing urban sprawl.

6.1.1 Greater Metropolitan Adelaide's Current Urban Form

Troy (2004, p.1) remarks that all major cities in Australia are low density in character; although some city centres have recently experienced higher density development. Greater Metropolitan Adelaide is no exception with an average population density of less than 600 people per square kilometre; with recent increases in density in the City centre and several coastal suburbs (Sivam et al., 2012, p.479).

---

[42] Activity space is a concept developed to aid in defining, describing and understanding human activity patterns (Rai 2007; Olaru 2005). The concept of activity space implies both *actual* movement – the activity; and a constraint to that movement – the space in which the activity occurs.

Given that many cities are a product of historical accident (Ashton, 1993; Powell, 2012), it is relevant to briefly consider Adelaide's historical development. In their text *Adelaide: A Brief History,* Gargett and Marsden, 1996 comment that:

> "[Adelaide] City's heritage reflects Adelaide's varied roles in Colonial and State history, as well as the sequences of land use, building construction, and social and economic pursuits since the first year of formal British settlement in South Australia. Indeed, the built environment mirrors all of the major historical forces which have helped to shape South Australia".

Settled by Europeans in 1836, Adelaide began its life as a planned city of free settlers (Bunker, 1985, p.307) – in contrast to many of its sister capital cities that have a history of convict settlement (Hughes, 1988). The capital city of Adelaide was laid out by Colonel William Light, the first Surveyor-General of South Australia (Dutton and Elder, 1991). The City has a distinct north-south and east-west grid system consisting of wide roads that run the length and breadth of the City. One of the enduring elements of Light's design is a series of parklands generally 600 metres in depth that surround the City and are more than 900 hectares in area (McDougall and Vines, 2006, p.2).

Radiating from the City are arterial roads that connect what were surrounding villages including the major coastal township of Glenelg and Adelaide's main port of Port Adelaide – although few of these roads were included in Light's plan (McDougall and Vines, 2006, p.55). Post war immigration was at its peak during the 1950s, 1960s and early 1970s with the 'Long-Boom' driven by manufacturing in Australia's major cities (Hugo, 2011). The satellite town of Elizabeth in Adelaide's northern suburbs – named after Queen Elizabeth II - was developed during this time as a major manufacturing hub centred around the General Motors-Holden's Ltd car plant and the Long Range Weapons Establishment (now the Defence Science and Technology Organisation) (Forster, 1974, p.31). Government provided housing helped promote this area to United Kingdom and European migrants looking for a better life in Australia – although the social and economic fortunes of Elizabeth have suffered since the 1970s (Forster, 1974, p.32).

A car dominant culture along with abundant land saw the development of fringe suburbs to the north and south of Adelaide (Bunker, 1985, p.310) – constrained by the coast to the west and hills to the east. Over time, many of these outer suburbs have been subsumed by ever increasing population growth and suburban development (Forster, 2006).

The current development of Greater Metropolitan Adelaide is in a state of flux. Historically high population growth driven by skilled migration and overseas students, and falling household size due to changing societal norms and an ageing population, led to significant growth in the demand for housing – peaking in 2008/2009 at approximately 20,000 per year. Since this time, international migration to South Australia has declined - although it is still at a comparatively high level - and the demand for housing has fallen dramatically (Housing Industry Prospects Forum, 2012). If population growth continues Greater Metropolitan Adelaide will either continue to sprawl to the north and the south, or it will need to adopt a higher density model of urban development – encapsulated by the concepts of New Urbanism and Smart Growth[43] that are foreign to most living in a city dominated by single storey detached dwellings on an individual block of land (Government of South Australia, 2010b).

6.2 Characterisation of Urban Form

To operationalise the concept of urban form within a population projection framework requires that the various manifestations of urban form are characterised and classified to identify their key elements and clear differences. So, how can urban form be characterised and classified, and what is the relationship between different characterisations of urban form, the lifestyle attributes that each may offer, and the demography that may either be attracted or opposed to such urban form?

Marion and Horner (2008) use a classification scheme based on the mix of jobs and population to describe urban activity and its relationship to the structure of urban form. This generalised scheme provides one possible approach to the classification of urban form. The term urban activity is used in this scheme to imply the intensity of the socio-physical relationship between society and its built environment. Borrowing from Marion and Horner (2008) the following six classes can be identified:

- Even: an evenness of distribution of urban activity over space at lower intensity
- Centralised: a dominance of urban activity within a central core
- Concentrated: an evenness of distribution of urban activity at a higher intensity
- Polycentric: a mix of different urban activities within a number of activity centres
- Clustered: a concentration of similar urban activity within one or more centres
- Hybrid - a combination of the above.

[43] New Urbanism and Smart Growth are dealt with in Chapter four in relation to the principles adopted by most state government planning agencies in Australia.

The above urban form scheme is useful in that it describes potential spatial configurations of urban form using objective nomenclature and descriptors. But what it fails to do is provide a link between urban form and the more subjective evaluation of potential household preference for any particular urban form; nor does it address the supply-side issues of what type of dwellings developers are willing to provide based on economic fundamentals. This requires a classification scheme that embodies a sense of potential lifestyle for households that may choose to live within that urban form and an economic perspective based on cost differentials and the pursuit of profit.

Newton (2004, p.9) examines six alternative scenarios of future urban form that convey – to a degree - a more experiential notion of potential lifestyle:

- Business as Usual – the extrapolation of current patterns into the future, i.e. laissez-faire, low density, dispersed
- Compact city – increased population and density of inner suburbs
- Edge city – increased population, housing densities and employment at selected nodes within the city, with increased investment in orbital freeways linking the edge cities
- Corridor city – a focus on growth along linear corridors emanating from the Central Business District and supported by upgraded public transport infrastructure
- Fringe city – additional growth predominantly on the fringe of the city
- Ultra city – additional growth predominantly in provincial cities within 100 km of a capital city and linked by high-speed rail transport.

6.2.1 Urban Form Scenarios

The benefit of adopting a scenario approach to population and urban futures is that it overcomes the need to base projections entirely on past trends and provides a method to explore and compare potential futures. Carrington (2007, p.161) explains:

> “Among the large range of forecasting techniques, scenarios are the most complex, eloquent and subtle. They combine the rigour of theory and statistics with the essential flair and imagination necessary [for] the future of multi-faceted issues embracing economy, society, the environment, and international relations. They do this in a structured way to tell multiple credible stories about the subject of investigation. Decision-makers frequently blend scenarios according to their informed judgement to generate hybrid policies guiding preferred outcomes. Used in this way, the power of evidence based scenarios lies only partially in their accuracy; more significant is their capacity to stimulate ideas”.

The complexity, eloquence and subtlety of scenarios provides the mechanism by which urban form can be characterised and incorporated into the conceptual framework developed in this study. Lutz (1996a, p.37) encapsulates this idea in his statement that:

> "The scenario approach, based on assumptions of experts, offers the possibility of seeing the hypothesised impact of unpredictable events, and seems to be the best means for analysing structural change in addition to parameter uncertainty".

Lutz's comment goes to the heart of this study. Urban form scenarios provide the structure by which the panel of experts can evaluate potential structural changes which may be both unpredictable and uncertain. The issue of uncertainty in population projection practice was addressed in Chapter two.

6.2.2 Urban Development Typologies

Urban form is a complex of interrelated structures and relationships within the physical and functional urban space. No single description or typology can capture the myriad patterns of functional urban form that differ and change through time and over space. There are no distinct geographic boundaries between types of urban form and any typology of urban form requires judgement as to the classification system adopted and what urban form is included in each class.

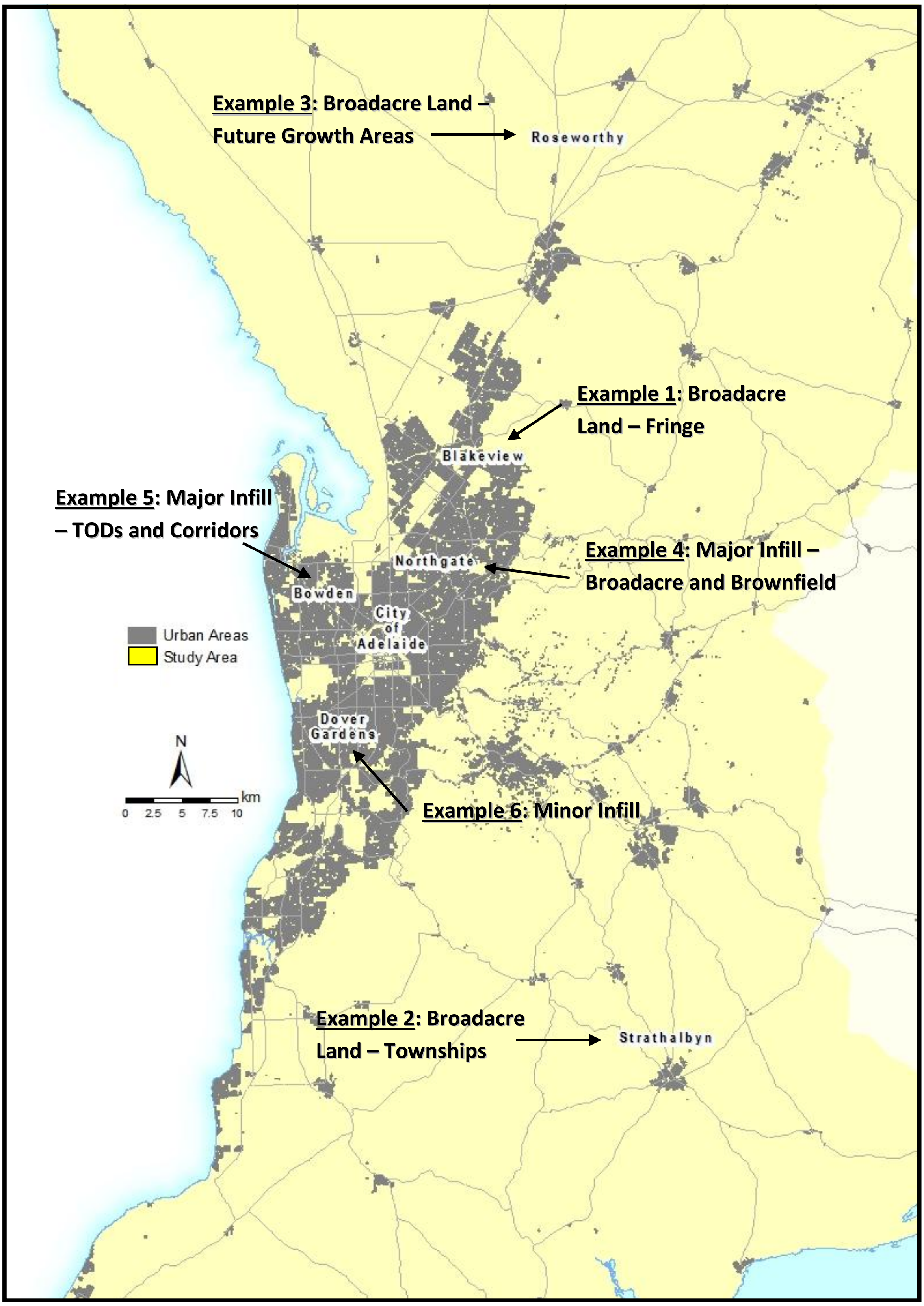
One of the key elements of the framework developed in this study to evaluate the forces that shape future urban form, is the development of a typology of urban form scenarios. These scenarios are utilised in the framework as possible or likely future urban forms resulting from the forces acting within the urban system. The links between each force and urban form scenarios are addressed in Chapter seven.

Notwithstanding the complexity of delineating urban form typologies, the literature review in Chapter four identifies a number of distinct urban forms – some considered desirable and others less so. There is a clear distinction in the literature and in government policy between the concept of increased density and consolidation, and the continuation of what is referred to as "urban sprawl" (Anderson et al., 1996; Myers and Gearin, 2001). The concept of Transit Oriented Development (TODs) and corridor growth is also accepted in the literature and government policy as a distinct type of urban form – one that is contained within designated areas, is medium or high density and contains mixed-use activities. Likewise, urban and natural amenity – although not a specific type of built environment – identify relative locations of urban development in the vicinity of high concentrations of urban amenity or accessible to natural amenity (Graves, 1980; Partridge, 2010).

This Chapter describes five types of urban form that can be identified within the study area for this study. The 30 Year Plan for Greater Adelaide and recent changes to government policy provide the basis for these urban form scenarios; along with the current trajectory of growth in the region (Government of South Australia, 2010a; Government of South Australia, 2010b).

Greater Metropolitan Adelaide in South Australia is used in this study as an example of an expanding city undergoing population increase and urban change. The South Australia government has adopted a planning strategy with a 30 year horizon that includes New Urbanism principles such as increased densification and Transit Oriented Development; as well as controlled growth in designated growth areas on the urban fringe and surrounding townships (Government of South Australia, 2010a). To monitor the progress of the planning strategy the South Australian government has developed a program to estimate the current land availability and dwelling potential within the Greater Adelaide Area known as the Housing and Employment Land Supply Program (Government of South Australia, 2010b, p.8). To aid in this monitoring process six development typologies have been developed based on previous and planned development patterns. A description and an example of each of these development typologies follows (Figures 6.2 to 6.7). Figure 6.1 shows the location of each of the examples within Greater Metropolitan Adelaide.

Figure 6.1: Urban Development Typologies Location Map



Example 1: Broadacre land - fringe

Broadacre fringe growth is a traditional form of urban expansion in the Adelaide Metropolitan Area. This type of development is defined as residential development on land greater than 4000 hectares and occurs on the northern and southern fringes of metropolitan Adelaide. Figure 6.2 identifies an area of proposed urban expansion in the outer northern region of the metropolitan area. The existing urban suburbs of Blakeview and Craigmore are programmed to expand north shown by the dashed box.

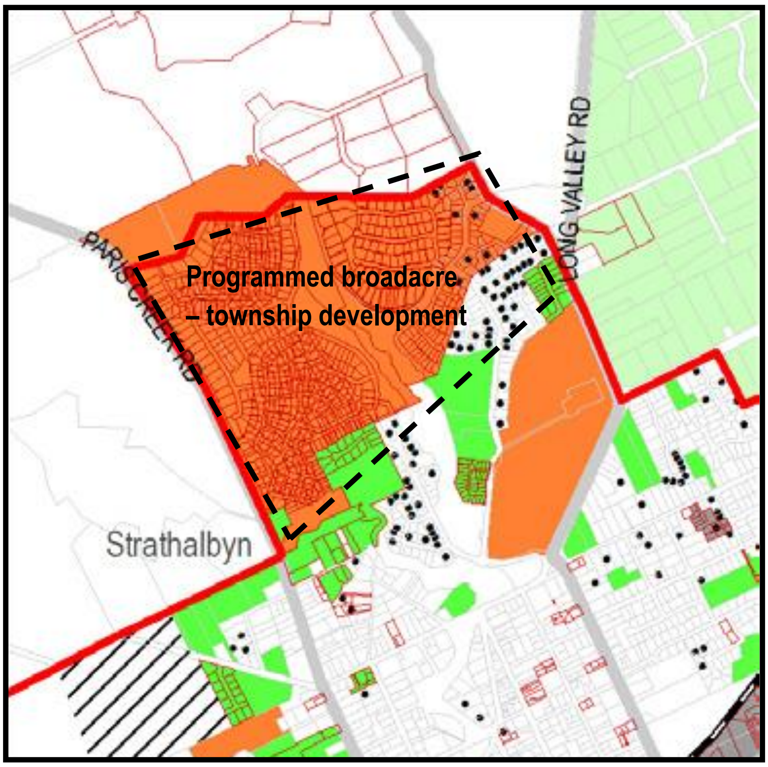
Figure 6.2: Broadacre land – fringe

Source: Government of South Australia, 2010b, Housing and Employment Land Supply Program Report 2010, Greater Adelaide, Department of Planning and Local Government, p.28-29.

Example 2: Broadacre land - townships

'Broadacre land – townships' comprises broadacre land in the towns surrounding metropolitan Adelaide to the north, east and south (Adelaide is bounded by coast to the west). Strathalbyn is a township of 4,000 people approximately 60 kilometres southeast of metropolitan Adelaide. Due to its proximity and natural amenity Strathalbyn has been growing for a number of years. For this reason broadacre township development is programmed to expand the township's dwelling capacity. The area to be expanded is roughly shown by the dashed box in Figure 6.3.

Figure 6.3: Broadacre land – townships

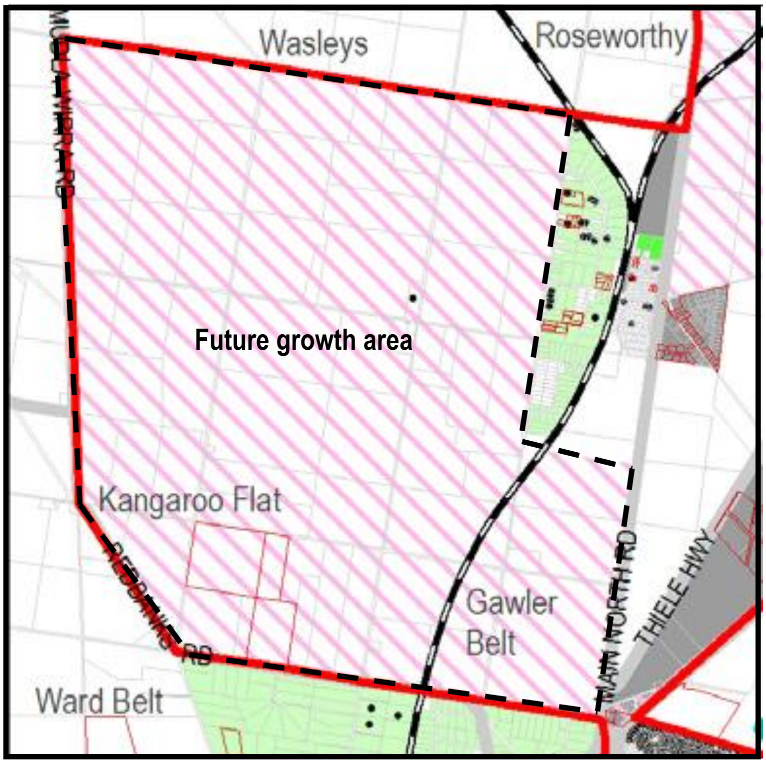


Source: Government of South Australia, 2010b, Housing and Employment Land Supply Program Report 2010, Greater Adelaide, Department of Planning and Local Government, p.28-29.

Example 3: Broadacre land – future growth areas

'Broadacre land – future growth areas' are defined as significant land areas outside of metropolitan Adelaide that may be rezoned for future residential development; these areas are generally north of metropolitan Adelaide. Roseworthy is a small rural township of 700 people approximately 50 kilometres north of metropolitan Adelaide. Roseworthy has been identified in the 30 Year Plan for Greater Adelaide as a major growth area that may eventually house up to 100,000 people (Carr, 2012). The dashed area shown in Figure 6.4 identifies an area of approximately 2,000 hectares that may be developed over the next 30 years with additional expansion to the northeast after this time. The south east corner of this potential development will abut the larger northern township of Gawler.

Figure 6.4: Broadacre land – future growth areas

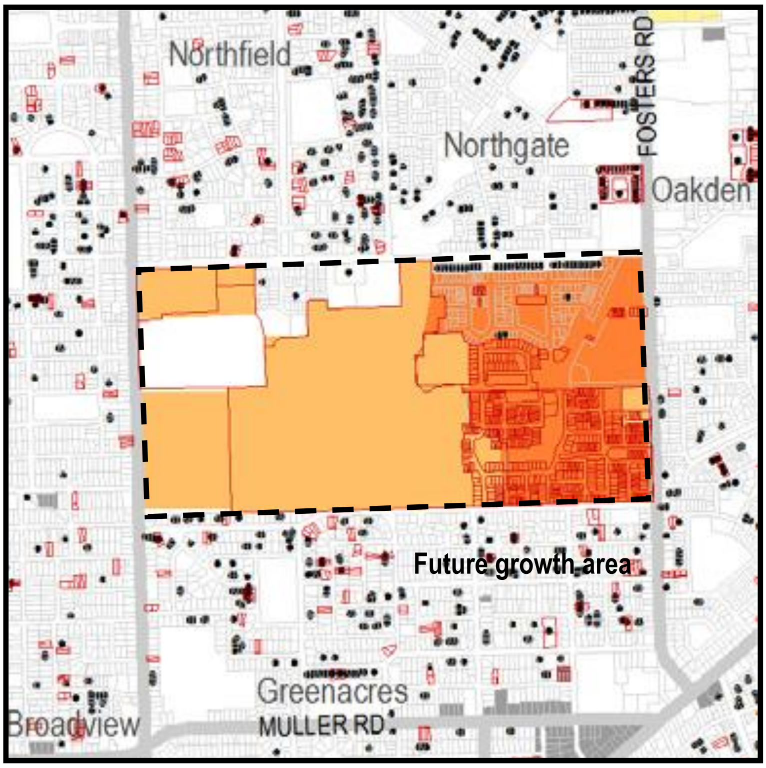


Source: Government of South Australia, 2010b, Housing and Employment Land Supply Program Report 2010, Greater Adelaide, Department of Planning and Local Government, p.28-29.

Example 4: Major infill - broadacre and brownfield sites

‘Major infill – broadacre and brownfield sites’ include all major infill development sites (producing more than 10 dwellings) within the Adelaide metropolitan area. This type of development has been a major source of dwellings for metropolitan Adelaide over the past two decades. Large tracts of industrial or agricultural land and consolidated holdings of public housing that are generally surrounded by or adjacent to existing urban development, is turned over to private residential development. This example identifies an area of previously government owned land approximately eight kilometres from the City centre that is currently being developed into medium density housing. The new suburb is known as Light’s Vision – a reference to Colonel William Light and glimpses of the City. The area of development is shown by the dashed box in Figure 6.5.

Figure 6.5: Major infill – broadacre and brownfield sites

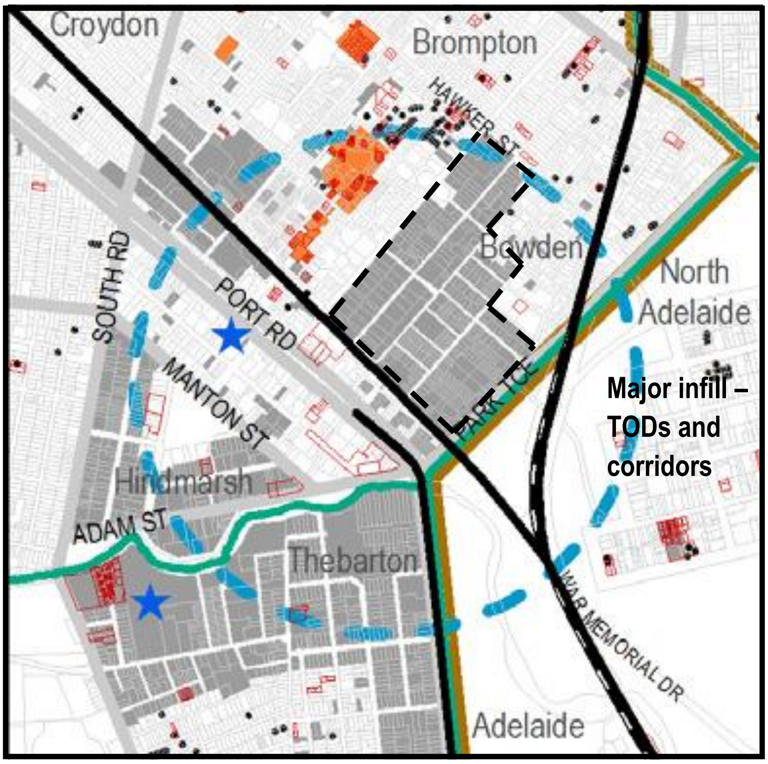


Source: Government of South Australia, 2010b, Housing and Employment Land Supply Program Report 2010, Greater Adelaide, Department of Planning and Local Government, p.28-29.

Example 5: Major infill – TOD and transit corridor development

'Major infill – Transit Oriented Development (TOD) and transit corridor development' are types of urban form included in the 30 Year Plan for Greater Adelaide that describe medium to high density mixed use development at designated locations and along major transport corridors. This style of development is in its formative stage in metropolitan Adelaide. Although there are some 14 TODs and associated corridors identified in the 30 Year Plan for Greater Adelaide (Government of South Australia, 2010a), an industrial area abutting the north eastern parklands surrounding the City of Adelaide known as Bowden is the only tangible example of this new type of proposed development to be in the development pipeline. The proposed Bowden TOD is shown by the dashed box in Figure 6.6.

Figure 6.6: Major infill – TODs and transit corridors

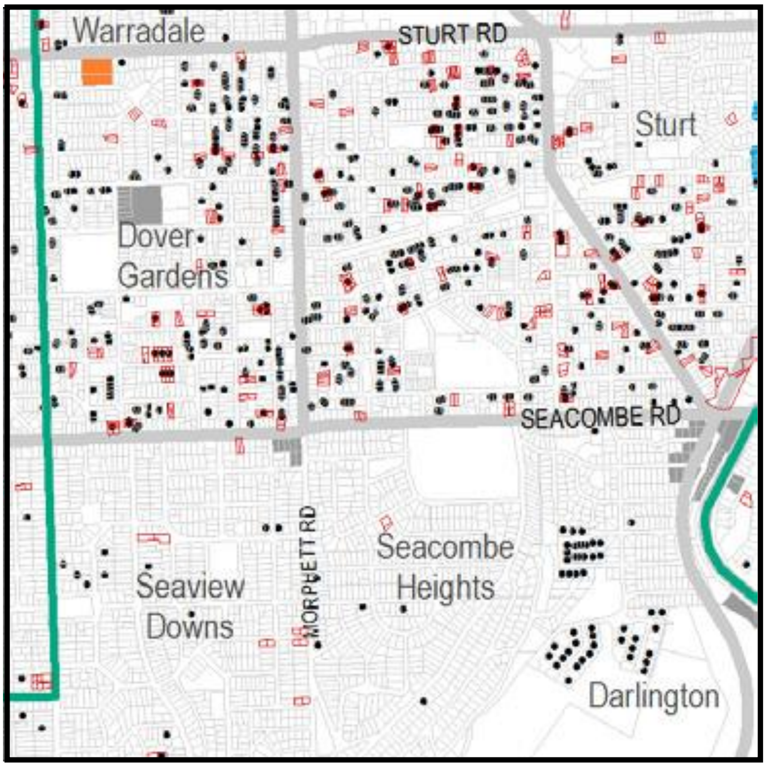


Source: Government of South Australia, 2010b, Housing and Employment Land Supply Program Report 2010, Greater Adelaide, Department of Planning and Local Government, p.28-29.

Example 6: Minor infill

Minor infill - generally a single existing dwelling replaced with two or more residential dwellings - has been occurring in metropolitan Adelaide for several decades but has become more economically viable over the past two decades as many of Adelaide's suburbs developed through the 1950s to 1970s shift to a capital value to site value approaching one – that is, the majority of the value of the property is in the land. For those dwellings in appropriately located development zones it is profitable to demolish a single dwelling, sub-divide the block and build two dwellings. The black dots in Figure 6.7 illustrate dwellings that have been replaced by two or more dwellings over recent years in middle-ring suburbs approximately ten kilometres southwest of the City of Adelaide.

Figure 6.7: Minor infill



Source: Government of South Australia, 2010b, Housing and Employment Land Supply Program Report 2010, Greater Adelaide, Department of Planning and Local Government, p.28-29.

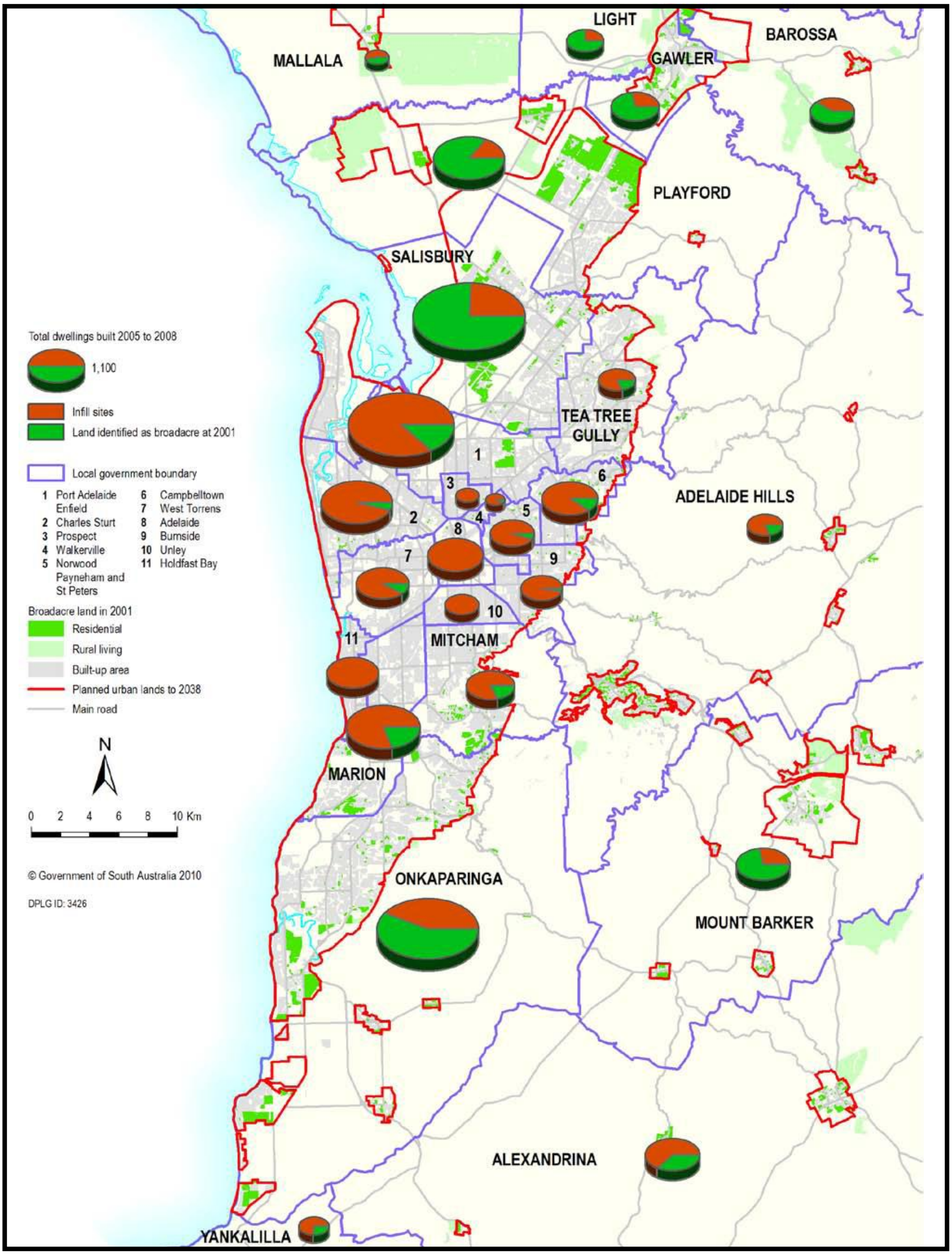
6.2.3 Recent Growth Trends

Over recent years the majority of development activity within the Adelaide region has occurred in areas that would be categorised as broadacre – fringe; broadacre townships; major infill – broadacre and brownfields sites; and minor infill. Minor infill development is widespread across the Adelaide region - particularly within metropolitan Adelaide (Government of South Australia, 2010b). Minor infill development has consistently contributed about one third of Adelaide's dwelling needs with the remainder coming from broadacre and major infill development (Government of South Australia, 2010b). During the period 2006 to 2010, fifty percent of residential development occurred within the three broadacre categories and fifty percent within the three infill categories (Government of South Australia, 2010b). The Adelaide planning strategy has a target of redirecting urban growth to achieve 70 percent development within the three infill categories and 30 percent in broadacre categories over the 30 year period (Government of South Australia, 2010a).

Over the ten year period between 1999 and 2008, 80 per cent of all residential dwelling construction consisted of detached dwellings. The remaining development consisted of semi-detached housing and retirement units with only 4 percent flats and apartments (Government of South Australia, 2010b, p.37).

Figure 6.8 is a summary of development activity by land supply type (infill and greenfield) for local government areas within the Adelaide region between 2005 and 2008. The major share of this development occurred within the metropolitan area with a trend of infill development in the inner metropolitan area; shifting to greenfield development towards the urban fringe. This pattern is a result of the dwindling supply of greenfield land supply in the existing built up areas and rezoning of land from rural to residential toward the fringe. The pattern of development shown in Figure 6.8 illustrates the recent and current growth patterns in Greater Metropolitan Adelaide. If the forces currently shaping urban form were to continue into the future, this trajectory of growth would continue within the constraints of currently available residential land supply.

Figure 6.8: Dwellings built by land supply type, metropolitan Adelaide, 2005 to 2008



Source: Government of South Australia, 2010b, Housing and Employment Land Supply Program Report 2010, Greater Adelaide, Department of Planning and Local Government, p.39.

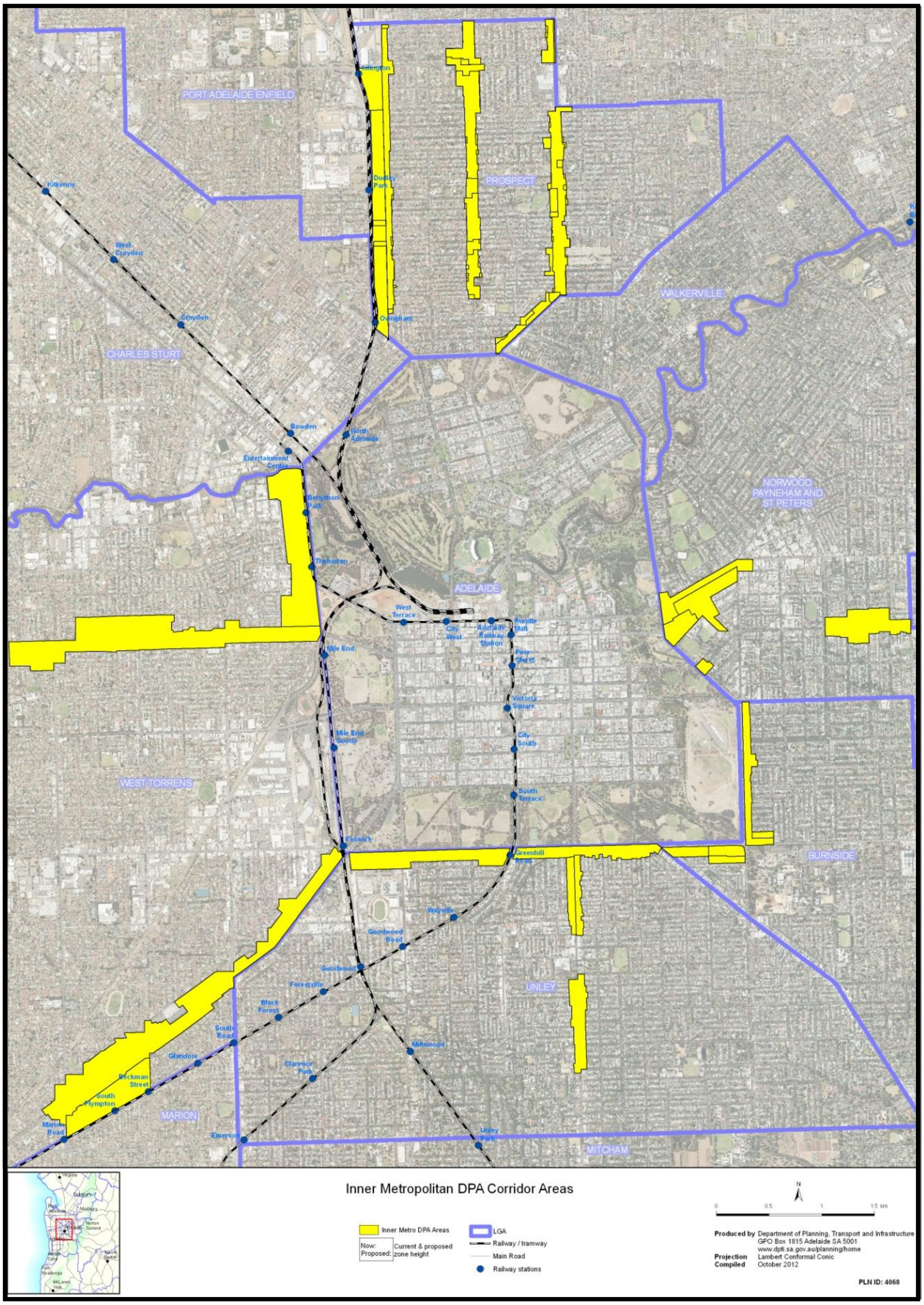
6.2.4 Inner-Rim Growth

In 2012 the Government of South Australia announced an additional strategy for residential development that focused on the City of Adelaide – effectively one square mile comprised of the Central Business District with one and two bedroom high-rise apartments; recent medium density townhouse developments particularly in the southeast corner of the City; and low density and low quality housing within most of the City square mile (Government of South Australia, 2012a).

The Government of South Australia has a target to increase the number of people living in the City of Adelaide from 20,000 to 75,000 over the next 30 years. The Capital City Development Plan Amendment approved in 2012 has changed the allowable building heights to provide the potential for targeted growth (Government of South Australia, 2012b). Building heights have been substantially increased for much of the City square mile.

An early implementation strategy for the 30 Year Plan for Greater Adelaide is in the form of an Inner-Rim Growth Project that comprises planning instruments that will potentially result in uplift in suburbs adjacent to the City of Adelaide (Government of South Australia, 2012b). Figure 6.9 highlights in yellow the areas for potential uplift adjacent to and radiating along major arterial roads from the City of Adelaide. If successful, this policy will result in multi-storey apartment blocks around the City fringe, significantly increasing the number and density of population around the City.

Figure 6.9: Potential Residential Development in Inner-rim Suburbs of Adelaide



Source: Government of South Australia, 2012(b)

6.3 Urban Form Scenarios in this Study

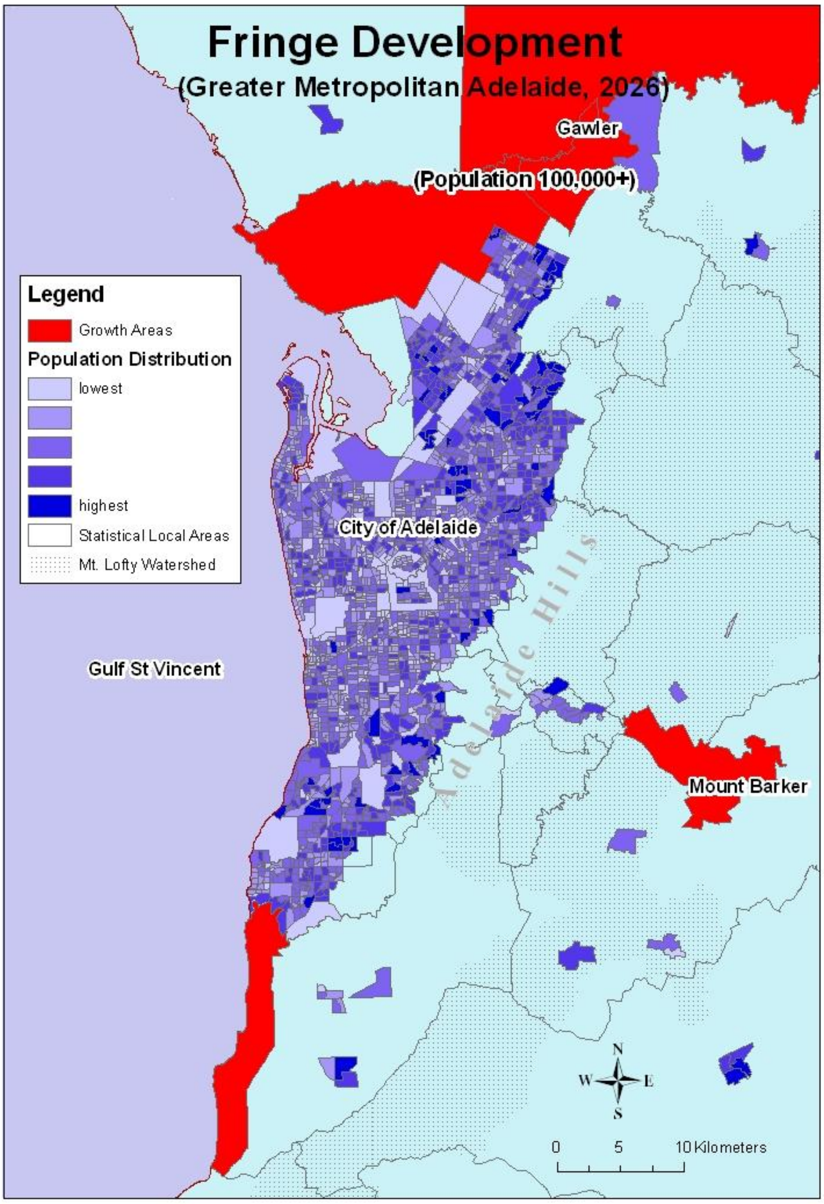
The six urban development typologies identified above, along with recent development trends and the focus on the City of Adelaide and adjacent suburbs, provide a basis for developing urban form scenarios for Greater Metropolitan Adelaide.

For the purposes of this study, the three broadacre categories are collapsed into a single category representing outward urban growth on the fringe and continuation of urban sprawl. Although major infill of broadacre and brownfield sites and minor infill are two separate processes operating at different scales, both processes result in a continuation of increased densification within the inner metropolitan region. This infill activity is a process that has been occurring over the past two decades which differentiates this activity from planned infill in TODs and transit corridors which at this stage is conceptual and unproven in Greater Metropolitan Adelaide. For this reason TODs and corridor growth is retained as a separate development category. The focus on inner-City development is a departure from traditional increased densification as it is concentrated within the square mile of the City of Adelaide and adjacent suburbs, and aims to facilitate significantly higher densities across and around the City. This city-centric development – which includes uplift in adjacent suburbs - is considered as a separate category. Finally, recent development trends in both location and type of dwellings along with the necessary drift toward future broadacre development opportunities in the outer parts of metropolitan Adelaide – particularly to the north – provides a development scenario for Business as Usual.

Based on the above evaluation, five urban form scenarios are adopted in this study. These scenarios are illustrated in Figures 6.10 to 6.14. These highly stylised maps are included in the expert panel questionnaire used within the modified argument-based approach to elicit responses from the expert panel – discussed in Chapter three. The maps provide the panel with a visual depiction of the five potential outcomes for future urban form to which the panel can respond. Major growth areas are shaded red.

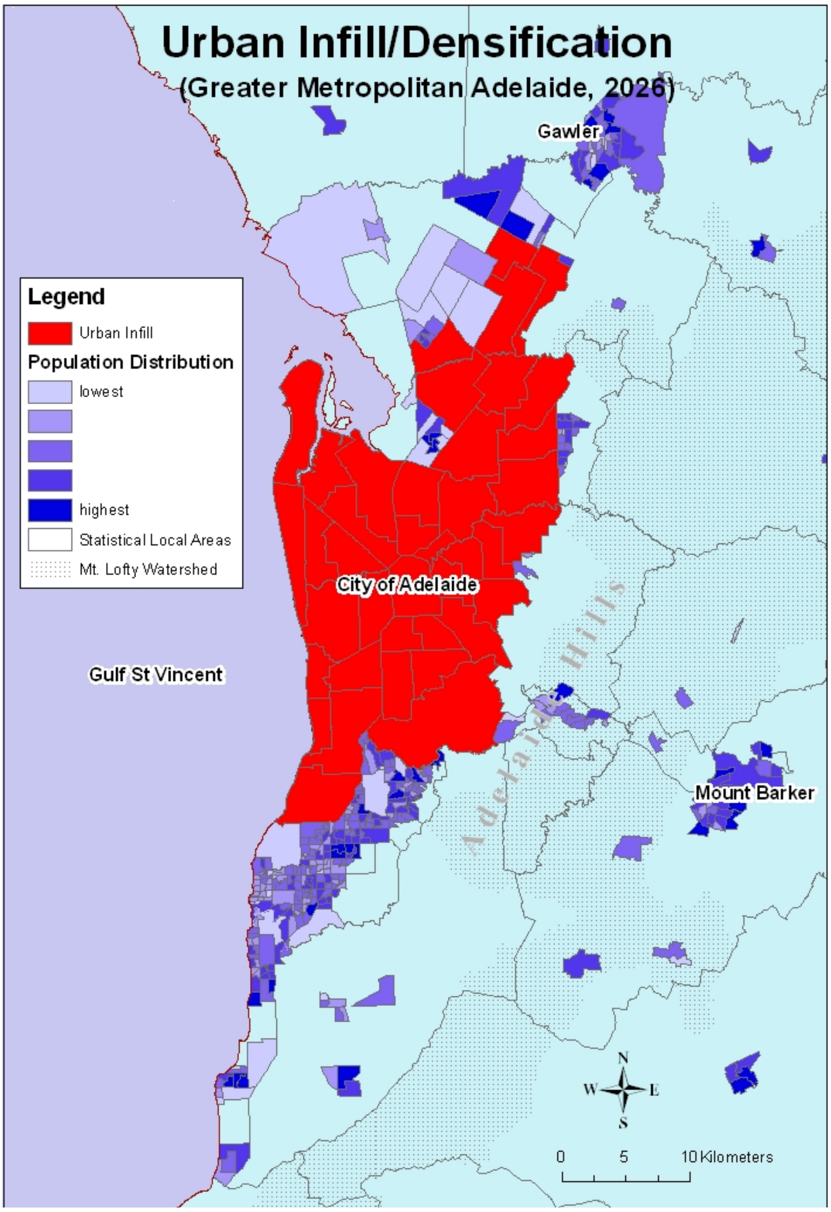
Scenario 1: Fringe Growth (see Figure 6.10) – low density, detached dwellings in the outer metropolitan and peri-urban regions. Fringe growth is concentrated in the north – this aligns with the identification of growth areas in the 30 Year Plan for Greater Adelaide (Government of South Australia, 2010a). Fringe growth can also occur in a strip at the southern end of metropolitan Adelaide but is constrained by restrictions on urban development in the grape growing region of McLaren Vale (Government of South Australia, 2013a). Significant growth is also occurring in the township of Mount Barker which has access to the City of Adelaide via a major freeway.

Figure 6.10: Fringe Development Scenario, 2026



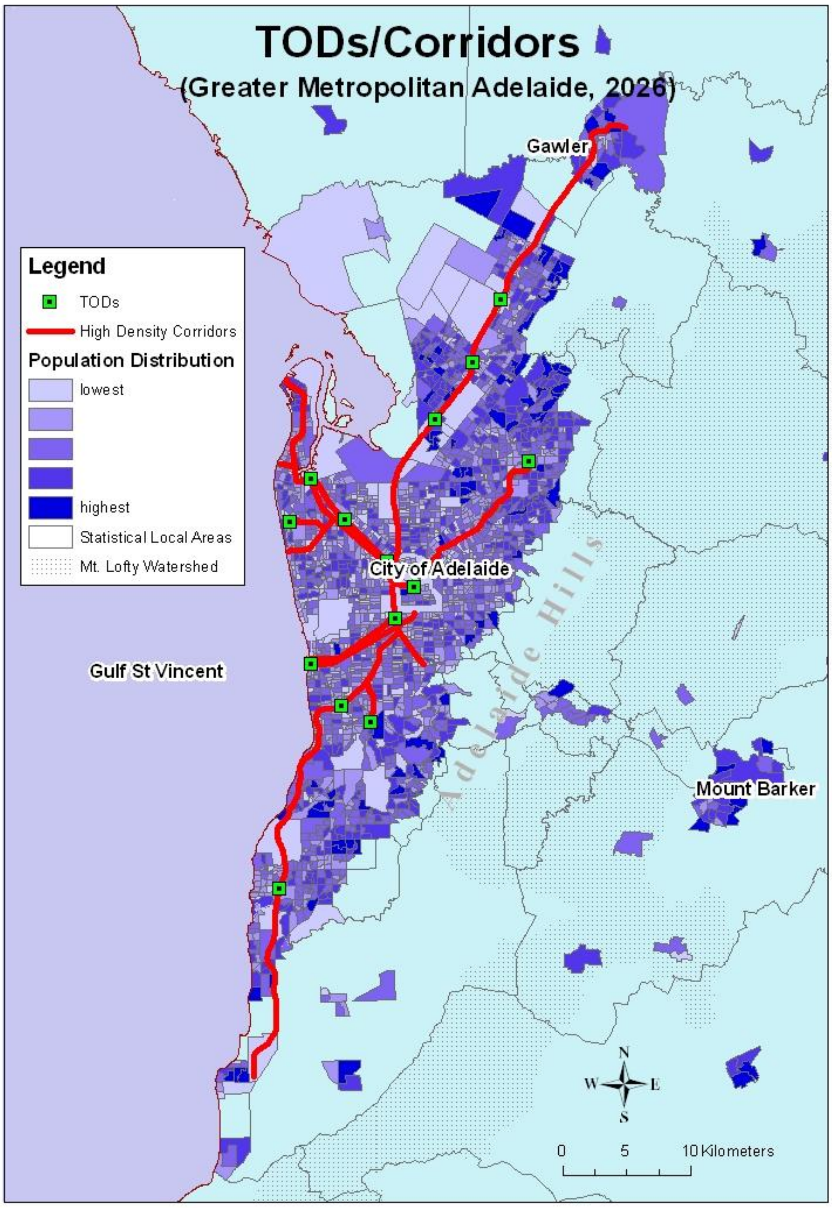
Scenario 2: Urban Infill (see Figure 6.11) – medium density development in the inner metropolitan area. Urban infill has been a major contributor to residential development in metropolitan Adelaide over the past two decades (Government of South Australia, 2010b). The major types of infill are: minor infill usually comprising a single dwelling replaced by two detached or semi-detached dwellings; brownfield development on land rezoned from non-residential to residential; the replacement of public housing for private dwellings; and conversion of government owned land to residential. This scenario assumes that minor infill and brownfield conversion continues, leading to increased densification of metropolitan Adelaide. Government efforts to facilitate TODs and corridor growth, and peri-urban township growth are less successful. Under this scenario, fringe growth is halted or at least delayed.

Figure 6.11: Urban Infill Scenario, 2026



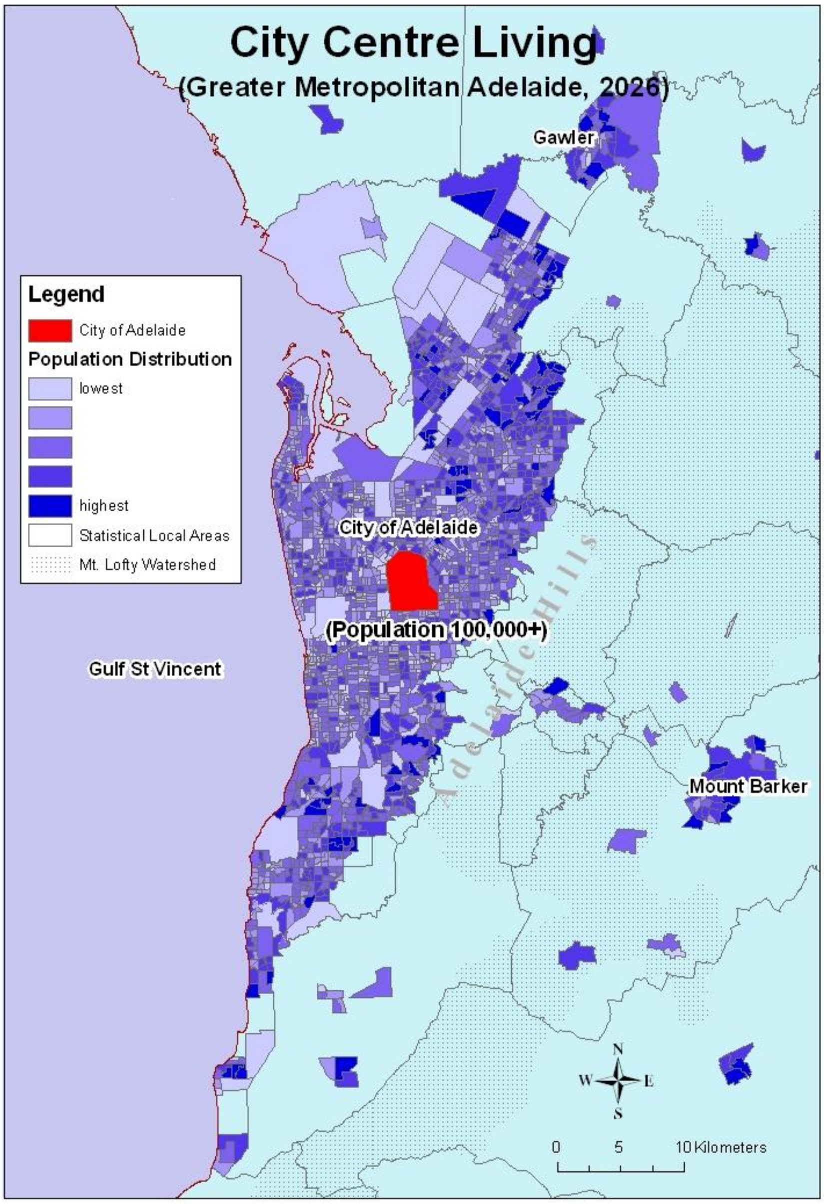
Scenario 3: TODs and Corridor Development (see Figure 6.12) – medium and high density development along designated transit corridors within the metropolitan area. The TODs and corridor scenario assumes that government policies directing growth toward service hubs and along major transit corridors is successful. Minor infill, fringe and surrounding townships grow but to a lesser extent than Business as Usual.

Figure 6.12: TODs/corridors Scenario, 2026



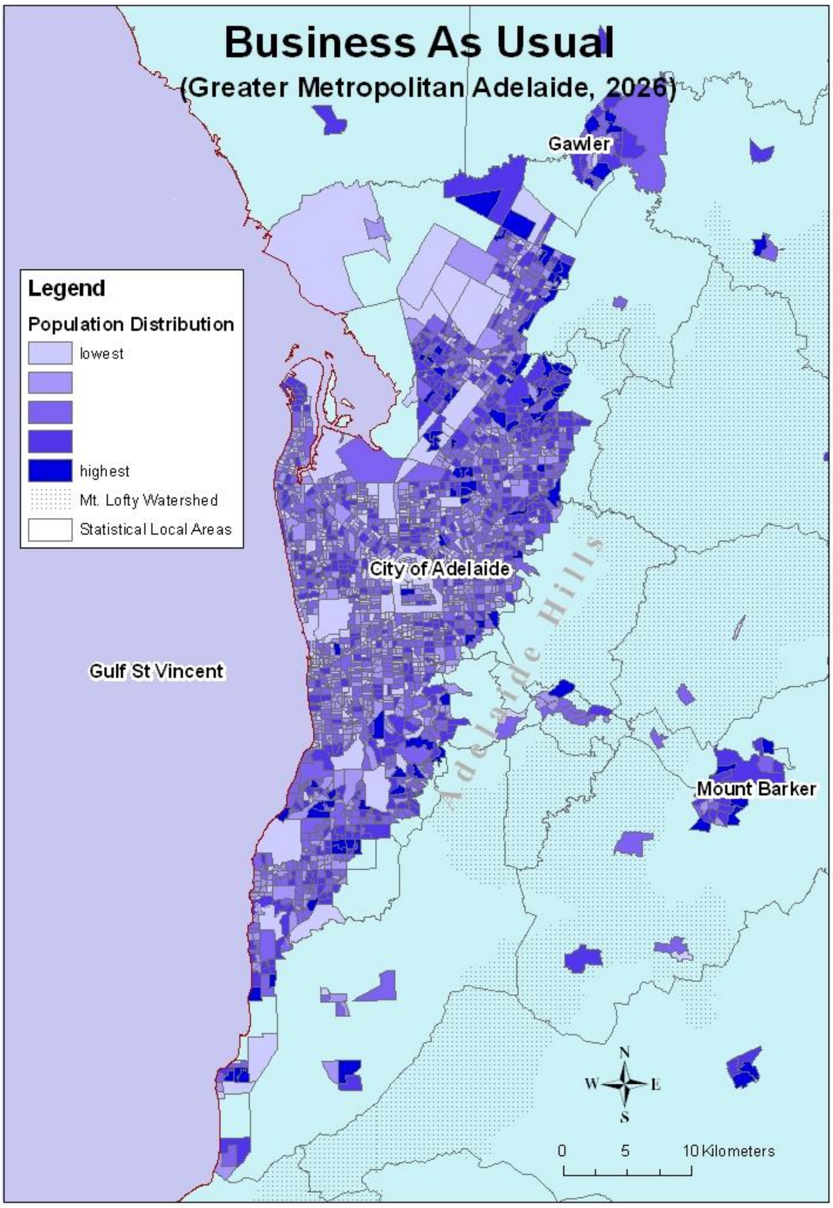
Scenario 4: City-Centric Living (see Figure 6.13) - high density development within the City square mile and adjacent suburbs. City-centric living assumes a dramatic increase in the number of people living in the City centre drawing growth away from other forms of development. Due to recent government policy changes (Government of South Australia, 2012a) this scenario has been altered to include high density development in adjacent city suburbs. This alteration serves to emphasise city-centric growth – essentially centralisation rather than dispersal of the population.

Figure 6.13: City-Centric Living Scenario, 2026



Scenario 5: Business as Usual (see Figure 6.14) The Business as Usual population projection scenario assumes a continuation of recent development trends. Fundamentally, this consists of continued minor infill and fringe growth; along with development of peri-urban townships. The City of Adelaide experiences some growth but TODs and corridor growth does not occur.

Figure 6.14: Business as Usual Scenario, 2026



6.4 Population Outcomes for Urban Form Scenarios

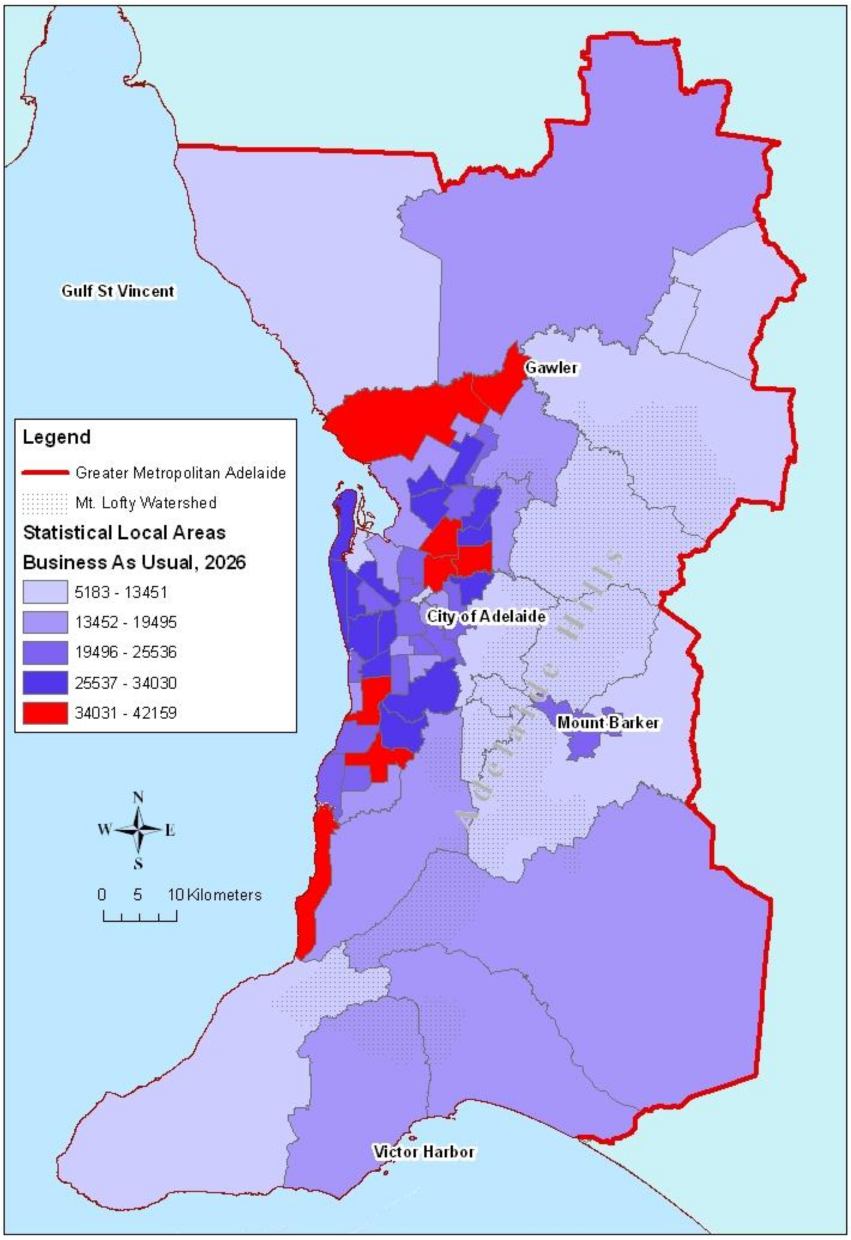
The five stylised scenarios for urban form presented to the expert panel (Figures 6.10 to 6.14) are useful for visualising the concepts that underpin each scenario. But these scenarios do not illustrate the population distributions that would result from a population projection for Statistical Local Areas (SLAs)[44] for each urban form scenario. The Urban Infill scenario for example suggests a uniform densification throughout the central metropolitan area. This is of course unrealistic and the result of general infill will be selective with some local areas increasing in density where other local areas will remain relatively unchanged. One of the reasons for this variability in densification will be local zoning with minimum block sizes prohibiting subdivision or multistorey development. Other reasons include the value of the underlying land compared with the improvements on that land – the capital value to site value ratio; the desirability of the area which may include socio-economic undesirability or lack of amenity; and of particular relevance in metropolitan Adelaide's leafy and affluent eastern suburbs, resistance from the local community to change.

To illustrate the population outcomes associated with each of the five urban form scenarios Figures 6.15 to 6.19 provide the outcomes of local area population projections that have used dwelling distribution assumptions developed around the urban form concepts embodied in each scenario. Total populations and total dwellings are the same in each scenario and it is only the distribution that differs between scenarios. As discussed in Chapter two, the SASPPS cohort component model is used to produce population projections for SLAs; and the HAM model is used to produce dwelling distributions which constrain the SLA population projections. The land availability and dwelling potential assumptions provided to the HAM model for each urban form scenario is based on the principles of that scenario. For example, the TODs and corridor scenario is provided with land availability and dwelling potential in the 14 TODS and along corridors identified in the 30 Year Plan for Greater Adelaide for future medium to high density development.

Figure 6.15 illustrates the population outcome under the Business as Usual scenario. Areas of major growth occur in those areas that have currently zoned and available land capacity for additional growth; and those areas that are likely to increase due to minor infill. Fringe locations to the north and south of metropolitan Adelaide receive little additional growth as they are at this time not zoned for residential development.

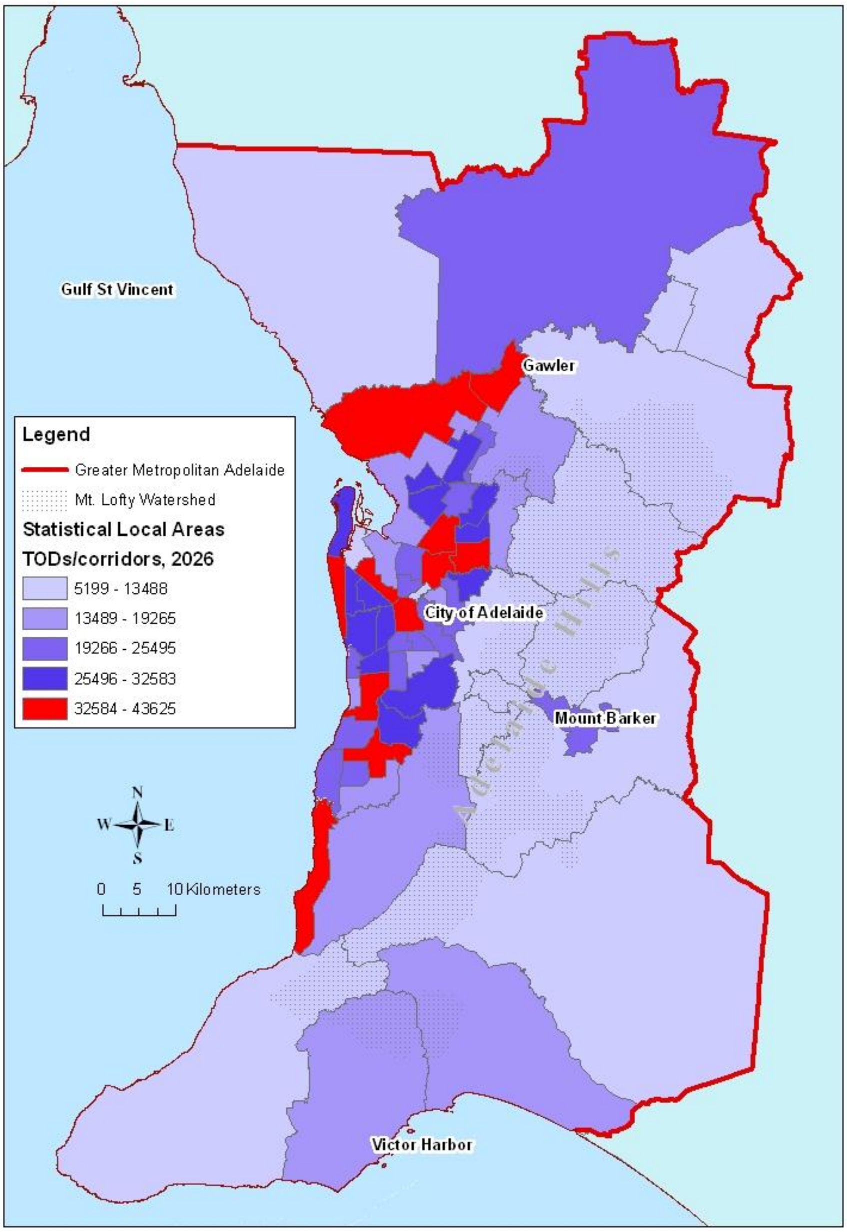
[44] SLAs are part of the previous ABS statistical geography as discussed in Chapter two.

Figure 6.15: Business as Usual Scenario, Total Population, 2026



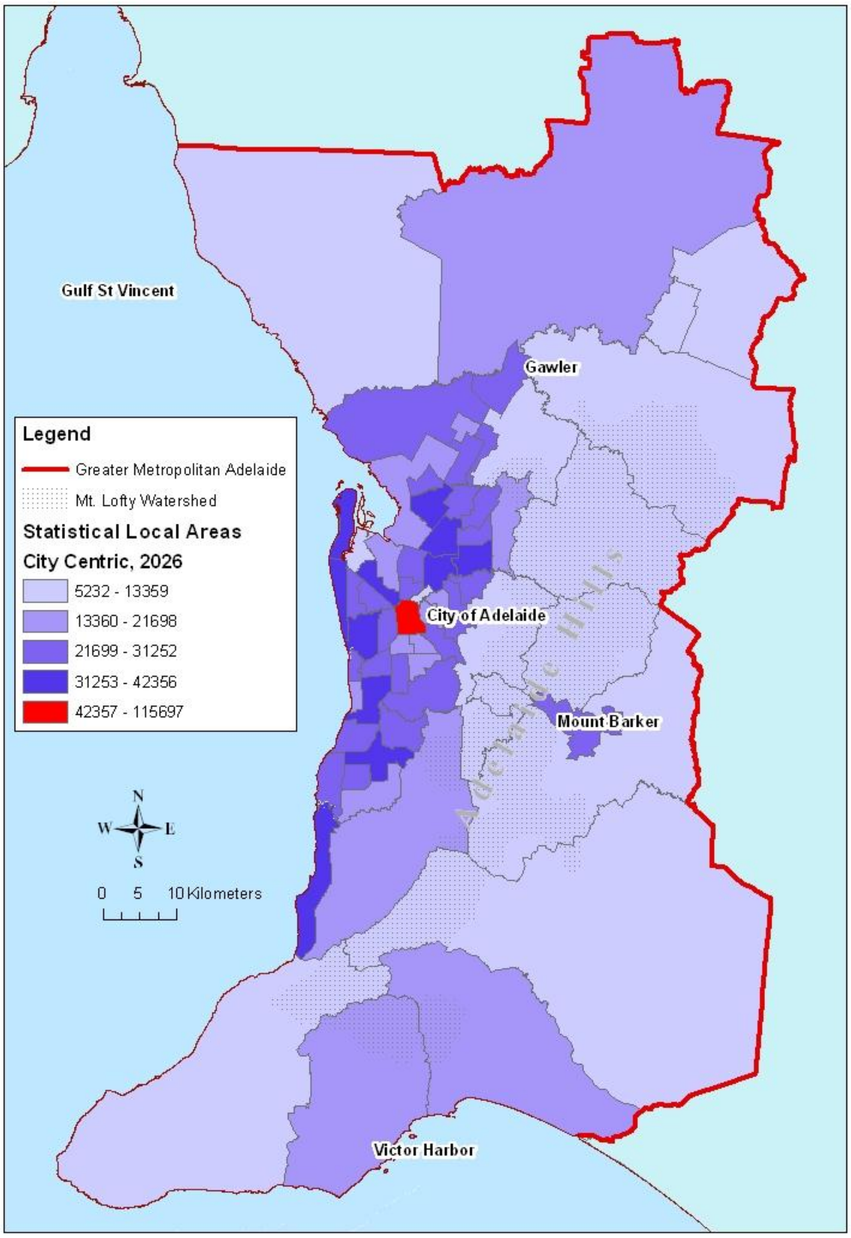
By comparison, the TODs/Corridor scenario in Figure 6.16 displays much greater growth in the City of Adelaide and within the corridor to the northwest from the City to the coast. This corridor has been identified as a priority growth area within the 30 Year Plan for Greater Adelaide (Government of South Australia, 2010a). The City of Adelaide is included in this scenario as it can be considered to be Greater Metropolitan Adelaide's only existing TOD given that almost all public transport radiates from the City; it contains the greatest concentration of jobs; it has gained momentum in terms of higher density living; and has almost limitless potential for multistorey development – notwithstanding political and institutional resistance to such growth. Fringe growth in the northern suburbs of metropolitan Adelaide continues as this area has existing momentum and capacity to provide significant traditional detached housing at affordable prices (Government of South Australia, 2010a).

Figure 6.16: TODs/corridors Scenario, Total Population, 2026



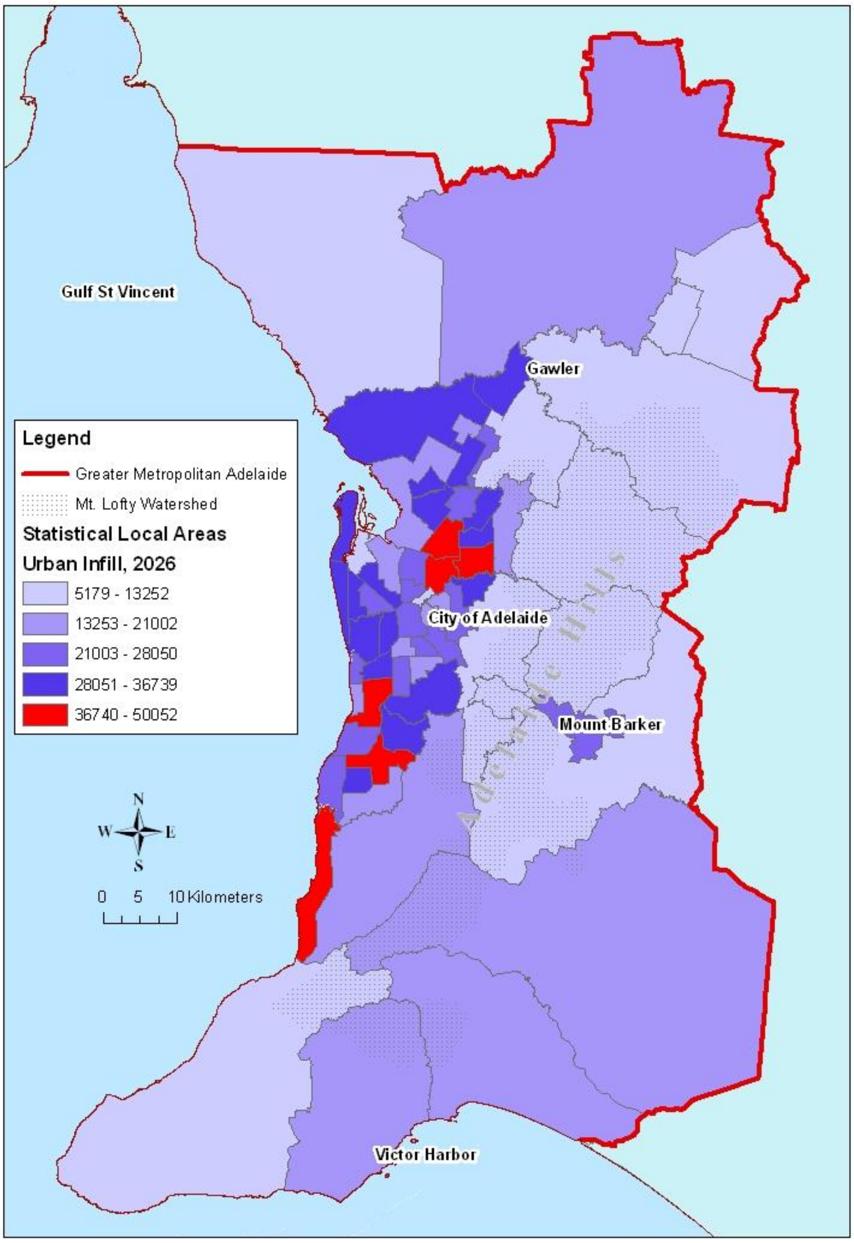
The City-centric scenario in Figure 6.17 downplays growth in other areas of Greater Metropolitan Adelaide except for suburbs adjacent to the City of Adelaide. This scenario depends very much on the extent of overall population growth in Greater Metropolitan Adelaide. Given the restricted area of the City and surrounding suburbs and the likely continued demand for detached and semi-detached dwellings, there is an upper limit of infill and therefore population increase that could occur in these areas. Therefore, this scenario also assumes strong growth in SLAs other than the City.

Figure 6.17: City-Centric Scenario, Total Population, 2026



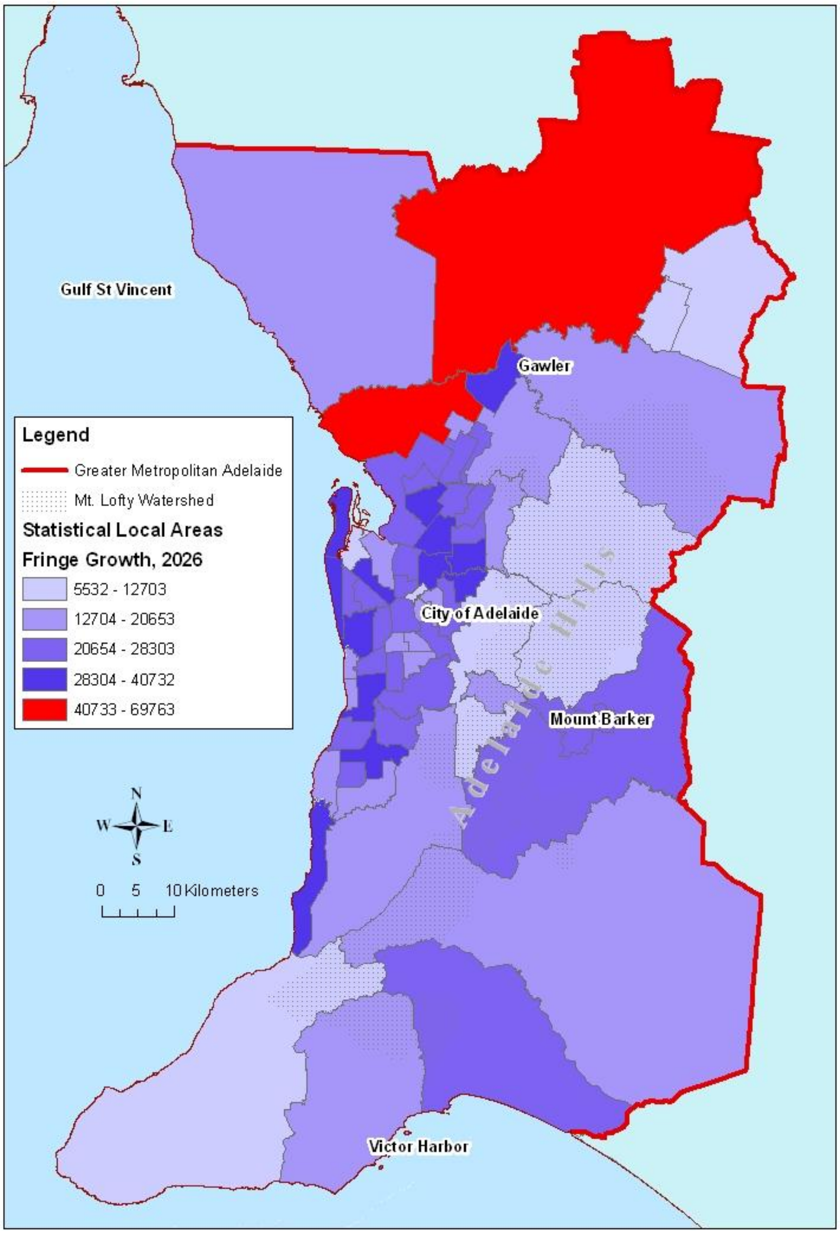
The Urban Infill scenario in Figure 6.18 highlights those areas that have the potential to increase population density through general infill – typically two dwellings replacing one. Those areas to the north and south of metropolitan Adelaide that have high growth are new developments and not due to infill. These fringe growth areas illustrate the limitations of general infill to absorb a rapidly growing population.

Figure 6.18: Urban Infill Scenario, Total Population, 2026



The dominance of growth on the northern fringe in Figure 6.19 illustrates a continuation of the past trend of urban sprawl in Greater Metropolitan Adelaide. Under this scenario developers continue producing detached, single storey dwellings on greenfield sites putting pressure on the State government to rezone these areas for residential use. The areas in the north of Greater Metropolitan Adelaide have been identified in the 30 Year Plan for Greater Adelaide as areas for future residential development (Government of South Australia, 2010a). The population growth to the north would occur adjacent to the township of Gawler.

Figure 6.19: Fringe Growth Scenario, Total Population, 2026



6.5 Conclusion

This Chapter forms an important element of the conceptual framework presented in Chapter one. Urban form scenarios are necessary to encapsulate possible urban futures from the "... multiplicity of plausible development pathways ..." (IPCC, 2007, p.700). Distilling the essence of contradistinctive development pathways, enables the evaluation of plausible urban form scenarios using the modified argument-based approach. The application of this approach is the subject of the next Chapter.

Chapter 7 Applying the Modified Argument-Based Approach

This Chapter describes the application of the modified argument-based approach in the context of the conceptual framework developed in this study. The arguments relevant to the five urban form scenarios and used in the expert questionnaire are presented. An argument-force matrix and tables of arguments supporting or negating each urban form scenario are then generated as discussed in Chapter three.

The major forces are then linked to the five urban form scenarios developed in Chapter six. This step enables the results of the modified argument-based approach to be weighted by the panel members' opinions of the importance of each force as discussed in Chapter three.

7.1 Developing the Arguments

To rephrase Rittel and Webber's (1973, p.162) thoughts on understanding the wicked problem of the city system, the wicked problem of developing local area population projection assumptions needs to be based on an argumentative process in the course of which an image of the problem, and of the solution, emerges from the participants of the process, as a product of judgement, subjected to critical argument.

The four pillars of economics, government policy, environmental constraints and lifestyle preferences, and the review of the literature on the relevance of these four pillars to residential location choice and urban form, provide the foundation for developing the arguments required for the argument-based approach. These arguments need to capture *elements* of the issues raised in the literature to be included in an expert panel questionnaire, as discussed in Chapter three. The responses of the panel of experts will ultimately determine the relevance and impact of each argument on future urban form. The structured approach in the modified argument-based approach of combining and evaluating the responses of the panel of experts provides the mechanism, whereby Rittel and Webber's *image* of the problem and the solution emerge. This image is ultimately a product of the judgement of the panel of experts, subjected to the critical evaluation of the projection practitioner.

7.1.1 Guiding Principles

The arguments relevant to future urban form have been developed here, with reference to the cross-disciplinary literature review in Chapter four, and the five urban form scenarios developed in Chapter six. The principles underpinning these arguments are:

1. Arguments must be contestable
2. Each argument must be elemental in nature, as discussed in Chapter three
3. Arguments must be associated with one or more of the four forces influencing future urban form
4. Arguments must be associated with one or more of the five urban form scenarios
5. A judgement must be made whether the argument supports or negates the likelihood of each urban form scenario.

Due to the complexity of urban form, the arguments developed for this study cannot be exhaustive. They do, however, attempt to capture the key themes covered in the literature review in Chapter four, with each argument making a statement about future urban form. What is required is sufficient coverage of the major issues to enable the evaluation process to differentiate between the likelihood of each of the five urban form scenarios.

7.1.2 The Arguments

The arguments used in the expert panel questionnaire were generated using a ‘systems thinking’ approach, based around the five urban form scenarios. The literature review in Chapter four provides the base information to develop arguments that relate the four forces of economics, government policy, environmental constraints and lifestyle influences, to possible future urban form. Using the key themes contained in the literature review, elemental arguments were generated and associated with one or more of the future urban form scenarios.

Systems thinking is a method of problem solving that considers the components of a system and their behaviours and interactions, rather than focusing on an isolated component or issue (Forrester 1969; Richmond 2000). The systems thinking approach is used in many diverse applications, to both identify and better understand the issues of concern. Examples of the application of systems thinking include: Melhuish et al. (2005), evaluating the possible economic futures for the Murchison, a vast region of dry land grazing in Western Australia that experienced extreme drought conditions during the first half of the 2000s; Langridge et al. (2005), modelling possible futures and scenarios for the Margaret River wine and tourism region in Western Australia; and Usher and Strachan (2013, p.818), with their use of 'mental models' combined with expert elicitation to better understand the uncertainties in the complex energy-economic system.

In the context of this study, this approach is applied at a high level only. Starting with the five urban form scenarios and the four forces, the components of the system are progressively included in a systems diagram with links to relevant scenarios and forces. The components of the system are drawn from the literature review. For example, the economic influences on continued fringe growth give rise to both dwelling price and the cost of travel as system components. Dwelling price is reflected in the arguments relating to rising metropolitan house prices and cheaper house prices on the fringe. The cost of travel is reflected in arguments relating to increasing oil prices and travel time, and the trade-off between these issues and the price of a dwelling. By progressively adding components to the system, relating these components to relevant urban form scenarios, and developing arguments to reflect these relationships, a set of arguments is generated that describes the structure and behaviour of that dimension of the urban system of interest – possible future urban form.

As previously stated, this is not an exact science and the set of arguments cannot be exhaustive. What is required is a set of arguments that adequately describes the system and enables an evaluation of likely future urban form using the modified argument-based approach.

Table 7.1 contains the arguments generated from the systems thinking approach; an allocation of these arguments to urban form scenarios; and an allocation to whether these arguments support or negate that urban form scenario. Individual arguments can be allocated to more than one scenario and may support one scenario but negate another. The intention here is to generate sufficient substantive arguments from the systems thinking exercise to populate the arguments for and against each urban form scenario. Some arguments, such as 'Families continue to prefer detached dwellings on large blocks' apply to more than one scenario - in this case, Business as Usual and Fringe Growth – but are only included in one relationship, arguments for Business as Usual. Given the number of combinations between arguments and scenarios, the full set of relationships is more efficiently presented in the form of a matrix. This issue is addressed in the construction of the argument-force matrix (Table 7.3) and the allocation of arguments supporting or negating each scenario in Tables 7.4 and 7.5.

Table 7.2 is a list of unique arguments generated from Table 7.1. Some of these unique arguments have been rephrased for use in the panel questionnaire. Following the structure of the modified argument-based approach developed in Chapter three, this unique list of arguments is then associated with each of the four forces. This allocation is shown in Table 7.3 as an argument-force matrix – shaded cells showing a relationship between that argument and that force. The allocation of arguments results from the systems thinking exercise. Continuing with the example above concerning the trade-off between oil prices, travel time and the price of a dwelling, this relationship generated argument 24 in Table 7.2, that 'Cheaper, larger houses on the fringe will compensate for increased travel time/cost'. Considering the four forces developed for this study, this argument has two major threads: cheaper houses and increased travel costs, which are economic in nature; and larger houses and increased travel time, which have lifestyle implications. This argument has, therefore, been allocated to both economic and lifestyle in Table 7.3.

Table 7.4 is a matrix of arguments considered to support each urban form scenario; and Table 7.5 is a matrix of arguments considered to negate each scenario - shaded cells showing a relationship between that argument and that scenario. These two tables are derived directly from Table 7.1; and indirectly from the systems thinking exercise. The generation of Tables 7.3, 7.4 and 7.5 serve two purposes: they provide an index between each argument and relevant forces and scenarios; and they facilitate the evaluation of panel member responses, consistent with the modified argument-based approach described in Chapter three.

Table 7.1: Arguments Potentially Impacting on Urban Form Scenarios

Scenario	Arguments For	Arguments Against
Business As Usual	• Property developers control where and what is built • Property developers have preference for low density dwellings. • Detached and semi-detached, single storey dwellings are the most affordable. • Household preferences will be very difficult to change. • Families continue to prefer detached dwellings on large blocks. • Desalination plants will overcome water supply problems and allow continued growth. • Clean technology vehicles result in no change in travel behaviour. • Rising metropolitan house prices will force families to the fringe. • Cheaper, larger houses on the fringe will compensate for increased travel time/cost	• Increasing oil prices will drive densification. • Increasing congestion and travel time will drive densification. • Increasing congestion will increase public transport use and supply. • Rapid population growth will drive densification. • Water supply issues will drive densification to improve water efficiency. • Encroachment on agricultural/horticultural land will limit fringe growth. • Encroachment on winery regions will limit fringe growth. • Environmental awareness will drive increased density • An increasing number of retirees are downsizing to apartments
TODs/corridors	• Increasing oil prices will drive densification. • Increasing congestion and travel time will drive densification. • Increasing congestion will increase public transport use and supply. • Climate change will reduce the use of the car. • There is an increased desire to live close to work. • Rapid population growth will drive densification. • Environmental awareness will drive increased density. • Increasing number of retirees downsizing to apartments. • Increasing demand for amenity-based lifestyle. • Young adults and some immigrants will embrace denser, apartment living. • Water supply issues will drive densification to improve water efficiency.	• Cost of TOD dwellings will detract buyers and developers. • Clean technology vehicles result in no change in travel behaviour. • Insufficient residential land consolidation limits TODs/densification. • Resistance of industry and commerce to move to allow densification. • Apartment living will not take off. • Apartments are not affordable for most people. • Apartments are too small for most people. • Apartment living is restricted to young adults and retirees. • Community resistance to densification. • Property developers control where and what is built. • Property developers prefer to build low density dwellings. • Rising metropolitan house prices will force families to the fringe.
City-Centric Living	• Increasing oil prices will drive densification. • Increasing congestion and travel time will drive densification. • Climate change will reduce the use of the car. • Environmental awareness will drive increased density. • Increasing demand for amenity-based lifestyle. • Increased local and overseas students living in the City. • Increasing number of retirees	• Noise and safety issues deter people from living in the City. • Apartment living will not take off. • Apartments are not affordable for most people. • Apartments are too small for most people. • Apartment living is restricted to young adults and retirees. • Adelaide Airport will be moved out of the metropolitan region. • The high cost of TOD dwellings will detract buyers and developers.

	downsizing to apartments. • There is an increased desire to live close to work. • Young adults and some immigrants will embrace denser, apartment living.	• Industry will resist relocating which will limit residential densification. • Household preferences will be very difficult to change.
Urban Infill	• Increasing oil prices will drive densification. • Major public facilities such as the Showgrounds will be relocated to the Adelaide Park Lands. • Adelaide Airport will be moved. • Environmental awareness will drive increased density. • Increasing number of retirees downsizing to apartments. • Detached and semi-detached, single storey dwellings are the most affordable. • Household preferences will be very difficult to change. • Increasing congestion and travel time will drive densification.	• Clean technology vehicles result in no change in travel behaviour. • Climate change will reduce the use of the car. • Community resistance to densification. • Government intervention to reduce opportunistic infill. • There are limited opportunities for replacing a single house with two or three smaller dwellings. • Resistance of industry and commerce to move to allow densification. • The Adelaide Park Lands will never be developed. • Public concern over population increase will limit overseas migration.
Fringe Development	• Rising metropolitan house prices force families to the fringe. • Cheaper, larger houses on the fringe will compensate for increased travel time/cost. • Clean technology vehicles result in no change in travel behaviour. • Improved public transport will make fringe attractive. • Telecommuting and working from home will make fringe attractive. • Land release on the fringe. • Rapid population growth will make fringe growth inevitable. • Detached, single storey dwellings are the most affordable. • Property developers control where and what is built. • Property developers prefer to build low density dwellings	• Increasing oil prices will make fringe unattractive. • Increasing congestion and travel time will make fringe unattractive. • Environmental awareness will limit the demand for fringe growth. • Climate change will reduce the use of the car. • Community pressure will limit fringe growth. • Encroachment on agricultural/horticultural land will limit fringe growth. • Encroachment on winery regions will limit fringe growth. • Lack of public transport will limit fringe growth. • Lack of local jobs will limit fringe growth.

Table 7.2: List of Unique Arguments Potentially Impacting on Urban Form Scenarios

Index	Argument
1	Property developers control where and what is built.
2	Property developers prefer to build low density dwellings.
3	Detached and semi-detached, single storey dwellings are the most affordable.
4	Household preferences will be very difficult to change.
5	Families continue to prefer detached dwellings on large blocks.
6	Desalination plants will overcome water supply problems and allow continued growth.
7	Public concern over population increase will limit overseas migration.
8	Clean technology vehicles will result in no change in travel behaviour.
9	Increasing oil prices will drive densification.
10	Increasing congestion and travel time will drive densification.
11	Increasing congestion will increase public transport use and supply.
12	Climate change will reduce the use of the car.
13	Rapid population growth will drive densification.
14	Environmental awareness will drive increased density.
15	An increasing number of retirees are downsizing to apartments.
16	There is increasing demand for amenity-based lifestyle.
17	Young adults and some immigrants will embrace denser, apartment living.
18	Water supply issues will drive densification to improve water efficiency.
19	There will be an increase in local and overseas students living in the City.
20	There is an increased desire to live close to work.
21	Public facilities such as the Adelaide Showgrounds will be relocated to the Park Lands.
22	Adelaide Airport will be moved out of the metropolitan region.
23	Rising metropolitan house prices will force families to the fringe.
24	Cheaper, larger houses on the fringe will compensate for increased travel time/cost.
25	Improved public transport will make living on the fringe attractive.
26	Telecommuting and working from home will make living on the fringe attractive.
27	New land releases on the fringe will be readily taken up.
28	Water supply issues for Adelaide will encourage development of a second city.
29	A slower lifestyle will make living in a smaller, second city attractive.
30	Government infrastructure and employment initiatives will drive a second City.
31	High speed trains will connect regional centres in the future.
32	A decentralisation policy will be adopted as a sustainable population strategy.
33	Climate change will drive population to cooler and wetter regions.
34	Telecommuting and working from home will increase in the future.
35	Rapid population growth will make fringe growth inevitable.
36	The high cost of TOD dwellings will detract buyers and developers.
37	Insufficient and ineffective residential land consolidation will limit densification.
38	Industry will resist relocating which will limit residential densification.
39	Noise and safety issues deter people from living in the City.
40	Apartment living will not take off in South Australia.
41	Apartments are not affordable for most people.
42	Apartments are too small for most households.
43	Apartment living is restricted to young adults and retirees.
44	There is strong community resistance to densification.
45	Government will intervene to reduce opportunistic infill development in the suburbs.
46	There are limited opportunities for replacing a single house with two or three dwellings.
47	The Adelaide Park Lands will never be developed.
48	Increasing oil prices will make fringe living unattractive.
49	Increasing congestion and travel time will make living on the fringe unattractive.
50	Environmental awareness will limit the demand for fringe growth.
51	Community pressure will limit fringe growth.
52	Residential encroachment on agricultural/horticultural land will limit fringe growth.
53	Residential encroachment on winery regions will limit fringe growth.
54	Lack of public transport will limit fringe growth.
55	Lack of local jobs will limit fringe growth.

Table 7.3: Argument-Force Matrix

Argument	Economic	Lifestyle	Policy	Environmental
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				

Table 7.4: Arguments Supporting Each Urban Form Scenario

Argument	BAU	TODs	CCL	Infill	Fringe
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					

Table 7.5: Arguments Negating Each Urban Form Scenario

Argument	BAU	TODs	CCL	Infill	Fringe
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					

7.2 Subjective Assessment of Future Urban Form

The argument-based approach includes in its methodology a qualitative and subjective assessment by the expert panel of the factors being considered. In the case of urban form the following additional information is elicited.

The panel members are asked: “For each of the four forces – economic, government policy, environmental constraints and lifestyle preferences – the force will influence urban form towards which scenario?” The choices offered are:

1. Business as Usual - no major change in urban form
2. Transit Oriented and Corridor Development
3. City-centric living
4. Urban Infill
5. Fringe development
6. No influence on urban form.

The panel was then asked to distribute a total of 100 points over the forces; this distribution representing the panel member’s opinion of the relative importance of each force in determining future urban form.

The panel was provided with the five[45] scenarios for future urban form and asked to rank from highest (a rank of 1) to lowest (a rank of 5) the scenario that is ***most likely*** for the future urban form of Greater Metropolitan Adelaide over the next 15 years.

The panel was also asked to rank the five scenarios from highest (a rank of 1) to lowest (a rank of 5) the scenario that is ***most desirable*** to resemble the future urban form of Greater Metropolitan Adelaide.

Responses to these questions are presented in Chapter eight.

These additional qualitative and subjective questions were included to aid in the interpretation of the overall assessment of the panel’s responses. As discussed in detail in Chapter three, the panel responses are combined and evaluated to provide an

[45] The panel was presented with six urban form scenarios – the five described in this study plus a “second city” outside of metropolitan Adelaide scenario. The likelihood of a second city competing with Adelaide within the 15 year timeframe of this study was considered by the panel to be so remote that it has been excluded from the discussion and the evaluation to simplify the presentation of the questionnaire results. Arguments 28 to 33 relate directly to the second city scenario, but potentially also relate to other scenarios The exclusion of this scenario does not impact on the comparative evaluation in this study.

overall assessment of the panel for the likely future of urban form. Responses to the qualitative and subjective questions provide information that is incorporated in the calculation of the overall assessment; and are used as a comparative indicator of likely future urban form – presented in the conclusion to this study in Chapter nine.

7.3 Linking Forces and Urban Form

To enable the modified argument-based approach to be applied in its current setting a link is required between the four major forces and the five urban form scenarios developed in Chapter six. This step enables the weighting of the panel members' responses to the arguments by their opinion of the relative importance of each force on future urban form. This Section revisits the literature to make the link between the four forces and the five urban form scenarios.

7.3.1 Revisiting Future Urban Form Scenarios

As discussed in Chapter four, urban form is a complex of interrelated structures and relationships within the physical and functional urban space. No single description or typology can capture the myriad patterns of functional urban form that differ and change through time and over space. There are no distinct geographic boundaries between types of urban form, and any typology of urban form requires judgement of the classification system to be adopted, and what urban form is included in each class. Notwithstanding these limitations, Chapter six identified five urban form scenarios for this study:

- Fringe Growth – low density, detached dwellings in the outer metropolitan and peri-urban regions
- Urban Infill – low to medium density development in the inner metropolitan area
- TODs and transit corridors – medium and high density development along designated transit corridors within the metropolitan area
- City-centric Living - high density development within the City square mile and its adjacent suburbs
- Business as Usual – a continuation of increasing densification in the inner metropolitan area and low density development toward the urban fringe.

These five scenarios are discussed below in terms of the relevant economic, policy, environmental and lifestyle forces that either strengthen or weaken the likelihood of that urban form outcome eventuating.

7.3.2 Economic Forces

There is a strong theme in the economics literature of the trade-off between housing costs and the location of and accessibility to employment and local amenity. This theme is considered extensively in the residential location choice literature (Dieleman 2001; Kay and Marsh 2007; Montgomery and Curtis 2006). Urban space is not a blank canvas and the current housing stock provides both opportunities in terms of potential redevelopment and an obstacle for future growth. Fringe growth on greenfield development sites provides vast opportunities for developers to provide housing at competitive prices – assuming infrastructure costs are defrayed by local or state government – and for households to purchase space that is at a premium closer to the city centre.

In reality, residential location decisions also include non-market variables, such as lifestyle, environmental characteristics and amenity, which are considered in a variety of economic theories including the Tiebout hypothesis and quality of life indices (Krupka, 2007; Richardson, 1977; Tiebout, 1956).

Another common theme that emerges from the economic literature is that the cost of housing is a major determinant of where households choose to live (Berger and Blomquist, 1992; Greenwood and Hunt; 1989; Montgomery and Curtis, 2006). There is strong support in the literature and within government publications that urban consolidation has economic-wide benefits arising from reduced lot sizes and more efficient use of infrastructure (Buxton and Tieman, 2005; Government of South Australia, 2010a; NSW Government, 2010; State Government of Victoria, 2008; Yates, 2001). However, the cost of medium and high density infill developments in all capital cities is high compared to detached dwellings on the fringe (Government of Australia, 2011; Kulish et al., 2001).

The trade-off between housing affordability and accessibility is confounded by poor transport infrastructure on the fringe (Kulish et al., 2001), and the embedded location costs associated with travel time and cost (Hugo, 2010). But these accessibility costs are reduced given the decline of the Central Business District as a focus of employment, and the increase in employment in the suburbs (Garreau, 1991); increasing dual-earner households; and non-work trips outnumbering home-based work trips (Waddell, 1996).

One of the principal processes of increasing urban density in metropolitan Adelaide over the past two decades has been minor infill – effectively replacing one dwelling for two (Government of South Australia, 2010b). This process has a strong economic basis both for the small investor undertaking the development and the efficiency returns of reducing the cost of the now smaller block of land and generally smaller dwelling.

There is strong evidence in the literature that fringe growth is strengthened by the availability of more affordable housing compared to high density inner-city and infill development. There is also strong empirical evidence that economic factors favour minor infill (Government of South Australia, 2010b). On this basis, for the purposes of this study, it is assumed that economic factors – in particular the cost of housing – strongly support the continuation of fringe growth and minor infill in existing suburbs. Taken together, continuation of fringe growth and minor infill also equate to the Business as Usual scenario.

7.3.3 Government Policy

Over recent decades most Australian states have developed planning strategies to address rapidly growing population, and concerns about road congestion and vehicle emissions. The primary strategy adopted to address these issues is to implement policies to promote urban consolidation and to increase urban density, particularly major infill development on residential and brownfield sites, and to reduce urban sprawl (NSW Government, 2010; Government of Western Australia, 2010; Government of South Australia, 2010a; Queensland Government, 2009; State Government of Victoria, 2008) – what Forster (2006) describes as a policy of containment, consolidation and centres. The adoption of these principles is not restricted to Australia with most developed countries accepting the view that higher urban densities lead to reduced vehicle use (Mindali, 2004).

One of the primary aims of the 30 Year Plan for Greater Adelaide is to locate the majority of new housing in current urban lands, particularly around transport corridors (Government of South Australia, 2010a). Although the plan also includes the provision of land for new growth areas on the fringe and in surrounding townships, the Government of South Australia has a stated target that 70 per cent of all new dwellings will be located in infill locations – currently 50 per cent - within the 30 year time frame of the plan. This 70 per cent target is also stated in the Sydney Metropolitan Plan (NSW Government, 2010). It is clear that there is explicit policy contained within all of

Australia's state-level planning strategies to increase urban densities and promote infill development within the existing urban footprint.

In the interpretation of the 30 Year Plan for Greater Adelaide, there has been a strong focus on increasing the population living in the City of Adelaide and its neighbouring suburbs (Government of South Australia, 2012a; 2012b). Two planning instruments have been adopted to facilitate this inner-City growth – an "Inner-Rim Growth Project" and the City of Adelaide development plan amendment (Government of South Australia, 2012a; 2012b).

Notwithstanding the difficulties of implementing consolidation and infill policies and the impact of other forces acting on future urban form, it is clear that state-level strategic planning has an important role in facilitating future urban form. If successful, government policy will result in significant increases in urban densities and in major urban infill within TODs and corridors, and within the City of Adelaide and its adjacent suburbs.

7.3.4 Environmental Constraints

The two environmental strategies discussed in Chapter four to protect open space are urban growth boundaries and green belts. It was commented that although both strategies have been found to slow urban expansion, neither approach stops expansion (Gennaio, 2009, p.224). Although legislated as urban consolidation, the concept of an urban growth boundary emerged in South Australian government policy in the late 1980s (Government of South Australia, 1990, p.19). Greenbelts are also used to control Adelaide metropolitan fringe growth – one of the most notable being an area of open space south of the northern township of Gawler which restricts the northerly growth of metropolitan Adelaide (Government of South Australia, 2010a, p.171). A third strategy to protect open space followed the recent announcement of legislative instruments to effectively ban urban development in the grape growing regions north and south of metropolitan Adelaide (Government of South Australia, 2013a; 2013b). Given its location, the development ban in the northern region of the Barossa Valley is unlikely to have a major impact on the growth of metropolitan Adelaide as it does not bound the northern urban area. The McLaren Vale grape growing region to the south does have the potential to limit growth south as it is the southern boundary of the metropolitan region and creates a wedge along with the Adelaide Hills that severely limits future growth in the southern metropolitan area.

The urban growth boundary of Adelaide – which includes some outlying townships that are separate from the major urban region – is currently in a state of flux. The 30 Year Plan for Greater Adelaide does not explicitly mention the urban growth boundary, even though it was one of the primary instruments to limit urban growth prior to the plan's release (Government of South Australia, 2010a; Government of South Australia, 2003a).

Notwithstanding some noteworthy critics (Gleeson, 2010; Mindali et al., 2004; Troy, 1996) there is little doubt that car dependency and road congestion are major factors driving both government and non-government agendas toward urban consolidation and densification (Kenworthy, 2007; Mindali, 2004; Newman and Kenworthy, 1999; Soltani and Bosman, 2009). If these environmental agendas are successful, the urban form of choice would be denser, mixed-use development in Transit Oriented Developments along transport corridors and within the City centre and adjacent suburbs, with improved accessibility to employment and amenities. Although minor infill would also result in urban densification, this style of development does not necessarily satisfy the need for mixed-use development with improved accessibility.

7.3.5 Lifestyle

Lambiri et al. (2007) consider quality of life to be a key determinant in the decision of where to reside. But given the complexity, individuality and plurality of lifestyle, whose lifestyle and what facet of that lifestyle determines location decisions, and how is this translated to any particular or even relative location choice? Glaeser et al's (2001) four critical urban amenities of a rich variety of services and consumer goods, such as restaurants and theatres; aesthetics and physical setting; good public services such as schools and low crime; and accessibility, provide some insight into this complexity.

Within the Greater Metropolitan Adelaide region urban amenities are concentrated in a limited number of service hubs – either along a linear strip, within a distinct location or centre, and in the City of Adelaide square mile (Government of South Australia, 2007). In terms of relative location, these concentrations of amenity and service provision are more concentrated within the inner city, inner city suburbs and several coastal locations. In general terms, the concentration of amenity and services tends to decline toward the fringe (Government of South Australia, 2007).

In terms of planning policy, mixed-use and urban amenity are a major part of the concept of TODs and corridor development. If successful, these future hubs of amenity and services will also be concentrated within the existing urban area and in designated locations.

In terms of aesthetics and physical setting, the linear spatial extent of metropolitan Adelaide is bounded by sandy beaches to the west and cooler climes of the foothills to the east. Along with the grape growing region to the south, metropolitan Adelaide has three key natural amenity locations. Given the restrictions on urban growth to the south and in the Hills Face Zone to the east, the primary natural amenity for metropolitan Adelaide are coastal suburbs along its western boundary.

The resurgence of the role of the street and the neighbourhood as a lifestyle focus as reported by CABE (2005), also provides some guidance to the description of the relative location that may be emerging as desirable by at least a portion of the population. These neighbourhoods are a reflection of yesteryear based around images of vibrant neighbourhood living that still exists in some European towns and cities. The realisation of this image in a city such as Adelaide is more likely within the consolidating inner-suburbs, within the existing concentrations of amenity and within proposed TODs and corridors – and less so on the urban fringe. These neighbourhood outcomes are also less likely to eventuate in a Business as Usual scenario.

A confounding lifestyle factor in this amenity-based approach to future urban form is the preference of family households to have space – both in terms of the size of the dwelling and the land on which it sits. There appears to be no obvious change in this preference of family households although it is not clear to what degree this preference is based on lifestyle or affordable housing. Given this continuation in trend it is appropriate to include the preference of families to locate to fringe locations for lifestyle reasons in the Business as Usual scenario.

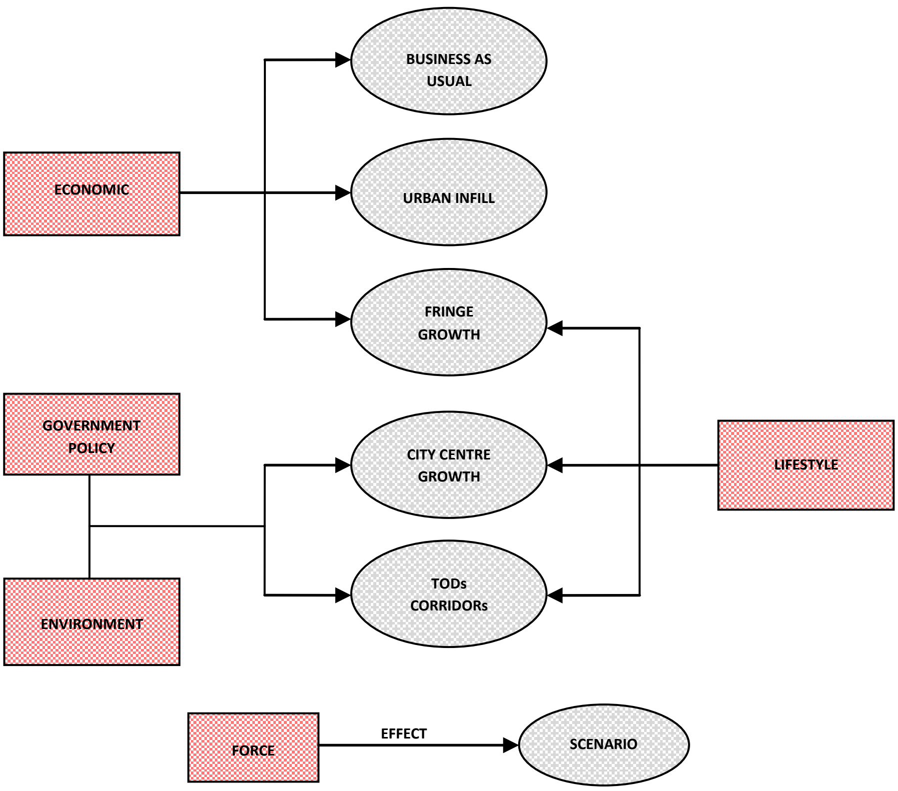
7.4 Summary of the Links between Forces and Urban Form Outcomes

The following summary illustrates the links made in this study between the four forces and the five urban form scenarios initially as a system linkage diagram; then by grouping forces and scenario outcomes; and finally by generating a scenario hierarchy of likely urban form outcomes based on an interpretation of the literature.

7.4.1 System Linkages

Figure 7.1 illustrates the linkages between the four forces and the five scenarios identified in this study. The relationships shown summarise the fundamental relationships discussed in the previous sections. Based on the literature review, economic forces primarily support the three scenarios of Business as Usual, Urban Infill and Fringe Growth; lifestyle forces primarily support Fringe Growth, City-centric Living and TODs and corridor development; government policy and environmental constraints primarily support City-centric Living and TODs and Corridor development.

Figure 7.1: Forces Acting on Urban Form Outcomes Based on the Literature



7.4.2 Scenario Hierarchy

Table 7.6 identifies which forces support each urban form scenario. Although this summary table assumes each force has equal weight, it does illustrate in broad terms the overall support for each scenario based on an interpretation of the literature review and provides an alternative view of the relationships between urban form and the forces that support each scenario outcome. Fringe growth is primarily supported by economic and lifestyle forces; infill development and Business as Usual are supported by economic forces only; TODs and Corridor development and City Growth are both supported by government policy, environmental constraints and lifestyle preferences.

Table 7.6: Forces Supporting Each Urban Form Outcome Based on Literature Review

SCENARIO	FORCE			
	ECONOMIC	POLICY	ENVIRONMENT	LIFESTYLE
FRINGE GROWTH	X			X
INFILL DEVELOPMENT	X			
TODs and CORRIDORS		X	X	X
CITY GROWTH		X	X	X
BUSINESS AS USUAL	X			

Source: Expert Panel Questionnaire

Table 7.7 places each urban form scenario in a hierarchy based on the number of supporting forces as interpreted in the literature. This general assessment of the literature suggests that TODs and Corridors and city centric living are the most likely future outcomes for urban form; followed by Fringe Growth and then Urban Infill and Business as Usual.

Table 7.7: Hierarchy of Likely Urban Form Outcomes

HIERARCHY	LITERATURE REVIEW	EXPERT PANEL OPINION	PANEL ARGUMENTATION
1	• TODS AND CORRIDORS • CITY CENTRIC LIVING	-	-
2	• FRINGE GROWTH	-	-
3	• URBAN INFILL • BUSINESS AS USUAL	-	-

Source: Expert Panel Questionnaire

7.5 Conclusion

This summary exercise serves to illustrate the general thrust of the literature as interpreted in this study. The hierarchy of urban form outcomes as derived by the literature review provides context to the argument-based approach reported on later. The two expert panel columns in Table 7.7 will ultimately provide a comparative view of the likely urban from outcomes based on the modified argument-based approach – derived from a formal and structured approach to evaluating the impact and validity of the four forces that shape future urban form; and the opinions of the expert panel.

Chapter 8 Evaluation of Panel Responses

8.1 Overview

This Chapter presents the results of the expert panel questionnaire. It also evaluates the adequacy of panel response in terms of whether sufficient data has been collected in the process. The summary results of the questionnaire highlight the variability across and within the panel members' responses. The results for the weighted average outcomes of arguments for and against each urban form scenario are presented along with combined overall results. These combined results represent the relative likelihood of each urban form outcome eventuating based on the evaluation of the panel responses to the questionnaire. The opinions of each panel member and the summary opinion of the group for the most likely and the most desirable future urban form are provided as a comparison to the results of the argument evaluation and the results of the literature review.

Finally, the population projection outcomes representing the most likely urban form outcomes based on the results of the modified argument-based approach are presented and discussed.

8.2 Saturation as a Measure of Adequacy

As discussed in Chapter three, in qualitative research, saturation is necessary to know when enough data have been collected. Given the mixed-methods approach adopted for this study, the general concept of saturation also applies here. Unfortunately, there is no formal definition of saturation, or approach to determining when saturation has been reached (Bowen, 2008, p.150).

The concept of saturation is an important measure of both the appropriateness of the size of the expert panel; and the degree to which the panel results are likely to have covered the issue of concern. A panel of nine panel members is consistent with the literature; and may be considered to be a relatively large expert panel in the context of expert elicitation. Therefore, it is not the 'sample' size of the panel that is important but sampling adequacy (Bowen, 2008, p.140). One indicator of sampling adequacy, and therefore potential saturation, is the level of variability within and between panel responses.

Saturation in the context of this study is defined as capturing sufficient variability in responses to illustrate a broad coverage of the forces and urban form scenarios considered. Variability within individual responses indicates uncertainty; variability between panel members indicates that additional data is being added to the results; similarity in results indicates a level of redundancy. The variability of panel responses is discussed below.

8.3 Panel Responses

To recap, for each of the arguments the expert panel was asked without considering the possible impact of this argument on urban form, do you think it is:

1. Certainly true
2. More true than false
3. Don’t know / ambivalent
4. More false than true
5. Certainly false.

And, assuming that the argument is true, whether it would have a MAJOR impact on the general character of Greater Metropolitan Adelaide's urban form over the next 15 years. The choices offered were:

1. Strongly agree
2. Tend to agree
3. Neither agree nor disagree
4. Tend to disagree
5. Strongly disagree
6. Don't know.

Responses were converted to a score as outlined in Chapter three. Appendices A3 and A4 contain the panel members’ responses for the validity and impact scores for each of the 55 arguments converted to a score. These responses are summarised in tabular and chart form below.

As a summary measure, Table 8.1 shows the frequency of panel member scores for the validity question for each statement. The panel member numbers have been randomly assigned to each member and do not indicate any particular panel member. The variability within and between individual responses to whether statements were true or false is illustrated in Figure 8.1 as a Boxplot[46]. One measure of the variability between panel members’ responses is the interquartile range – the difference between

[46] A Boxplot is a graphical representation of the distribution of a dataset. In this case, for each panel member the maximum and minimum values correspond to the upper and lower ends of the thinner vertical line; the median value corresponds to the thicker horizontal line; and the 1st and 3rd quartiles correspond to the upper and lower bounds of the vertical box.

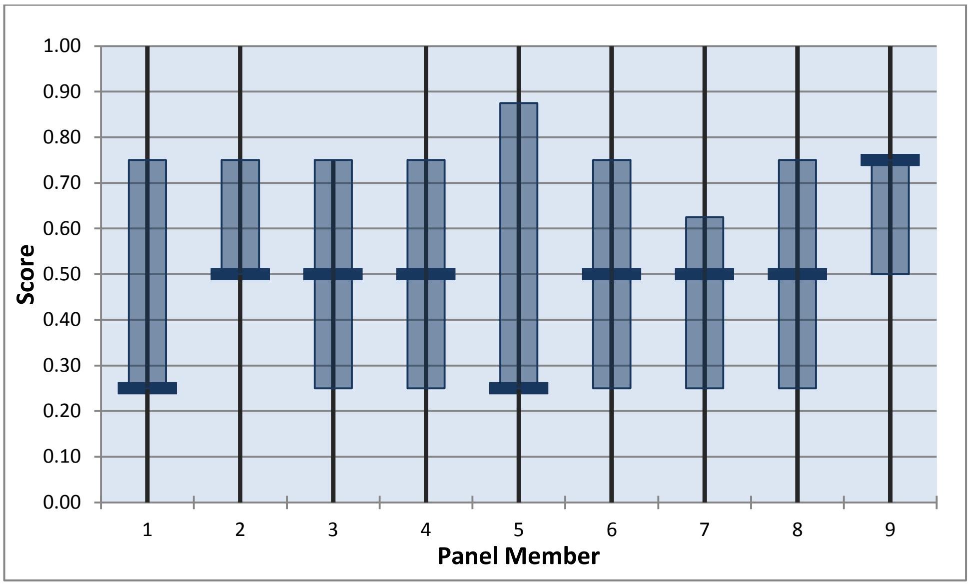
the 1st and the 3rd quartiles. Using this measure, five of the nine panel members' responses have an interquartile range of 0.5 – between 0.25 and 0.75. This indicates relative consistency in response frequencies between members. This consistency is supported by the six median scores of 0.5. Panel members two, five, seven and nine show more variability within the panel. However, this is only a summary view of the responses to validity. Appendices A3 and A4 reveal that although there is relative consistency between members for the frequency of scores, these scores generally apply across different arguments when comparing panel members' responses. This is an important outcome as it is the variability between experts that illustrates the strength of the argument-based approach – this variability potentially allowing differentiation in the evaluation of the likelihood of each urban form scenario eventuating.

Table 8.1: Individual Panel Member's Frequency of Validity Scores

		Panel Member									
	Weight	1	2	3	4	5	6	7	8	9	Sum
Certainly false	0.00	10	1	1	7	13	4	8	2	1	**47**
More false than true	0.25	18	10	15	18	18	19	13	19	12	**142**
Don't know/ambivalent	0.50	8	19	18	10	3	10	20	14	2	**104**
More true than false	0.75	12	23	21	16	7	15	12	18	32	**156**
Certainly true	1.00	7	2	0	4	14	7	2	2	8	**46**

Source: Expert Panel Questionnaire

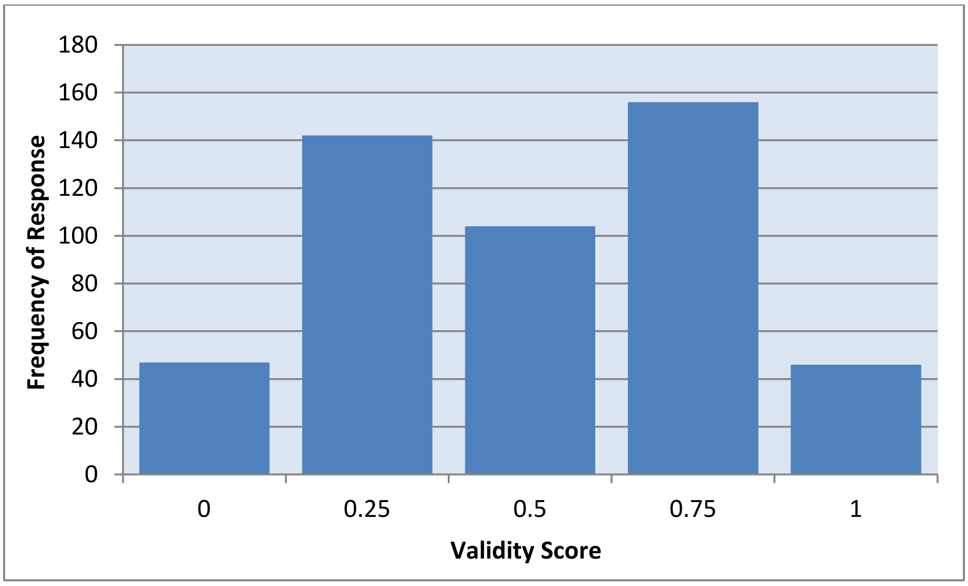
Figure 8.1: Distribution of Individual Panel Member's Validity Scores



Source: Expert Panel Questionnaire

Overall the panel response to validity shows some bias towards agreeing that the statements are true. This result provides support to the inherent validity of the statements. However, it may also suggest some "acquiescent response bias"[47]. This issue is taken up in the consideration of the combined validity and impact scores below. Notwithstanding this potential bias, given that 80 per cent of responses are definitively in agreement or disagreement – rather than the more neutral "Don't know / ambivalent" – these results are considered to be robust in terms of their contribution to the modified argument-based methodology.

Figure 8.2: Panel Frequency of Validity Scores



Source: Expert Panel Questionnaire

The frequency of the individual expert scores for the likely impact of each statement is shown in Table 8.2. There is substantial variability between panel members' responses. Panel member one responded frequently that statements did not have a great impact on future urban form (0.25 and 0.00[48]) while panel member nine considered almost all of the statements to have an impact. This variability is illustrated further in Figure 8.3. Comparing this distribution with those for the validity responses in Figure 8.1, it is clear that the interquartile range is extremely variable between panel members, indicating a broad range in the responses to the impact question. The median values however, show some commonality, with five members displaying a median value of 0.75 and three members displaying a value of 0.5. Overall, the

[47] Acquiescent response bias refers to a tendency for respondents to agree to most assertions regardless of their veracity (Smith, 2004).
[48] Although a score of zero can indicate a response of either "Strongly agree" or "Don't know", there were no "Don't know" responses to the impact question.

variability in responses is a positive outcome. The modified argument-based approach requires that panel member responses are sufficiently varied to enable a clear distinction between the likelihood of urban form scenarios eventuating.

In terms of saturation, the level of variability supports the notion that there is a broad coverage of the issues by the panel – panel members having differing views on the substantive arguments.

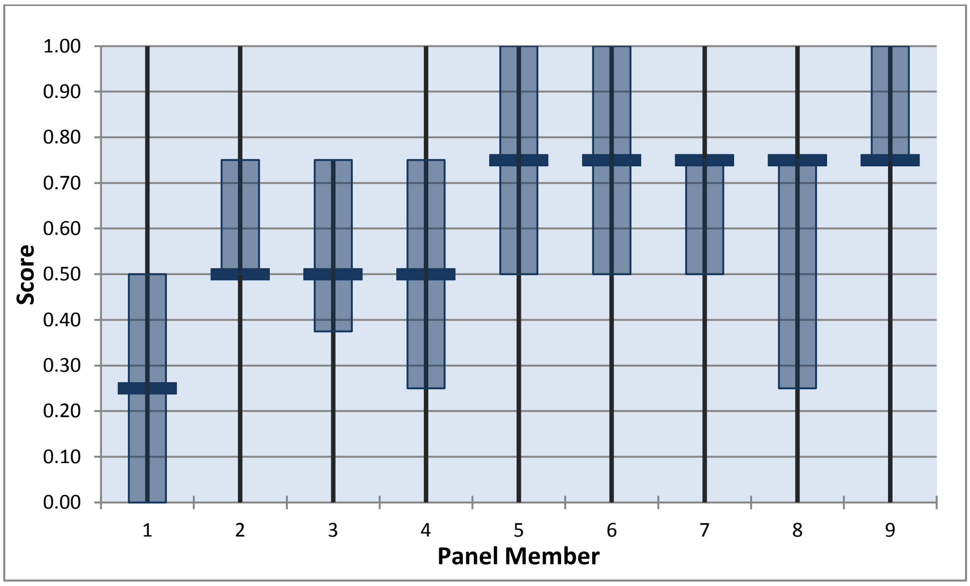
As for validity scores, Figure 8.3 is only a summary of panel responses. Actual variability between and within expert responses is much greater than that illustrated, as shown in Appendix A4.

Table 8.2: Frequency of Impact Scores

		Panel Member									
	Weight	1	2	3	4	5	6	7	8	9	Sum
Strongly disagree/don't know	0.00	20	5	2	6	1	3	1	1	1	40
Tend to disagree	0.25	20	7	12	19	7	8	9	16	4	102
Neither agree nor disagree	0.50	4	18	18	10	14	8	14	4	0	90
Tend to agree	0.75	6	20	23	16	17	15	28	31	29	185
Strongly agree	1.00	5	5	0	4	16	21	3	3	21	78

Source: Expert Panel Questionnaire

Figure 8.3: Distribution of Individual Panel Member's Impact Scores

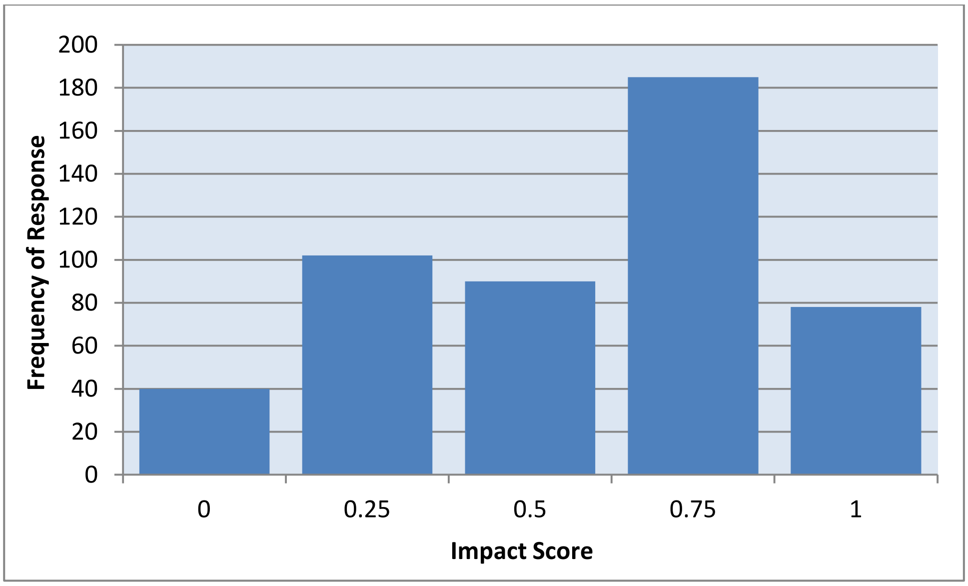


Source: Expert Panel Questionnaire

Figure 8.4 illustrates the overall panel distribution of impact scores (the last column in Table 8.2). There is a tendency toward strong agreement that the statements would have a major impact on the future of urban form. As commented regarding the validity scores, this may indicate that the statements are inherently relevant to the future of urban form but may also be further evidence of acquiescent response bias.

The next stage in the modified argument-based approach is to combine the validity and impact scores for each statement and for each panel member. The validity and impact scores are multiplied together to obtain a score for each argument and for each individual panel member. This combined score forms the foundation of the modified argument-based approach as it provides a relative score that represents the view of each respondent of the influence that each statement has on the potential outcomes of future urban form. When all of the respondents' scores are combined they provide a panel view of the potential influence of each argument. The results of this process are shown in Appendix A5 which includes each individual member's score and the average of non-zero scores for each argument.

Figure 8.4: Expert Panel Frequency of Impact Scores



Source: Expert Panel Questionnaire

The frequencies for the combined scores are shown in Table 8.3 and the distribution of these scores is illustrated in Figure 8.5. These combined scores form the basis of the modified argument-based approach, as discussed in Chapter three. One observation that can be made is the overall low median and quartile outcomes within the possible range of 0 and 1. This outcome is expected given that there are six possible combined scores for validity and impact below 0.5 and only three above. The range of responses would therefore be expected to be skewed toward lower values.

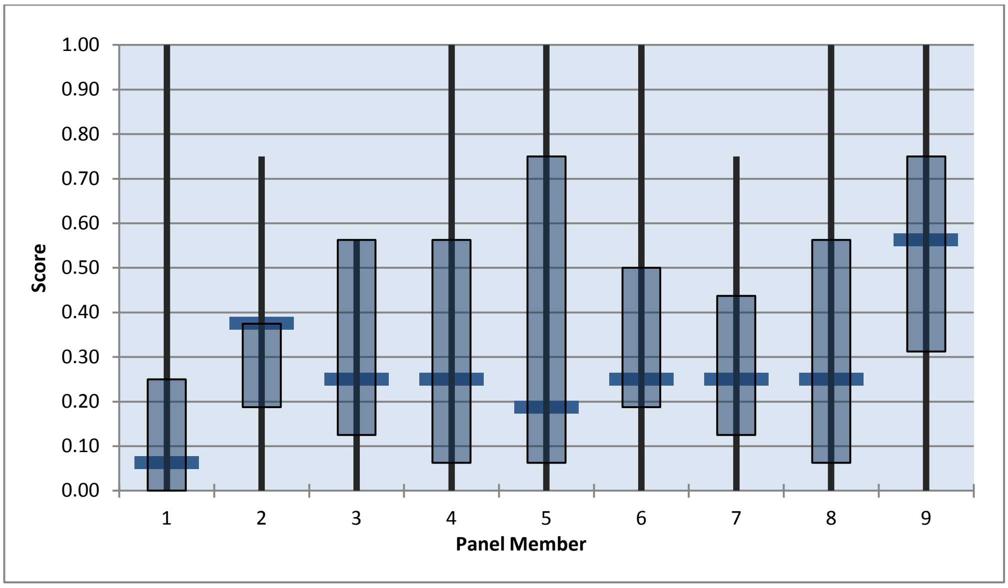
Table 8.3: Validity by Impact Scores Frequencies

	Panel Member									
Score	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Sum**
0	23	6	2	7	13	6	9	2	1	**69**
0.0625	8	3	12	18	2	1	3	13	3	**63**
0.125	5	4	0	0	9	2	8	3	0	**31**
0.1875	4	2	3	0	7	11	5	6	9	**47**
0.25	2	7	17	10	3	14	6	4	1	**64**
0.375	4	20	1	0	1	5	10	7	2	**50**
0.5	1	1	0	0	0	4	2	0	0	**8**
0.5625	3	9	20	14	3	3	11	17	18	**98**
0.75	2	3	0	4	6	6	1	1	14	**37**
1	3	0	0	2	11	3	0	2	7	**28**

Source: Expert Panel Questionnaire

What is of interest is the variability in the responses between respondents. As previously mentioned, one of the aims of the argument-based approach is to obtain a variety of responses from a diverse expert panel; and to make a judgement on the adequacy of the panel in terms of saturation. The results in Appendix A5 and in Figure 8.5 show a high level of variability between panel members. This outcome is positive in terms of adequacy and the notion of saturation.

Figure 8.5: Distribution of Individual Panel Member Validity by Impact Scores



Source: Expert Panel Questionnaire

Figure 8.6 shows the frequency of responses for each of the possible combined validity by impact scores. The first observation that can be made is that a combined score of zero has the second highest frequency. A score of zero can occur with a combination of “Certainly false” for validity and “Strongly disagree” or “Don’t know” for impact. In the current weighting system, there are 14 possible combinations of validity and impact out of a total of 30 combinations that can result in a zero score. This makes the relatively high number of zero scores unsurprising. Of greater importance are the low number of 0.5 outcomes and the very high number of 0.5625 outcomes.

An outcome of 0.5 can result from a combination of “Certainly true” for validity and “Neither agree nor disagree” for impact; or “Don’t know/ambivalent” for validity and “Strongly agree” for impact. Considering the first combination, if a panel member considers a statement to be certainly true, it may be reasonable that they would have a view of the likely impact of that statement on urban form – that is, they are unlikely to “neither agree nor disagree” that the statement would have an impact. The alternative combination may also be unlikely. If a panel member does not know or is ambivalent whether a statement is true or false, they may be less likely to have a very strong view concerning the argument’s impact on urban form.

The high number of 0.5625 outcomes may have a more profound origin. This score can only result from a combination of the validity and impact scores of 0.75 (“More true than false” and “Tend to agree”). As previously discussed, a high number of these two scores may indicate the presence of acquiescent response bias. Combined, these scores produce a disproportionate number of 0.5625 scores – potentially resulting in a strong bias toward agreeing with the statements for both validity and impact.

It is worth stating at this point that the presence of acquiescent response bias may have less of an impact on the outcomes for this categorical and comparative assessment than for a continuous variable such as the level of net overseas migration. The reason for this is that it is the comparative outcome that is important and not the absolute outcome or magnitude of the overall assessment. As long as the overall assessment scores differentiate between the five urban form scenarios, the magnitude of the scores is less important.

In addition to providing responses to the 55 arguments, each of the panel members was asked for their opinion regarding the importance of each of the four forces that may influence future urban form for Greater Metropolitan Adelaide – economics, government policy, environmental constraints and lifestyle preferences – and their opinion on the most likely and most desirable future urban form.

Figure 8.6: Validity by Impact Score Panel Frequencies

Source: Expert Panel Questionnaire

The argument-based approach and the modified argument-based approach incorporate the opinion of the relative importance of each force in the evaluation of panel member responses. Table 8.4 shows the results of the panel's distribution of 100 points over the four forces with regard to the importance of each force. Seven of the respondents considered economic forces to be dominant or jointly dominant in determining future urban form; with one respondent giving an 80 per cent weighting. Only one respondent considered policy to dominate. Using the average of the respondents rating scores, economic forces were considered to be almost twice as important as lifestyle and policy and three times as important as environmental constraints.

Table 8.4: Relative Importance of Each Force (Score out of 100 points)

	Force				
Panel Member	Economic	Lifestyle	Policy	Environment	Sum
1	40	30	10	20	**100**
2	50	10	30	10	**100**
3	35	25	30	10	**100**
4	30	30	20	20	**100**
5	80	15	3	2	**100**
6	25	20	40	15	**100**
7	30	25	30	15	**100**
8	50	10	15	25	**100**
9	50	30	10	10	**100**
Average	**43**	**22**	**21**	**14**	**100**

Source: Expert Panel Questionnaire

The panel members were also asked for their opinion on the most likely and the most desirable future urban form by ranking each urban form scenario from 1 (the most likely/most desirable) to 5 (the least likely/least desirable). Tables 8.5 and 8.6 contain the relative rankings of each expert and the average for the panel.

Table 8.5: Panel Ranking of Most Likely Urban Form Outcome

	Panel Member									
Scenario	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Average**
BAU	1	2	5	2	1	5	1	1	2	**2**
TODs	5	3	1	5	2	1	5	2	5	**3**
CCL	4	5	2	4	4	4	4	5	3	**4**
Fringe	2	4	3	3	5	2	3	3	4	**3**
Infill	3	1	4	1	3	3	2	4	1	**2**

Source: Expert Panel Questionnaire

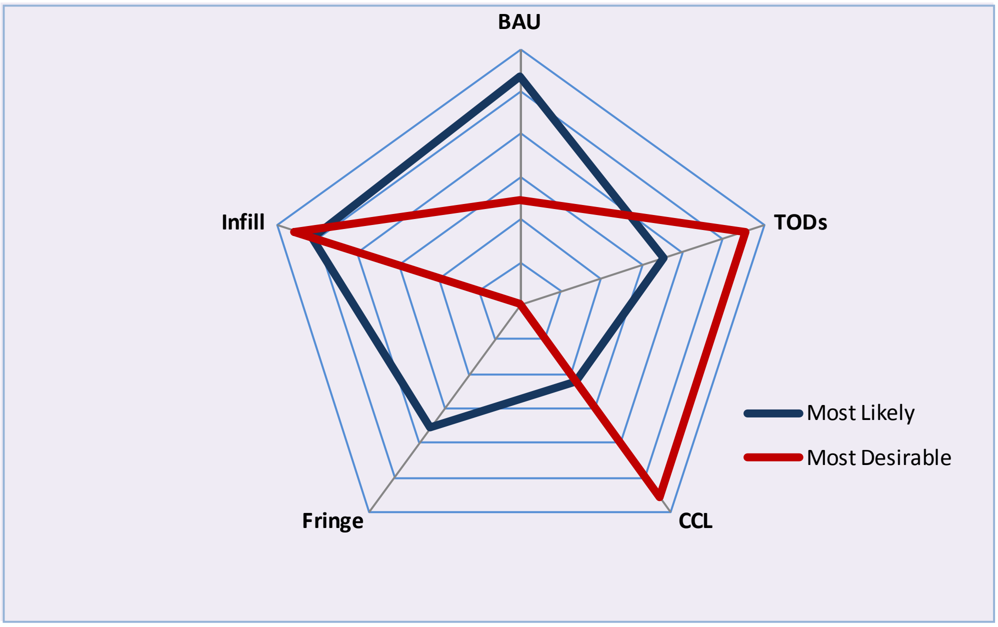
Table 8.6: Panel Ranking of Most Desirable Urban Form Outcome

	Panel Member									
Scenario	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Average**
BAU	1	4	5	4	4	4	4	4	4	**4**
TODs	5	2	1	3	2	1	1	2	3	**2**
CCL	4	3	3	1	1	3	2	1	2	**2**
Fringe	2	5	4	5	5	5	5	5	5	**5**
Infill	3	1	2	2	3	2	3	3	1	**2**

Source: Expert Panel Questionnaire

As an aid in interpreting these rankings the average score has been inverted by subtracting its value from five and displaying the resultant inverted rank scores in the spider diagram in Figure 8.7. This diagram visually illustrates the panel's view that Business as Usual and Urban Infill are the two most likely urban form outcomes, followed by TODs and corridor development and Fringe Growth. In contrast, City-centric Living, TODs and corridor development and Urban Infill are considered to be the most desirable urban form outcomes.

Figure 8.7: Panel Ranking of Most Likely and Most Desirable Urban Form Outcomes



Source: Expert Panel Questionnaire

8.4 Evaluation of Panel Responses

Two levels of evaluation are reported on here. The first follows the evaluation process outlined in Figure 3.2, except that it does not scale the argument weights for the panel's opinion of the relative influence of each force on future urban form. This evaluation provides a view of the panel's responses unimpeded by the direct opinion of the panel. The second evaluation includes the panel's opinion of the relative influence of each force and therefore is akin to the original formulation of the argument-based approach. This Section reports on the weighted outcomes for both positive and negative arguments that relate to each urban form scenario; the combined weighted average outcomes; and the distribution of these outcomes for the two levels of evaluation discussed above. Appendices A6 to A19 contain an expanded set of tables that provide the intermediate results of the evaluation process.

8.4.1 Weighted Average Outcomes Excluding Relative Influence of Forces

Table 8.7 shows the results for the weighted average outcomes for those arguments that are identified as supporting each urban form scenario. Following the original formulation of the argument-based approach, the metric of interest in this table is the sum of the weighted averages for each scenario in the last column. As previously discussed, the magnitude of individual results for the modified argument-based approach is of no relevance. The sum of the weighted average outcomes is a relative score which is compared between urban form scenarios. Based on these positive arguments, the scenario with the greatest score of 4.33 is Fringe Growth; followed by Business as Usual and City-centric Living. Given the prevalence of TODs and corridor development in the literature and in government policy, it is surprising that this scenario scored least in this positive argument measure. This inconsistency is also evident in the panel's opinion of the most likely outcomes in Figure 8.7 – Infill and Business as Usual.

Table 8.7: Weighted Average Outcomes for Positive Arguments

	Expert									
Scenario	1	2	3	4	5	6	7	8	9	Sum
BAU	0.45	0.43	0.36	0.30	0.61	0.43	0.32	0.43	0.63	**3.98**
TODs	0.15	0.32	0.31	0.37	0.42	0.41	0.34	0.28	0.49	**3.09**
CCL	0.09	0.35	0.40	0.52	0.48	0.53	0.45	0.31	0.61	**3.74**
Infill	0.48	0.41	0.31	0.31	0.31	0.40	0.34	0.25	0.52	**3.33**
Fringe	0.47	0.45	0.43	0.31	0.69	0.48	0.35	0.52	0.63	**4.33**

Source: Expert Panel Questionnaire

Table 8.8 shows the results for those arguments that have been identified as negating each urban form scenario. As with the positive arguments, the sum of the weighted average outcomes is of interest. These scores are represented with a negative sign to indicate that they detract from the urban scenario and to allow for a combined score to be produced. Although the distribution of the negative scores is lower than for the positive scores, the TODs and corridor development scenario has the greatest negative score indicating that this outcome is least likely based on negative arguments only. Business as Usual and Fringe Growth had the two lowest negative scores indicating that these scenarios have the least opposition within the arguments.

Table 8.8: Weighted Average Outcomes for Negative Arguments

	Expert									
Scenario	1	2	3	4	5	6	7	8	9	Sum
BAU	-0.18	-0.31	-0.30	-0.39	-0.39	-0.37	-0.33	-0.27	-0.52	**-3.06**
TODs	-0.40	-0.38	-0.33	-0.32	-0.60	-0.39	-0.32	-0.41	-0.64	**-3.78**
CCL	-0.48	-0.37	-0.26	-0.26	-0.53	-0.31	-0.25	-0.31	-0.64	**-3.41**
Infill	-0.33	-0.34	-0.36	-0.30	-0.63	-0.38	-0.33	-0.43	-0.59	**-3.67**
Fringe	-0.16	-0.32	-0.31	-0.40	-0.40	-0.35	-0.33	-0.28	-0.52	**-3.07**

Source: Expert Panel Questionnaire

Table 8.9 brings the positive and negative arguments together and provides the overall outcomes similar to those in the original formulation of the argument-based approach. The sum column of Table 8.9 represents the overall weighted average outcomes for each scenario, combining the positive and negative outcomes from Tables 8.7 and 8.8.

These outcomes are not scaled for the opinion of the relative influence of each force and therefore assume that each of the four forces have equal weight. The overall results indicate that the most likely outcome for future urban form using the modified argument-based approach is a continuation of urban fringe growth. This is followed by Business as Usual. There is some support for City-centric Living but this is substantially less than for Fringe Growth. The overall results for TODs and corridor development and Urban Infill are negative which can be interpreted as indicating that these scenarios are unlikely to eventuate or to continue as a dominant urban form into the future based on the expert panel responses.

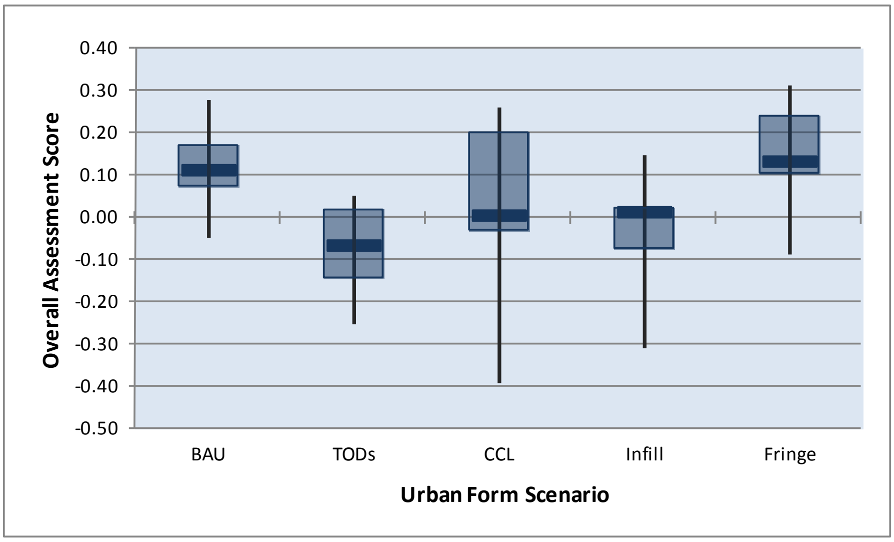
Table 8.9: Weighted Average Outcomes - Positive and Negative Arguments Combined

	Expert									
Scenario	1	2	3	4	5	6	7	8	9	Sum
BAU	0.28	0.11	0.07	-0.05	0.21	0.08	0.01	0.17	0.13	**1.01**
TODs	-0.25	-0.07	-0.02	0.05	-0.18	0.02	0.03	-0.13	-0.14	**-0.69**
CCL	-0.40	-0.02	0.14	0.26	-0.05	0.22	0.20	0.01	-0.03	**0.33**
Infill	0.15	0.07	-0.05	0.01	-0.31	0.02	0.02	-0.18	-0.08	**-0.34**
Fringe	0.31	0.13	0.12	-0.09	0.28	0.14	0.02	0.24	0.10	**1.26**

Source: Expert Panel Questionnaire

Figure 8.8 shows the distribution of the panel results for the combined weighted average outcomes. These summary statistics provide an alternative view of the overall results. There is a clear differentiation between all scenarios with Fringe Growth showing the most positive results for most summary measures – median, maximum and first and third quartiles. This is followed by strong support for Business as Usual. The distribution of the overall results for Fringe Growth, Business as Usual and TODs and corridor development are low, illustrated by the small interquartile range. This can be interpreted as the panel having a high level of confidence in its view of the likelihood of Business as Usual, TODS and corridor, and Fringe Growth scenarios. The results for the City-centric Living scenario are more dispersed indicating that the panel has less confidence in the outcome for this scenario.

Figure 8.8: Weighted Average Outcomes - Positive and Negative Arguments Combined



Source: Expert Panel Questionnaire

8.4.2 Weighted Average Outcomes Including Relative Influence of Forces

The following results are also based on the weighted average outcomes of the panel responses but are scaled to the panels' opinion on the relative influence of each force. This step incorporates the notion that economics, government policy, environmental constraints and lifestyle preferences exhibit different levels of influence on the future of urban form. Each panel member's validity by impact score is scaled based on their opinion of the relative influence of each force and the results of the argument-force mapping exercise. Table 8.10 shows the results for the weighted average outcomes for the positive arguments. As in the evaluation excluding the opinion of the relative influence of forces, Fringe Growth and Business as Usual have the greatest positive score. The three scenarios with the least support change order, with the City-centric Living scenario being least likely based on positive arguments alone.

Table 8.10: Weighted Average Outcomes - Positive Arguments (incl. Opinion of Force)

	Expert									
Scenario	1	2	3	4	5	6	7	8	9	Sum
BAU	1.01	0.87	0.68	0.46	1.85	0.84	0.57	0.84	1.42	**8.54**
TODs	0.32	0.50	0.56	0.60	0.74	0.68	0.56	0.46	0.96	**5.38**
CCL	0.11	0.38	0.50	0.77	0.61	0.67	0.63	0.36	0.92	**4.95**
Infill	1.01	0.83	0.53	0.54	1.25	0.70	0.56	0.59	1.13	**7.14**
Fringe	1.02	1.01	0.84	0.46	2.09	0.98	0.64	1.11	1.40	**9.54**

Source: Expert Panel Questionnaire

Table 8.11 shows the results for negative arguments including the opinion on force weights. The ranking of the first three scenarios remains the same as for the evaluation without the opinion on force weights – that is, TODs and corridor growth has the least support, followed by Urban Infill and then City-centric Living. Fringe growth and Business as Usual switch ranking with the negative arguments favouring continued Fringe Growth over Business as Usual.

Table 8.11: Weighted Average Outcomes - Negative Arguments (incl. Opinion of Force)

	Expert									
Scenario	1	2	3	4	5	6	7	8	9	Sum
BAU	-0.32	-0.43	-0.45	-0.56	-0.58	-0.50	-0.46	-0.40	-0.79	**-4.49**
TODs	-0.79	-0.66	-0.52	-0.43	-1.58	-0.63	-0.48	-0.71	-1.13	**-6.93**
CCL	-0.95	-0.58	-0.38	-0.39	-1.46	-0.45	-0.39	-0.54	-1.19	**-6.31**
Infill	-0.64	-0.59	-0.63	-0.41	-1.64	-0.61	-0.50	-0.74	-1.03	**-6.81**
Fringe	-0.29	-0.42	-0.41	-0.59	-0.61	-0.45	-0.45	-0.41	-0.80	**-4.42**

Source: Expert Panel Questionnaire

Table 8.12 shows the final overall outcomes for future urban form. The combined positive and negative arguments, scaled to the opinion of each panel member on the relative influence of each force indicate a continuation of fringe growth, followed by Business as Usual. The overall sums for the scenarios of Urban Infill, City-centric Living and TODs and corridor development are all negative. Based on the arguments included in this exercise and the opinion of the panel members on the relative influence of each force, this result suggests that these scenarios are unlikely to eventuate or to continue as a dominant urban form into the future.

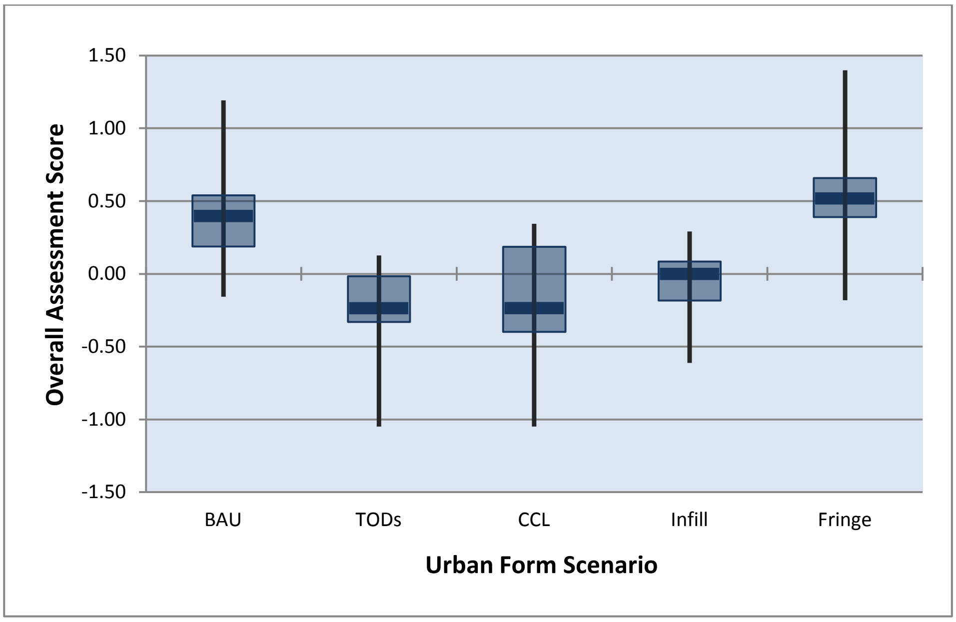
Table 8.12: WAVE Outcomes Positive and Negative Arguments Combined (incl. Opinion of Force)

	Expert									
Scenario	1	2	3	4	5	6	7	8	9	Sum
BAU	0.66	0.40	0.19	-0.16	1.19	0.29	0.06	0.40	0.54	**3.58**
TODs	-0.56	-0.24	-0.02	0.13	-1.05	-0.02	0.03	-0.33	-0.31	**-2.37**
CCL	-0.94	-0.26	0.07	0.34	-1.05	0.19	0.19	-0.24	-0.40	**-2.09**
Infill	0.29	0.17	-0.18	0.09	-0.61	0.02	0.00	-0.25	-0.03	**-0.50**
Fringe	0.72	0.54	0.39	-0.18	1.40	0.49	0.14	0.66	0.52	**4.67**

Source: Expert Panel Questionnaire

Figure 8.9 confirms this overall outcome. Fringe growth and Business as Usual clearly out rank the competing scenarios for all summary measures.

Figure 8.9: Distribution of Weighted Average Outcomes Positive and Negative Combined



Source: Expert Panel Questionnaire

8.5 Population Outcomes for Likely Urban Form Scenarios

Although the conceptual framework developed for this study has a focus on future urban form outcomes, the final goal of the framework is to aid in the development of assumptions for local area population projections. The modified argument-based approach is designed to provide guidance on the emphasis to be given to the likely distribution of the population across geographic space. The methods used to produce population projections in South Australia were discussed in detail in Chapter two.

The results from the modified argument-based approach indicate that the most likely future urban form outcomes for the study area are continued fringe growth and Business as Usual. To complete the aim of this study, these urban form scenarios have been translated to local area population projections using the projection models and procedures outlined in Chapter two. Fundamentally, the SAASPPS cohort component model and the HAM housing-land use model, are used to produce a distribution of the population based on a projection of the future distribution of dwellings. The assumptions developed for the projection of the future distribution of dwellings are based on assumptions about likely future urban form. Effectively, development opportunities provided to the HAM model are constructed around the eventuation of continued urban fringe growth and Business as Usual scenarios. See Appendix A20 for details.

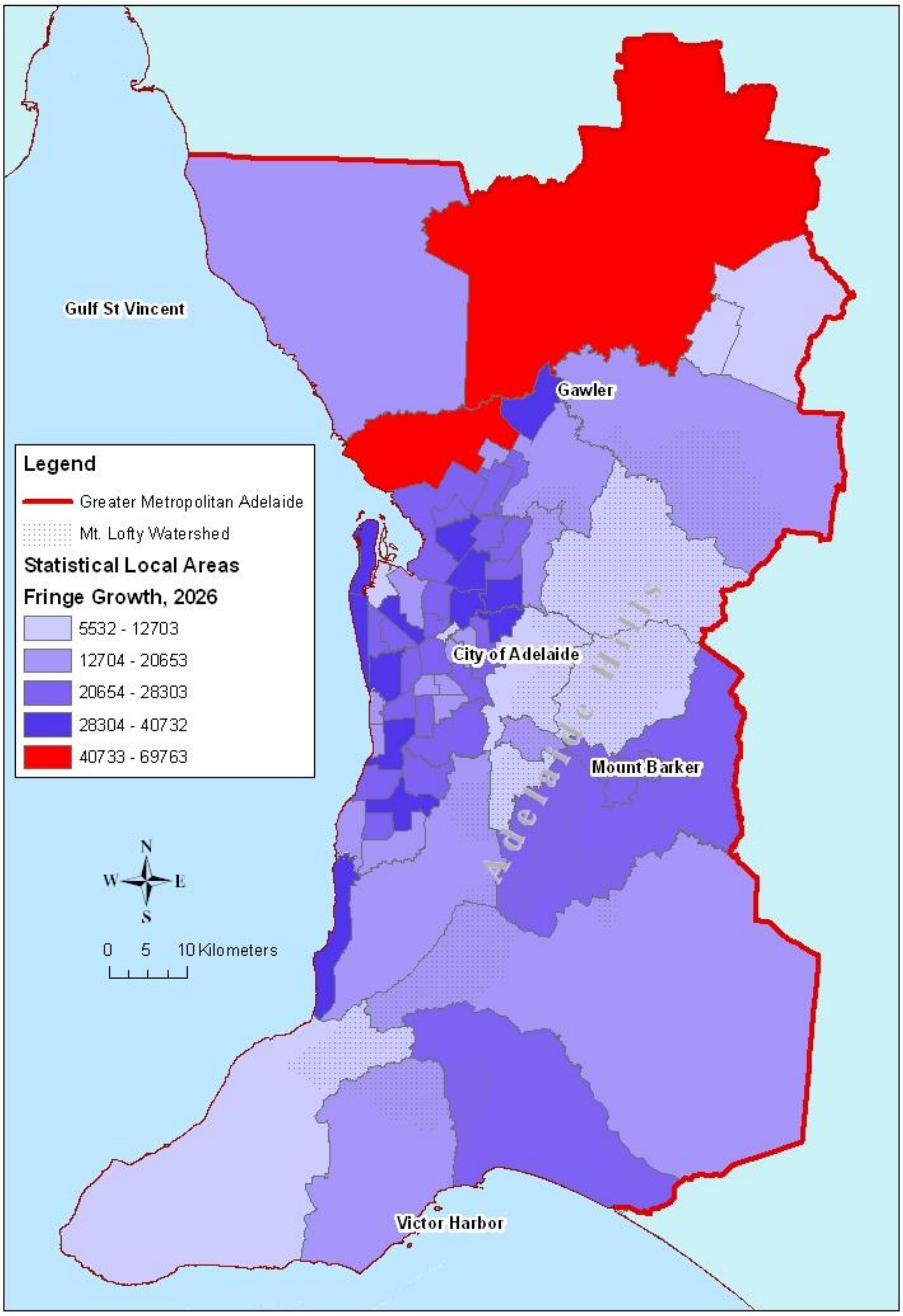
Figure 8.10 shows the population distribution based on the Fringe Growth scenario. Continued fringe growth results in projection outcomes that are heavily biased to the available residentially zoned land to the north of Greater Metropolitan Adelaide – shaded red.

Under this scenario, pressures for continued fringe growth result in the State government rezoning large tracts of land to residential use. This area has enormous potential for future growth. The relatively large area of the high growth SLA in the north of the study area is due to its current low population[49]. The majority of the growth opportunities in this SLA are in the southern part of the SLA adjacent to the township of Gawler. The adjoining high growth SLA of Playford West – also shaded red – is also relatively large. This SLA has been rapidly growing for some years and has substantial potential for further growth.

The logic underpinning the continuation of fringe growth as the most likely urban form outcome is that the lower cost of housing on the fringe outweighs the cost of commuting and lack of surrounding services and amenity that may be accessible closer to the City of Adelaide. In addition, the environmental measure of a loosely defined urban growth boundary has been breached with expansion of urban growth into agricultural land to the north. Government policy in the form of urban consolidation is assumed to have failed – particularly with regard to TODs and corridor growth. This is likely due to a lack of demand for the type of dwelling stock on offer in these developments or the uneconomical nature of large-scale apartment developments within an Adelaide context.

[49] ABS SLAs are designed to contain roughly the same number of people. This results in low density areas having large SLAs by area.

Figure 8.10: Fringe Growth Scenario, Total Population, 2026



The SLAs shaded dark blue in Figure 8.10 also display strong growth. These areas are either economical for minor infill – the replacement of one dwelling for two or three – or offer a lifestyle advantage around natural or constructed amenity. However, the dominant household location choice in this scenario is for cheaper, larger homes on relatively large blocks of land that are available on the fringe.

Figure 8.11: Business As Usual Scenario, Total Population, 2026

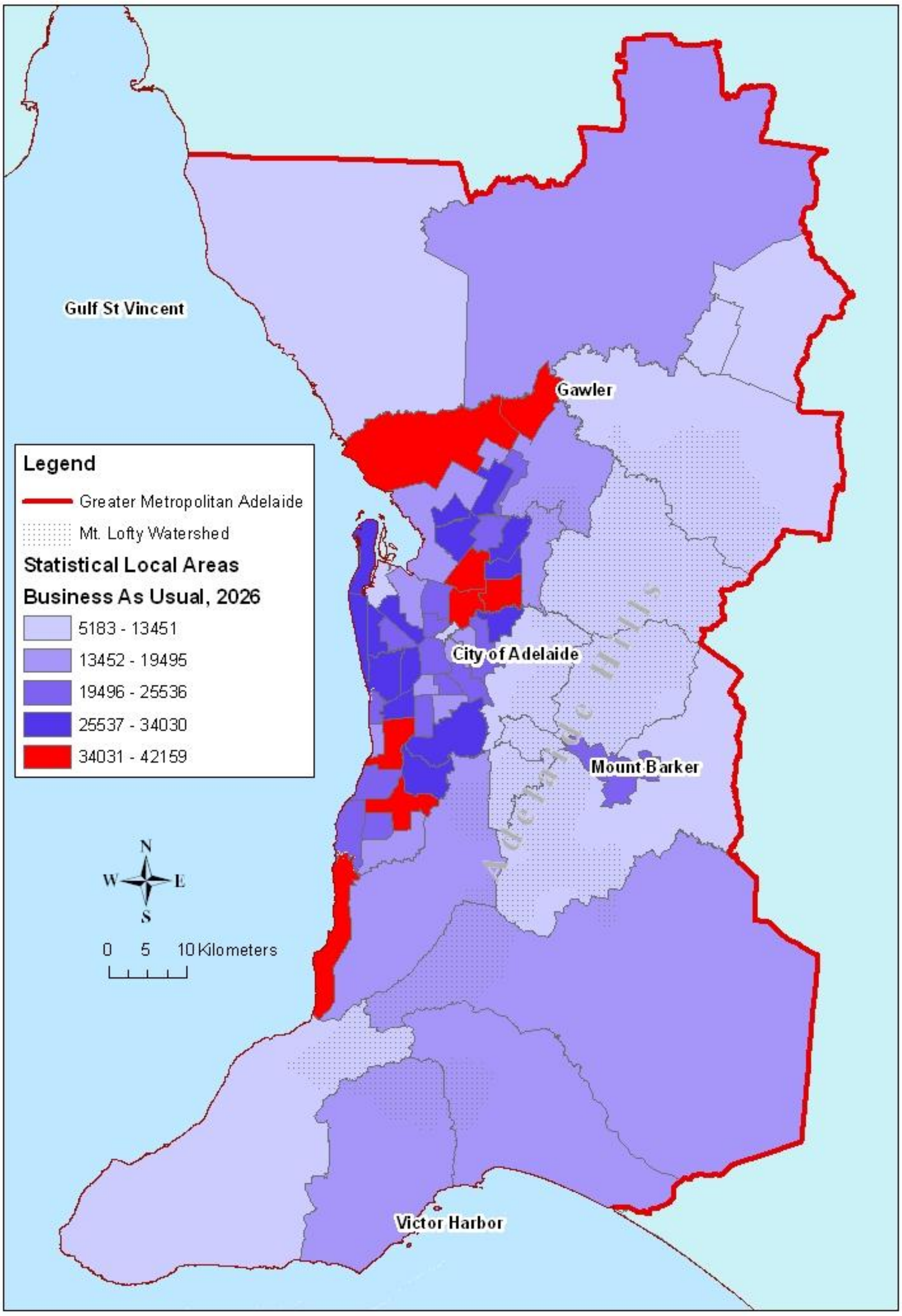


Figure 8.11 shows the distribution of the population that would result from the Business as Usual scenario. The large, northern SLA that dominates growth in the Fringe Growth scenario receives little growth as there is sufficient development potential within the metropolitan area not to require additional greenfield land on the fringe.

The key difference between the Fringe Growth and the Business as Usual scenarios is the significantly higher growth in minor infill developments in SLAs closer to the City of

Adelaide. As discussed in Chapter six, minor infill has traditionally represented a third of all new dwelling stock within the study area. An assumption of Business as Usual necessarily continues the availability of existing housing stock for redevelopment. The SLAs of major growth in this scenario are areas of ageing dwelling stock leading to economical minor infill development. The demand for infill development around existing constructed amenity and demand for southern coast lifestyle continues.

The Business as Usual scenario assumes a balance between the cost of housing and commuting with a substantial number of households choosing to live closer to the City of Adelaide and other amenity hubs. The environmental outcomes of containment of urban growth and urban consolidation are a bi-product of lifestyle choices and economic considerations rather than conscious environmental concerns. Government policy facilitates urban consolidation but not to the extent included in government strategic plans.

However, the SLA of Playford West receives significant growth similar to the Fringe Growth scenario; along with the neighbouring township of Gawler. These areas have significant existing infrastructure and services and provide a variety of block sizes at reasonable prices.

8.6 Conclusions

This Chapter has discussed the results of the panel responses to the expert panel questionnaire on future urban form. The foundation of the modified argument-based approach are the responses of the panel members to the Likert scales for each argument. Chapter three discussed the application of non-probability sampling in the context of qualitative and mixed-methods research. The concepts of saturation and diminishing returns are relevant to both the evaluation of responses and an understanding of the results of the approach.

The scores associated with the Likert scales facilitate the quantitising of responses for use in the evaluation stage of the approach. The goal of the approach is to arrive at comparative numerical outcomes that can differentiate between urban form scenarios. The definition of saturation for this study relates to capturing sufficient variability in responses to illustrate a broad coverage of the forces and urban form scenarios. The evaluation of the panel member responses in this Chapter clearly demonstrates the variability between panel member responses. This high level of variability provides support for the adequacy of the expert panel, and indicates a broad range of views from panel members.

The variability within the responses is sufficient to differentiate between urban form scenarios. Fringe Growth and Business as Usual being the most likely outcomes based on the results of this study. Within the definition of saturation adopted in this study, these results support the notion that sufficient data have been considered to both cover the key issues; and differentiate between scenarios.

Chapter 9 Conclusions

9.1 Overview

This Chapter initially discusses how this study has addressed the research question, followed a discussion of the evaluation process and the use of judgement as applied in this work. The practical applications and feasibility of the modified argument-based approach are then covered. Potential future work is then identified before offering some concluding remarks.

The research question posed in this study is how can the judgement required in setting local area population projection assumptions be improved? To address this question, a structured and systemic approach has been adopted that looks beyond opinion and individual judgement, toward what has been termed 'objective' judgement. The conceptual framework presented in Chapter one leverages two key methodologies for considering future uncertainty – expert elicitation and scenarios.

As a focal point, this study considers the assumption regarding the future spatial distribution of the population. Many local area population projection methods couple land use allocation and cohort-component models (Pittenger, 1976; Smith et al., 2001; Wilson, 2012). Land-use allocation models need to consider, either explicitly or implicitly, likely changes to future urban form. The projection methodology used in this study requires an explicit determination of future urban form to enable a distribution of dwellings and local area population totals. Future urban form is used in this study as an example of an assumption that is complex, has inherent uncertainty, and requires judgement. Future urban form also lends itself to the development of scenarios and, as such, satisfies the requirements of the conceptual framework as it is characterised in this study.

All urban areas are unique: geographically, environmentally, economically and socially – and in terms of their urban form. The urban form of the study area - Greater Metropolitan Adelaide in South Australia - is a product of government planning, historical accident and the influence of the myriad of forces that have shaped its present form. To better understand the current and future urban form of the study area requires an understanding of the major forces that act on the urban system to both shape and distort urban form outcomes.

The approach taken in this study is to develop a conceptual framework that identifies potential urban pathways for the study area, which are then represented as urban form scenarios. The argument-based approach developed by IIASA (Lutz, 2006; Lutz, 2009), is modified to allow a comparative evaluation of the forces that shape future urban form and the substantive arguments underpinning these forces.

The context of the conceptual framework is that the four forces of economics, government policy, environmental constraints and lifestyle preferences are in conflict. The individuals, households, developers, institutions and government agencies that breathe life into these forces are equally in conflict.

Through a cross-disciplinary review of the literature across the domains of economics, planning policy, environmental constraints and lifestyle preferences, the major forces that shape urban form have been considered. Through the literature, the complexity and uncertainty of the impact of these forces has been highlighted. It is clear from the literature review that the stated aims of many planning strategies have been questioned by many in the field; the proposed benefits of New Urbanism and Smart Growth philosophies are potentially untested; the commitment of developers to, and the economic viability of, high density residential living in a city such as Adelaide is uncertain; and the assumed changing preferences of the young and retirees towards apartment living are yet to materialise.

As discussed in Chapter three, expert elicitation is a formal process designed to address issues that are highly uncertain and have a range of possible futures (Usher and Strachan, 2013, p.812). Given the uncertainty and the range of possible urban futures, expert elicitation is highly suited to the evaluation of likely future urban form. The development of assumptions for likely future urban form in this study are based on the evaluation of responses from an expert panel; facilitated by the modified argument-based approach.

The results of the argument-based approach are not a summary of the panel members' opinions; they are an interpretation of the responses to elemental arguments concerning future urban form. Given the conceptual difference between expert opinion and the interpretation of arguments, it is important to understand that the results of the argument-based approach are an objective evaluation of the panel's responses. These objective results can differ markedly from the opinion of the panel. Indeed, this potential difference is the major reason why the argument-based approach is adopted and modified for this study.

The following discussion considers this difference by comparing the panel's opinion of the likelihood of each urban form outcome eventuating; the results of the argumentation exercise; and the results of the literature review.

9.2 Addressing the Research Questions

The research questions addressed in this study are:

1. How can the judgement required in developing assumptions for the future spatial distribution of local area population projections be improved?
2. Can a conceptual framework that evaluates the substantive arguments that underpin possible future urban form outcomes aid in improving the development of these assumptions?

The associated aims of this study are to:

1. Develop a conceptual framework that uses scenarios to identify possible future urban form outcomes
2. Identify the major forces shaping future urban form
3. Use an expert panel to evaluate these major forces based on the argument-based approach developed by IIASA (Lutz, 2006; 2009)
4. Identify the most likely future urban form outcome by evaluating the substantive arguments associated with each major force and each urban form scenario
5. Produce a population projection scenario of the most likely distribution of the population based on the most likely urban form outcome.

As stated at the beginning of this study, the development of population projection assumptions ultimately relies on the judgement of the projection practitioner, on expert opinion of the likely levels and trends in demographic factors, or on the contribution of a panel of experts; and that this judgement is made at a point in time, with limited information and with the knowledge that reality is continually changing.

To aid in this judgement, this study has modified the argument-based approach (Lutz, 2006; 2009) to evaluate possible urban form outcomes for Greater Metropolitan Adelaide in South Australia. The cross-disciplinary literature review has provided a view of the substantial influences that potentially shape urban form and an insight into the possible future spatial distribution of the population. An evaluation by an expert panel of the substantive arguments that either support or negate various scenarios of future development pathways, offers an alternative to the individual judgement of the population practitioner or disciplinary-specific experts in their field.

By necessity this study has taken a slice through reality to facilitate a structured approach in the form of a conceptual framework. This requires a representation of reality through the classification of urban form and the forces that shape it.

As stated previously in this study, there is no *solution* to the problem of developing population projection assumptions. The methodology developed in this study is considered to overcome some of the problems inherent in intuitive judgement (Kahnerman and Tversky, 1977), by facilitating the objective judgement of a panel of experts. The argument-based approach (Lutz, 2006; 2009), and the modified argument-based approach developed in this study, are designed to cut-through inherent biases in developing assumptions - such as anchoring to recent events and the potential herd mentality of panels - to provide an alternative view of likely futures. This alternative view is based on a rigorous and structured approach that is defensible and potentially more accurate and politically acceptable than assumptions based on intuitive judgement alone (Kahneman and Tversky, 1977).

The research questions address a fundamental issue in developing local area population projections that require independent projections of the likely future distribution of dwellings. The premise of this study is that future urban form will *reflect* the distribution of future populations. A better understanding of future urban form will therefore provide insight into the likely future distributions of the population.

As discussed in Chapter one, there is a silent war raging in the cities, in the suburbs and on the urban fringe, with forces pushing and pulling the urban fabric towards vastly different urban form outcomes. The outcomes of the battles waged will determine both where and how we live our lives. A starting point in understanding these battles is to understand the forces at play; and to understand these forces requires an ontology – a classification – of the broad themes that may influence future urban form. The ontology developed in Chapter four adapts a common ontology of sustainable development and derives economic, government policy, environmental constraints and lifestyle preferences, as the major forces driving future urban form. These forces provide a sound structure for the cross-disciplinary review of the literature around urban structure and population distribution. These forces also provide an intuitive and easily understood classification scheme for the expert panel to make a judgement on their relative influence on shaping future urban form.

The ontology developed provides a broad classification scheme within which the arguments supporting and negating urban form outcomes can be considered. Through the literature review and the development of arguments for the modified argument-based approach, the four broad forces are both built up from their historical roots and deconstructed to elemental arguments. Through forces such as the need for affordable housing, the pursuit of amenity, facilitation by government policy or the reactions to the perceived cost to the environment, urban form changes over time towards an uncertain future.

Local area population projection practice is fundamentally an empirically driven process that is reliant on past trends, and the outcomes of assumption-based models. A mainstay of local area projections is the distribution of future populations based on assumptions concerning the future availability of dwellings. These housing allocation models are themselves reliant on assumptions on the future availability of residential land for development. Current government policy and current dominant paradigms are a strong influence on the assumptions regarding future land availability. An assumption based on New Urbanism and Smart Growth principles, such as Transit Oriented Development, will embed this outcome in the population outcomes. Assumptions of continued development on the urban fringe will do likewise. These assumptions are, therefore, critical to the projection outcomes for the future distribution of the population.

This study adopts a structured evaluation approach that deconstructs the broad forces that shape future urban form to their elemental arguments. These arguments are evaluated using a modified argument-based approach that allows for a comparative judgement to be made on the likely future of urban form.

The value of this approach is that it has the potential to look beyond current opinion and paradigms, and identify emerging trends that may be obscured by the current view. An alternative perspective is available by evaluating the elements of broad themes and forces that may provide vastly different outcomes to those derived from the literature and from expert opinion.

The fundamentally different outcomes determined for the literature review, expert opinion and the modified argument-based approach are a positive outcome for this study. The benefit of the conceptual framework and the modified argument-based approach is in its ability to provide this alternative view of future outcomes.

9.3 Evaluation of Urban Form – Three Perspectives

Within this study there have been three perspectives on future urban form:

- the literature review and an interpretation regarding the likely future urban form that would result if the dominant views for each force were to eventuate
- the opinion of the expert panel of the most likely and the most desirable future urban form
- the results of the structured element of the modified argument-based approach - an evaluation of the panel's responses to a range of arguments that compare the likelihood of each future urban form scenario eventuating.

9.3.1 Literature Review

Based on a cross-disciplinary literature review, Chapter four summarises the fundamental relationships between the four forces of economics, government policy, environmental constraints and lifestyle preferences, and the five urban form scenarios developed in Chapter six. Based on this interpretation of the literature review:

- economic forces primarily support the three scenarios of Business as Usual, Urban Infill and Fringe Growth
- lifestyle forces primarily support Fringe Growth, City-centric Living and TODs and corridor development
- government policy and environment constraints primarily support City-centric Living and TODs and corridor development.

Based on this interpretation of the literature the hierarchy of the most likely future urban form is:

1. TODs and corridor development and City-centric Living are the most likely future urban form

2. Fringe Growth is the next most likely

3. Urban Infill and Business as Usual are the least likely outcomes.

This hierarchy of future urban form outcomes, as interpreted through the literature review, is compared with the results of the modified argument-based approach below – both the opinions of the panel and the evaluation of the argument-based process.

9.3.2 Expert Opinion

In addition to providing responses to the 55 arguments, each of the panel members is asked for their opinion regarding the relative influence of the four forces that may influence future urban form for Greater Metropolitan Adelaide; and their opinion on the most likely and most desirable future urban form. These opinions are fundamentally different to the evaluation of the arguments in the modified argument-based approach in that they represent the intuitive judgement of the panel members. They are important in the discussion of future urban form because in general, opinion is both the desired and most common contribution that experts make to issues, such as the development of population projection assumptions. The major benefit of the argument-based approach, and the modified argument-based approach developed in this study, is the potential to deconstruct this expert opinion, and through the structured evaluation process to uncover an alternative set of panel views that differs from intuitive judgement.

The opinion of the panel members on the relative influence of each force on future urban form resulted in a definitive opinion that economics strongly determines future urban form. Lifestyle preference and government policy were considered to have approximately half the influence of economics. Environmental constraints – which feature prominently in the literature – were considered to have much less influence than the other forces.

The panel members were also asked for their opinion on the most likely future urban form. The panel viewed Business as Usual and Urban Infill to be the most likely future urban form outcomes; followed by TODs and corridor development, and fringe development.

9.3.3 Modified Argument-Based Approach

The modified argument-based approach developed in this study, provides an objective and comparative method to evaluate the responses of the expert panel to the substantive arguments and the forces that shape future urban form. Two levels of evaluation are reported on in Chapter eight: an evaluation that adjusts for the different number of arguments associated with each force but does not scale the validity by impact scores for the panel's opinion of the relative influence of each force on future urban form; and an evaluation that includes both weighting and scaling.

The overall results excluding opinion on the relative influence of each force indicate that the most likely outcome for future urban form is a continuation of urban fringe growth; followed by Business as Usual; with some support for City-centric Living. Results for TODs and corridor development and Urban Infill suggest that these scenarios are unlikely to eventuate or to continue into the future.

The overall results including the opinion of relative influence of each of the four forces also indicate that Fringe Growth is the most likely future urban form; followed by Business as Usual. Under this evaluation, Urban Infill, City-centric Living and TODs and corridor development are unlikely to eventuate or to continue as dominant urban forms into the future.

Table 9.1 compares the three perspectives from the literature review, the opinion of the panel and the results of the evaluation component of the modified argument-based approach, which included the panel opinion on relative influence of each force. Given the number of arguments and the leveraging power of the argument-mapping exercise, the outcomes for the argument-based approach allows for a clear differentiation between the five scenarios. The results for the literature review and panel opinion are less precise – ranked one to three - and therefore some scenarios cannot be separated. The hierarchy of likely urban form outcomes is, however, still decisive.

Table 9.1: Comparison of Likely Urban Form Outcomes (1 most likely to 3 (or 5) least likely)

SCENARIO	LITERATURE REVIEW	PANEL OPINION	ARGUMENTATION
TODS AND CORRIDORS	1	2	5
CITY-CENTRIC LIVING	1	3	4
FRINGE GROWTH	2	2	1
URBAN INFILL	3	1	3
BUSINESS AS USUAL	3	1	2

Source: Expert Panel Questionnaire

The results for the literature review, the panel opinion and the modified argument-based approach display vastly different outcomes for the likely future of urban form. The literature review shows a clear preference for a change in urban form toward densification and the principles of Smart Growth and New Urbanism. Surprisingly, Fringe Growth appears to be more likely than continued Urban Infill or Business as Usual. This result may be a reflection of the lifestyle preferences of family households for space in both dwelling and land; but may also reflect the availability of affordable housing on the fringe.

The panel opinion of the most likely future urban form is almost a mirror image of the literature review results. Urban Infill and Business as Usual are considered to be the most likely outcomes for future urban form. A major difference between the panel opinion and the literature review results is that Fringe Growth and TODs and corridor development are considered equally as likely by the panel members. One interpretation of the panel's opinion is that urban form will continue on a Business as Usual trajectory – Fringe Growth and Urban Infill together equating to Business as Usual – with the addition of TODs and corridor development. Other than City-centric Living, which is considered the least likely future urban form outcome, the panel opinion can be characterised as a conservative approach with little change to the current dynamics that shape urban form; but an approach that accepts the dominant views expressed in the literature that increased densification and an adoption of Smart Growth and New Urbanism principles will eventuate in the near future.

Possibly the most important outcome of this study is that the results from the modified argument-based approach differ significantly from the evaluation of the literature review and the panel opinion. The most likely urban form outcome based on the modified argument-based approach is for continued fringe growth; and the least likely outcome is for TODs and corridor development. Given the dominance of TODs and corridor development in the literature – particularly relating to environmental imperatives and contained within government planning strategies – this is an important finding.

Looking at the most likely outcome – Fringe Growth – and the second most likely – Business as Usual – the results of the modified argument-based approach indicate an underlying view that the dynamic forces that shape future urban form will result in continued development of detached dwellings on greenfield sites. By definition, there is a limited amount of greenfield sites available in the current urban area of Greater Metropolitan Adelaide. Over time, this low-density development will by necessity expand the fringes of the urban area and result in continued urban sprawl. Urban Infill, which is the third most likely urban form outcome, will continue, but is unlikely to stop future urban sprawl. It is interesting to note that minor infill, which accounts for about 30 per cent of Greater Metropolitan Adelaide's residential growth is likely to continue, yet it is not at the forefront of government policies. One of the primary goals of government policy is increased densification, which is occurring almost incidentally through developer and consumer preference.

Taken together, TODs and corridor development and City-centric Living describe a central plank of the South Australian government's planning strategy contained in the 30 Year Plan for Greater Adelaide (Government of South Australia, 2010a). In terms of the results for the modified argument-based approach, the forces that shape future urban form will not support this desired trajectory – and in all likelihood these forces will negate the development of TODs and corridors and City-centric Living.

In Chapter one of this study, it was commented that population projections can provide a measure of the gap between desired planning outcomes and the current trajectory and distribution of growth. A population projection scenario based on the findings of the modified argument-based approach, may provide some insight into whether the desired outcomes in the 30 Year Plan for Greater Adelaide are likely to be achieved. This finding would suggest that the focus of urban planning policy may need to be redirected from target growth, towards a better understanding of the forces that shape future urban form.

9.4 The Use of Judgement

The modified argument-based approach is designed to improve the judgement required for developing assumptions for local area population projections. Although counter-intuitive, to achieve this requires substantial judgement - from both the expert panel and the population projection practitioner.

An initial judgement must be made by the practitioner on the membership of the expert panel. This includes the background and academic discipline of the members and the number of members on the panel. The selection of members is guided by the concepts of adequacy and saturation, as discussed in Chapter three.

Although the modified argument-based approach is designed to transcend the intuitive judgement of panel members to derive the objective judgement of the panel, there is little doubt that the choice of panel members will influence the outcomes of the evaluation process. The choice of different panel members may or may not affect the final determination of the most likely urban form scenario. The issue for this study is whether the use of expert elicitation can improve the judgement required for developing assumptions. Given the uncertainty and range of possible urban futures, expert elicitation is an appropriate methodology to inform likely future urban form.

The development of the major forces and the substantive arguments used in the modified argument-based approach also requires judgement. This judgement, however, is informed by the cross-disciplinary literature review that explores the relationships between the four forces and urban form. The use of a systems-thinking approach aids in the construction of the substantive arguments for this study.

The modified argument-based approach does not require an exhaustive list of arguments to be effective. Indeed, an exhaustive list would be impossible to derive. What is required is sufficient coverage of the issues to enable a differentiation between the likelihood of each urban form scenario eventuating.

Similar to the choice of an expert panel, a different rendering and choice of substantive arguments may lead to different results. But given that these arguments are based on the literature review, there will be a commonality between any choice of arguments based on the same literature review.

Finally, the assignment of arguments to forces and to scenarios requires judgement. Once again, a different assignment may or may not result in different outcomes for the most likely urban form scenario. This assignment is also based on the literature review and the systems-thinking approach, and should therefore be soundly based on the influences and relationships that emerge from the literature.

9.5 Practical Applications of this Work

The argument-based approach is an established method that assists the development of assumptions for the official UK population projections at the national level (Shaw, 2008). This significant acceptance of the benefits of the method provides support for the in-principle use of the method in other contexts, such as in South Australia. The modification of the method for local area projections offered in this study is based on the same principles as the original form of the method and, as such, can borrow some legitimacy from the original form.

In terms of feasibility, the selection of local experts for inclusion in the expert panel is no different whether in the UK or in South Australia. In fact, getting buy-in from South Australian experts may well be an easier task than recruiting the esteemed panel used in this study.

The current process for peer review of the official South Australian population projections includes the establishment of an Interdepartmental Committee of academics and relevant departmental representatives to review the assumptions for the projections. This Committee could provide a base for an expert panel.

One of the critical strategic planning documents for South Australia is the 30 Year Plan for Greater Adelaide. One of the key requirements for the Plan is an understanding of the possible and likely futures of urban form. Without this understanding, the Plan could simply be an aspirational vision with little or no likelihood of success. A more objective evaluation of the likely future of urban form would provide a reality check to what may be nothing more than a political thought bubble.

9.6 Future Work

This study – building on the argument-based approach (Lutz, 2006; 2009) - provides a foundation for future scholarly work on improving the use of judgement in the development of assumptions for local area population projection practice.

The conceptual framework developed in this study is considered robust. The scenario approach to urban form outcomes, the ontology of forces and their associated arguments based on a cross-disciplinary literature review, and the application of the modified argument-based approach, provide a framework that can be applied to a variety of urban locations. The geographic specificity of the framework is embedded in the development of scenarios; the identification of forces and arguments; and the location-specific knowledge of the expert panel. This, in part, may explain the divergence between the general findings in the literature, and the results of the expert panel. Notwithstanding the robustness of the framework, each element of the framework would benefit from critical evaluation.

9.6.1 Urban Form Scenarios

As discussed in Chapter six, urban form is complex and does not exist in discrete spatial or built form classifications. Judgement is required to differentiate types of urban form and to associate this urban form with specific or relative locations. This study utilises urban development typologies developed by the South Australian urban planning authority, along with an interpretation of a Business as Usual scenario based on recent development trends.

Pre-existing urban form typologies are unlikely to be available in all urban areas. For this reason, the categorisation of urban form would benefit from a structured approach to developing possible urban form scenarios. Criteria around urban density; the mix of local activities; accessibility to services and other amenities; accessibility to job opportunities and to education facilities; and relative location within the metropolitan space, may all assist in developing such an approach.

9.6.2 The Forces that Shape Future Urban Form

The forces identified in Lutz (2006; 2009) and Shaw (2008), relate directly to the demographic factors of fertility, mortality and migration. As such, they are specific to the demographic factor to which they apply. The modified argument-based approach within the conceptual framework developed for this study, adopts an argument-mapping procedure that leverages each argument, and applies arguments to various forces and urban form scenarios. Arguments are presented to the panel without reference to the forces to which they may apply, as they may apply to more than one force. The forces identified that shape future urban form, are at a broader level than those for fertility, mortality and migration. One of the reasons for the broad ontology of forces is to facilitate the cross-disciplinary literature review. The adoption of disciplinary-wide forces ensures a more comprehensive coverage of the literature than would result from narrowly defined forces.

Lifestyle preference has been identified in this study as sufficiently important to future urban form to be addressed in its own right. Any future ontology of forces that shape future urban form may apply this same logic to the other forces – economics possibly standing out as a force that could be refined. Equally, other social forces, such as family formation or social equity, may be identified as relevant to urban form. There is considerable potential to develop alternative ontologies that may improve and refine the approach offered in this study. However, the principle of ensuring a comprehensive coverage of the literature and of forces is paramount in retaining the systems approach inherent in the conceptual framework.

9.6.3 The Modified Argument-Based Approach

The argument-based approach has been applied for a number of years to both world and national population projections (Lutz, 2006; Shaw; 2008). The United Kingdom Office for National Statistics has used the approach for several rounds of population projections for the United Kingdom and has developed an esteemed panel of experts that contribute to this process.

The modified argument-based approach developed in this study is in its formative stage. Although retaining the essence of the original form of the argument-based approach, by necessity fundamental elements of the approach have been modified to enable a comparative outcome for future urban form scenarios. The fundamental addition to the original form is the argument-mapping process. The approach taken in this study is for the author to make a judgement on the development of arguments; the relevance of each argument for each force; and whether each argument will support, negate or have no influence on each urban form scenario eventuating. Alternatively, argument-mapping could be derived by the expert panel – although there is a risk that this may pre-empt responses to the expert panel questionnaire. However facilitated, the argument-mapping exercise may benefit from expert opinion.

9.7 Concluding Remarks

As stated at the beginning of this study, the aim is not to provide a *solution* to the problem of developing local area population projection assumptions, as there is no solution - it is a wicked problem (Rittel and Webber, 1973, p.160). The conceptual framework developed in this study is intended to *aid* in developing local area population assumptions through an evaluation of the substantive arguments that underpin the forces that shape future urban form. Given the uncertainty associated with future urban form, the use of expert elicitation within the context of the modified argument-based approach, and the broader conceptual framework, provides a structured and systemic method to better understand likely urban futures.

The future urban development pathway for the study area is unknown, as is the distribution of the population associated with it. The intuitive judgement of experts in the fields of demography, urban geography and urban planning can all contribute to the evaluation of possible urban and population futures. What this study offers is an alternative to this intuitive judgement, in the form of ‘objective judgement’.

Appendices

A 1: IIASA/ONS EXPERT PANEL QUESTIONNAIRE (Lutz, 2006)

MAJOR FORCES INFLUENCING COHORT FERTILITY

Force F.1	Trend in ideal family size and the strength of individual desires for children
Argument F.1.1	It is part of human nature to want at least two children on average. This is unlikely to change in the future.
Argument F.1.2	Family size ideals will be on the decline as young people experience fewer children around them and hence have fewer children as part of their expectations of what constitutes a desirable life.
Argument F.1.3	There is likely to be a revival of the value attached to children and family life and it will become more fashionable again to have larger families.
Argument F.1.4	A strong desire for two child families will continue because of the value attached to siblings.
Argument F.1.5	The only floor (minimum level) on ideal family size is that most people will still want to experience parenthood and so will have at least one child.

Force F.2	Trend in the patterns of education and work, including the proportion of time to be dedicated to the professional side of life (in the context of globalization)
Argument F.2.1	Education and work will consume increasing proportions of our time and become more important as the main sources of our personal identities.
Argument F.2.2	New technologies and increases in productivity will reduce the time spent on work and increase leisure time.
Argument F.2.3	The knowledge society, which will lead to still longer times of young adulthood spent in education, will lead to a postponement of family formation processes.
Argument F.2.4	School reforms and reductions in youth unemployment in the future will lead to younger ages at which men and women become economically independent.
Argument F.2.5	Increasing female labour force participation and an increase in a woman's age at retirement will reduce the potential number of grandmothers as they will be working and will not be able to offer their services for childcare.
Argument F.2.6	New policies will allow young parents to reduce significantly their workload for several years with close to full compensation of income.
Argument F.2.7	We will likely see an increasing "division of labour" with some women becoming entirely work-oriented, while others are compensated by society for raising children.

Force F.3	**Changing macro-level conditions (government policies, childcare facilities, housing, etc.) that influence the cost of children in a broader sense**
Argument F.3.1	Governments will likely improve the financial support for children by raising child subsidies and tax benefits.
Argument F.3.2	There is likely to be a move in the direction of "professional parenthood" where some couples will specialise in raising larger families and receive compensation equivalent to that of other professional services.
Argument F.3.3	Governments will make sure that all women have access to comprehensive and free childcare starting at very young ages.
Argument F.3.4	Couples with young children and all pregnant women will have access to heavily subsidized or free housing supported by the government.
Argument F.3.5	Governments will pay a substantial birth premium which parents will have to spend mostly for the benefit of the child (childcare, education, housing).

Force F.4	**Changing nature and stability of partnerships**
Argument F.4.1	Relationships that last at least 20 years (the time needed to raise children) will be the exception in the future.
Argument F.4.2	Men and women in the future will much more equally share the burden of childcare and housework.
Argument F.4.3	There is a trend towards more self-fulfillment for men which does not include getting more

	involved in daily childcare.
Argument F.4.4	Men may be willing to share childcare responsibilities for the first child, but once they have experienced it, they will not want to do it for another child.
Argument F.4.5	There will be frequent divorces (separations) and remarriages (new unions) and a desire for additional children in a new partnership.
Argument F.4.6	It will become increasingly acceptable for women to have children and live as single mothers without a partner.

Force F.5	Changing bio-medical conditions (sperm quality and counts, female fecundability, new methods for assisted conception)
Argument F.5.1	There will be increasing problems with male fertility due to declining sperm quality as a consequence of environmental pollution and stress.
Argument F.5.2	Women will delay trying to become pregnant until later in life and to ages where fecundity is lower, which will lead to longer waiting times for conception and greater risks of not getting pregnant.
Argument F.5.3	In the future, medically assisted conception will solve a greater proportion of fecundity problems and more couples will be able to have all the children they actually want.
Argument F.5.4	The proportion of unplanned births will decrease due to improvements in contraceptives (increased effectiveness, reduced side effects and lower cost).

Force F.6	Changes in population composition and differential trends in population subgroups
Argument F.6.1	For ethnic minority women already resident in the UK and their descendants, fertility rates will converge to those for indigenous women.
Argument F.6.2	An increasing proportion of new migrants will come from countries where fertility rates are higher than in the UK.

MAJOR FORCES INFLUENCING LIFE EXPECTANCY

Force L.1	Changes in bio-medical technology
Argument L.1.1	Increased understanding of bio-medical ageing processes will allow us to develop effective anti-ageing strategies.
Argument L.1.2	Breakthroughs in the understanding of carcinogenic processes will lead to substantial reductions in mortality from cancers.
Argument L.1.3	Innovative medication will make so far untreatable diseases curable.
Argument L.1.4	Improvements in surgery including transplants and implants will enhance longevity.
Argument L.1.5	Unintended adverse consequences of new bio-medical technologies will outweigh their benefits.

Force L.2	Effectiveness of health care systems
Argument L.2.1	Cost of new treatments will be prohibitive to large segments of the population.
Argument L.2.2	There will be some very effective and easily affordable technologies.
Argument L.2.3	Because of the growing elderly population there will be limited access and increased waiting times for treatment.
Argument L.2.4	Our societies will be able to afford expensive new treatments.
Argument L.2.5	Progress in preventive medicine (screening, genetic testing) will lead to significantly lower death rates.
Argument L.2.6	Better and faster medical and health information dissemination will increase longevity.

Force L.3	Behavioural changes related to health
Argument L.3.1	Increases in sedentary lifestyle and adverse dietary changes will impact negatively on health.
Argument L.3.2	Substance abuse (alcohol and drugs) will lead to more premature mortality and accidents.
Argument L.3.3	Smoking prevalence will continue to decline.
Argument L.3.4	Increased awareness of the importance of physical activity will lead people to exercise more.
Argument L.3.5	Increased awareness of the importance of nutrition will lead people to adopt healthier diets.
Argument L.3.6	Increased stress levels will impact negatively on health.
Argument L.3.7	Increasing mental and social activities at old age will lead to greater longevity.

Force L.4	Possible new infectious diseases
Argument L.4.1	Emerging infectious diseases will lead to increases in overall mortality.

Argument L.4.2	Increasing drug resistance in known infectious diseases will lead to higher mortality.
Argument L.4.3	Increased capability of early detection and control will help to contain the spread and impact of new infectious diseases.
Argument L.4.4	A major flu epidemic (avian or other) is likely to occur over the next 25 years.

Force L.5	**Environmental change, disasters and wars**
Argument L.5.1	Increased frequency and intensity of natural disasters (such as flooding and strong storms) will lead to increasing mortality in the UK.
Argument L.5.2	Global warming will lead to the spread of malaria in Europe and result in higher mortality.
Argument L.5.3	More intensive heat waves during summer will lead to excess mortality among the elderly.
Argument L.5.4	Less extreme cold spells during winter will lead to lower mortality among the elderly.
Argument L.5.5	Global climate change will lead to a decline in food production in certain parts of the world and as a result, uncontrolled mass migration and conflicts will increase mortality in this country.
Argument L.5.6	Because of the European Union, we will not experience wars in our countries in the future.
Argument L.5.7	A "clash of civilizations" will lead to major conflicts that result in lower life expectancy in Europe.

Force L.6	**Changes in population composition and differential trends in population subgroups**
Argument L.6.1	The UK "golden cohorts" born between 1925 and 1945 have experienced relatively high rates of mortality improvement throughout their lifetimes. The rate of improvement in life expectancy will slow down as these cohorts reach advanced ages. Emerging infectious diseases will lead to increases in overall mortality.
Argument L.6.2	For ethnic minority groups already resident in the UK and their descendants, mortality rates will converge to those for the indigenous population.
Argument L.6.3	An increasing proportion of new migrants will come from countries where mortality rates are higher than in the UK.

MAJOR FORCES INFLUENCING NET MIGRATION GAINS

Force M.1	**Trends in the main motives for international migration**
Argument M.1.1	There will be an increase in the total number of people wishing to migrate to and from the United Kingdom for work related reasons.
Argument M.1.2	There will be an increase in the total number of people wishing to migrate to and from the United Kingdom for family reunification reasons.
Argument M.1.3	There will be an increase in the total number of people wishing to migrate to and from the United Kingdom for education or study reasons.
Argument M.1.4	There will be an increase in the total number of people wishing to migrate to the United Kingdom for the purpose of claiming asylum.
Argument M.1.5	There will be an increase in the total number of people wishing to migrate to and from the United Kingdom at the time of retirement.

Force M.2	**Trend in migration pressure resulting from changes in the countries of origin**
Argument M.2.1	High population growth and a large "youth bulge" in developing countries together with high unemployment will increase the pressure for out-migration.
Argument M.2.2	Worsening environmental conditions together with continued population growth will lead to a wave of "environmental refugees".
Argument M.2.3	Many developing countries will catch up in terms of economic growth and hence weaken the incentives for out-migration.
Argument M.2.4	Economies of new EU countries will catch up with those of the EU15 reducing inflows to, and/or increasing outflows from, the UK.
Argument M.2.5	Success in development in the poorest countries will lead to an increase in international migration, since people are more likely to migrate from semi developed countries than from the least developed countries.

Force M.3	**Trend in the attractiveness of the United Kingdom as a country of destination**
Argument M.3.1	Population ageing in the UK will result in a shortage of young labour which will make immigrants more welcome.
Argument M.3.2	Wages in the UK will continue to be a lot higher than in the new EU countries and outside the EU and hence we will continue to attract immigrants.
Argument	Existing networks with immigrant populations already resident in the UK will make it more

M.3.3	attractive to come to this country.
Argument M.3.4	English will become more dominant as an international language, increasing the attractiveness of the UK for immigrants.
Argument M.3.5	There will be serious problems with integration of immigrants in the UK and Europe generally and hence a widespread fear of cultural conflict will lead to very restrictive immigration policies.
Argument M.3.6	Out-migration of unemployed foreigners will be actively encouraged.
Argument M.3.7	The recent strength of the UK economy relative to other industrialized countries will not persist and many citizens will leave the country over the coming 25 years.

Force M.4	**Costs of migration (in the broader sense)**
Argument M.4.1	Increasing globalization and cheaper international airfares will make it easier to move from one continent to another.
Argument M.4.2	As migration pathways become more established, the readiness of future migrants to follow along these pathways will be greater.
Argument M.4.3	Internet and satellite TV make it easier for migrants to stay in touch with their family, friends and culture.
Argument M.4.4	Countries of origin will fight brain drain by reclaiming the cost of education for people who leave the country.
Argument M.4.5	The economic consequences for the poorest countries of substantial out-migration will put moral pressure on developed countries to limit immigration.

Force M.5	**Effectiveness of barriers to uncontrolled migration flows**
Argument M.5.1	There will always be international migration, no matter whether countries try to control it or not.
Argument M.5.2	Border control measures may not stop all illegal migration but they can clearly contribute to reducing the volume.
Argument M.5.3	More effective internal control (such as punishment of those who employ illegal immigrants) and deportation of illegal migrants will lead to a reduction in migration.
Argument M.5.4	There will be effective collaboration between EU and non-EU countries which will significantly reduce illegal immigration.
Argument M.5.5	Asylum seekers in the future will not be allowed to enter EU territory but rather will be kept in camps until each case is clarified.

A 2: An example of the argument-based approach

The following hypothetical example expands on the eleven steps summarised in Chapter three. Each step is explained along with the results of a randomly generated example of ten experts, five forces and five arguments for each force.

Step 1: *Identify the major forces that may shape the current and future population and demography*

This step requires the decomposition of each of the three demographic factors of fertility, mortality and migration into 5 or 6 "… presumably independent forces" (Lutz, 2009, p.13). These demographic factors are appropriate if the cohort-component model is being used for the projection process. In the case of local area population projections, other factors also come into play – in particular land constraints and the availability of dwellings, jobs and services. The identification and development of appropriate forces in this study is guided by the conceptual framework and a broad literature review. The forces relevant to local area population projections have been addressed in detail in Chapter four.

Step 2: *Define the arguments that support or negate these factors*

Define a set of specific arguments that have a potential influence on the future course of these forces that in turn would contribute to future changes in fertility, mortality and migration. Lutz (2009, p.13) suggests 5 to 9 arguments are appropriate depending on the force being considered. Lutz comments that these arguments are not set in stone and that they can change depending on the purpose or application of the exercise, and can be amended or added to by the group of contributing experts.

Similarly to the identification of appropriate forces, in this study the arguments supporting or negating these forces are guided by the conceptual framework and the literature review and addressed in Chapter seven.

Step 3: *Determine the validity of the arguments*

The panel of experts is asked to make an individual judgement about the validity of each argument based on "…scientific evidence to the best of their knowledge" (Lutz, 2009, p.14). A weighted Likert scale of five choices is offered to the experts:

Validity	Weight
1. Very likely to be right	1.00
2. More right than wrong	0.75
3. Do not know/ambivalent	0.50
4. More wrong than right	0.25
5. Very likely to be wrong	0.00

Each choice within the scale is given a weight which is used later in the evaluation stage of the process; these weights ranging from 1.00 to zero as defined above.

<u>Step 4</u>: *Determine the impact of the argument on the force*

The panel is asked to rate the likely impact of each argument on the demographic components. Similarly to the judgement on validity, the likely impact is evaluated by offering choices to the expert panel within a relative scale of 1 to 6 below; with each choice given a weight between +1 and -1.

<u>Impact of Argument</u>	<u>Weight</u>
1. A large upward influence	1.0
2. A small upward influence	0.5
3. Little or no influence	0.0
4. A small downward influence	-0.5
5. A large downward influence	-1.0
6. Don't know	0.0

Responses of "Little or no influence" and "Don't know" receive a score of zero; ultimately giving these arguments a zero weighting for the panel member concerned.

<u>Step 5</u>: *Combine the validity and impact scales for each expert and each argument*

The objective of this part of the process is to capture relevant and important arguments and to eliminate irrelevant and unimportant arguments.

To determine the experts' opinions regarding the relevance of an argument requires that the validity and the impact be considered together. An argument may be considered to be valid but have little impact. Alternatively, an argument may be considered to have a major impact – if it were to occur – but in reality may be considered to be invalid, irrelevant or very unlikely to occur.

The validity scores and the impact scores are combined by multiplying them together. Those arguments that are considered to be "Very likely to be right" and have "A large upward influence" will result in the maximum score of +1.0. Arguments that are considered to be "Very likely to be right" and have "A large downward influence" will result in the lowest score of -1.0. Multiplying impact responses of "Little or no influence" or "Don't know" to any validity score results in a combined score of zero. This results in elimination of the argument for the responding expert as indicated in the previous step.

Referring back to Figure 3.1 in Chapter three, the process to this stage is focussed on individual forces and individual arguments. This is illustrated by tracking from 'Demographic Factor A', through 'Force 1'; and to 'Argument F1.1' and its associated validity and impact scores. At this stage, expert 1 and expert 2's responses are separate; as are arguments F1,1 and argument F1,2. Force 2 and its associated arguments are also treated separately to this point.

Table A.2.1 contains the outcomes for the argument-based questionnaire for one particular force. Each of the ten hypothetical experts has scored the validity and impact of each of five arguments that are relevant to the force. As previously discussed, validity can be scored between 0 and +1 and impact can be scored between -1 and +1 by combining validity and impact scores for each expert and for each argument. For example, expert 1 has scored argument 1.1 with a validity of 0.75 – that is, a relatively strong valid argument – and scored impact as -1, implying that argument 1.1 would have a strong negative impact on the direction of force 1 if it were to occur. The result of this analysis implies that expert 1 considers that the overall effect of argument 1.1 on force 1 is relatively strongly negative – that is, a combined score of -0.75. To give some realism to this example, if force 1 was the effect of government policy on fertility, and argument 1 was that removal of the baby-bonus[50] would have a sustained downward influence on fertility levels, then expert 1 considers this statement to be more right than wrong and that the impact of the removal of the baby bonus would be a relatively large downward influence on long-term fertility levels.

[50] A 'baby-bonus' policy was introduced by the Australian Federal Government in 2002 to assist in the costs associated with having children. This benefit is part of a more general 'family-friendly' policy aimed at increasing fertility in Australia.

Table: A.2.1: Force1 Results

FORCE 1															
Expert #	Argument 1.1			Argument 1.2			Argument 1.3			Argument 1.4			Argument 1.5		
	Validity	Impact	Validity * Impact	Validity	Impact	Validity * Impact	Validity	Impact	Validity * Impact	Validity	Impact	Validity * Impact	Validity	Impact	Validity * Impact
1	0.75	-1	-0.75	0.5	0	0	1	0.5	0.5	0.25	-0.5	-0.125	1	-0.5	-0.5
2	0.5	0	0	0	-0.5	0	0	-1	0	0	0	0	0.75	0.5	0.375
3	0.5	-1	-0.5	0	-1	0	0	0.5	0	0	0	0	0.25	0	0
4	0.75	0	0	0.75	0.5	0.375	0.25	1	0.25	0.75	0	0	0.75	1	0.75
5	0.75	0	0	0.25	-1	-0.25	0	0.5	0	0	0	0	0.25	-0.5	-0.125
6	0	1	0	0.75	-1	-0.75	0	1	0	0.5	0	0	1	-1	-1
7	1	0	0	1	0	0	0	0.5	0	0.5	0	0	1	-1	-1
8	0.5	1	0.5	0.5	-1	-0.5	0.5	-0.5	-0.25	0.75	-0.5	-0.375	0.75	0	0
9	0	0	0	0.25	-0.5	-0.125	0.5	-0.5	-0.25	0.25	0	0	0.5	-0.5	-0.25
10	0.5	0	0	0.25	0.5	0.125	1	0.5	0.5	0	0	0	0	1	0

Step 6: *Calculate the weighted average scores for each force*

This stage of the evaluation collapses the arguments for individual experts into an average score for each force for each expert. Referring to Figure 6.1, the argument F1,1 score and argument F1,2 score are averaged to determine the weighted average score (WAVE) for force 1. This exercise is undertaken for each expert and for each force.

Only argument scores that are non-zero are included in calculating the weighted average scores. Lutz (2009, p18) states that the:

> "...rationale behind this calculation is that a score of zero implies that the argument is either considered totally wrong or irrelevant and should not be treated on an equal basis with arguments that imply either relevant shift upward or downward".

Table A.2.2 takes this example to the next stage of the evaluation process. The product of the validity and the impact for each argument is averaged over all arguments for each of the ten experts. The average of the arguments then provides a measure of the overall assessment by the expert of the influence of that force on the demographic factor being considered. In this example the average column in Table A.2.2 follows Lutz (2009) by excluding the arguments that have a zero score for the individual expert.

Table: A.2.2: Validity by Impact Scores

	VALIDITY * IMPACT					
Expert #	**FORCE 1**					
	Argument					
	1.1	**1.2**	**1.3**	**1.4**	**1.5**	**Average**
1	-0.75	0	0.5	-0.125	-0.5	-0.22
2	0	0	0	0	0.375	0.38
3	-0.5	0	0	0	0	-0.50
4	0	0.375	0.25	0	0.75	0.46
5	0	-0.25	0	0	-0.125	-0.19
6	0	-0.75	0	0	-1	-0.88
7	0	0	0	0	-1	-1.00
8	0.5	-0.5	-0.25	-0.375	0	-0.16
9	0	-0.125	-0.25	0	-0.25	-0.21
10	0	0.125	0.5	0	0	0.31

Step 7: *Determine the relative importance of each force as stated by each expert*

Each expert is asked to give their opinion on the relative importance of each force in shaping the demographic component by distributing 100 points over the number of forces. As Figure 3.1 in Chapter three illustrates, this process is separate from the evaluation of the arguments discussed in steps 2 through 6 above. The distribution of the relative importance of each force by each expert provides a relative weight to each force. The practical outcome of this stage is to determine the limits of the influence of each particular force which will ultimately temper the validity and impact of the arguments associated with those forces.

To continue with this example, Table A.2.3 illustrates the relative importance given to each of five forces by each of the 10 experts in the group. From these results it can be seen that expert 1 considers all forces to have an influence but forces 1 and 5 are more dominant; expert 2 considers force 1 to be the overall dominant force with force 4 having no relevance at all; and expert 5 considers all forces to have an influence with no particular force exerting a dominant influence. These relative importance scores are the overall subjective opinion of each expert of the relative importance of each force, with the sum of the importance of all forces equalling 100. It should be noted that the sum of the importance for all forces does not imply that these are the only forces that are relevant. The relative importance is a comparative scale only. If another force was considered in the overall process, then the relative scores for each force would be reduced overall.

Table: A.2.3: Relative Importance Scores

RELATIVE IMPORTANCE OF FORCE AS STATED BY EXPERT					
Expert #	**FORCE 1**	**FORCE 2**	**FORCE 3**	**FORCE 4**	**FORCE 5**
1	32	13	12	12	31
2	84	8	5	0	3
3	15	29	29	19	8
4	18	27	1	27	27
5	21	13	13	29	24
6	13	27	20	4	36
7	34	22	24	8	12
8	27	5	18	23	27
9	12	45	7	2	34
10	24	7	28	14	27

Step 8: *Combine the relative importance and weighted average scores*

The relative importance and weighted average scores are combined by multiplying the two relative scores – relative importance being treated as a percentage. The effect of this process is to scale the weighted average score for each force to the relative importance score for each force. This step provides the individual expert scores for each force that are used in the overall assessment. Table A.2.4 illustrates the outcome for the combined scores.

Table: A.2.4: Relative Importance by WAVE

OVERALL ASSESSMENT: RELATIVE IMPORTANCE * SCORE FOR EACH FORCE					
Expert #	FORCE 1	FORCE 2	FORCE 3	FORCE 4	FORCE 5
1	-0.07	-0.02	-0.05	-0.06	-0.08
2	0.32	0.00	0.01	0.00	0.00
3	-0.08	0.00	0.02	0.00	0.02
4	0.08	0.03	0.00	0.02	-0.07
5	-0.04	0.07	0.04	-0.13	-0.10

6	-0.11	-0.27	0.02	0.00	0.16
7	-0.34	-0.11	0.02	0.00	-0.05
8	-0.04	0.03	0.01	0.08	0.07
9	-0.03	0.00	-0.01	0.01	-0.01
10	0.08	0.03	-0.15	0.06	0.20

Step 9: *Calculate the overall assessment for the sum of forces and the average for each expert*

The final quantitative step in the evaluation process is to calculate the overall assessment of each expert; and for the group as a whole. The objectives of the overall assessment can be summarised as follows:

1. To identify the relative influence of each force as determined by each expert
2. To compare each expert's opinion of the impact of individual forces
3. To determine the overall view of each expert of the effect of the combined forces on the demographic factor
4. To determine the group opinion of the impact of each force on the demographic factor
5. To determine the group opinion of the combined effect of all forces on the demographic factor.

The measures used to address these objectives are:

1. Evaluate the scores for each individual for a particular force (the columns in the body of Table A.2.5). The dimensions of interest are the direction and magnitude of the scores for each individual; and the variability or consistency between experts within the force.

2. Evaluate the combined relative importance by weighted average scores for each expert for each force (the rows in the body of Table A.2.5). The dimensions of interest are the direction and magnitude of the scores for each force; and the variability or consistency between forces.

3. Calculate the sum for each expert of the combined relative importance and weighted average scores over all forces.

4. Calculate the average group score for each force.

5. Calculate the average for the group of the sums of all forces.

Each of the above objectives is considered in turn:

1. *To identify the relative influence of each force as determined by each expert.*

The weighted score for each expert for each force that combines the expert's opinion of the validity and importance of the arguments supporting or negating the force and the relative importance of each force comprises the body of Table A.2.5. Each row of the table therefore represents an individual expert's view of the overall impact of each force on the demographic factor. In this example, expert 1 in Table A.2.5 considers all forces to have a downward influence on the demographic factor with force 5 exerting the greatest force. Expert 6 considers force 1 and force 2 to have a downward influence; forces 3 and 5 to have a small upward influence; and force 4 to have no influence at all.

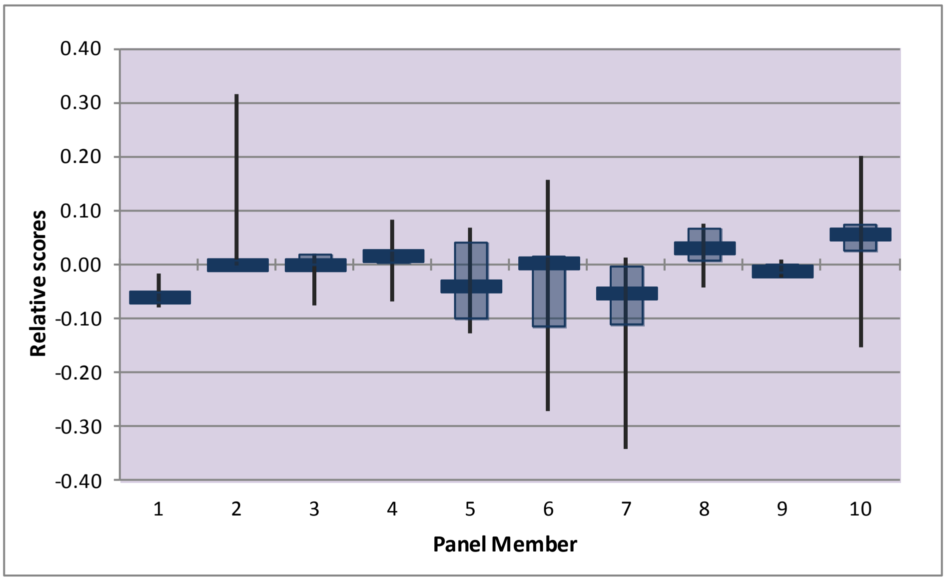
Table: A.2.5: Overall Assessment Scores

OVERALL ASSESSMENT: RELATIVE IMPORTANCE * SCORE FOR EACH FORCE						
Expert #	**FORCE 1**	**FORCE 2**	**FORCE 3**	**FORCE 4**	**FORCE 5**	**SUM**
1	-0.07	-0.02	-0.05	-0.06	-0.08	**-0.28**
2	0.32	0.00	0.01	0.00	0.00	**0.32**
3	-0.08	0.00	0.02	0.00	0.02	**-0.04**
4	0.08	0.03	0.00	0.02	-0.07	**0.06**
5	-0.04	0.07	0.04	-0.13	-0.10	**-0.16**
6	-0.11	-0.27	0.02	0.00	0.16	**-0.21**
7	-0.34	-0.11	0.02	0.00	-0.05	**-0.49**
8	-0.04	0.03	0.01	0.08	0.07	**0.14**
9	-0.03	0.00	-0.01	0.01	-0.01	**-0.04**
10	0.08	0.03	-0.15	0.06	0.20	**0.21**
Average	**-0.02**	**-0.02**	**-0.01**	**0.00**	**0.01**	**-0.05**

Figure A.2.1 shows the distribution of the outcomes for each panel member as a Boxplot. The Boxplot is a visual representation of the median, maximum, minimum and first and third quartile scores. The median score and the distribution of each expert's scores can be easily identified and compared in the Boxplot. Of particular interest is the extent and direction of the distribution for individual experts. A large distribution in both positive and negative directions can be interpreted as an expert's opinion that the forces included in the evaluation have no definitive influence on the direction of the future change in the demographic factor. A one sided distribution indicates that the expert may be confident of the direction of the effect but not its magnitude. Extreme maximum or minimum values with little or no difference between quartiles and the median may indicate that some forces are considered to have much greater influence in particular directions than other forces; but have limited overall effect when considered along with all forces. Consistency, variability, magnitude and direction are the important dimensions of interest in interpreting the Boxplot for the overall assessment of the group.

Comparison of scores between experts provides an indication of the relative consistency of the group. Median values that vary greatly between individual experts indicate disparity and uncertainty within the group as to the most likely outcome. This would suggest that some caution needs to be taken in interpreting the results of the argumentation exercise. If many experts display consistent distributions this may provide an indication of the possible upper and lower bounds for the demographic factor being considered.

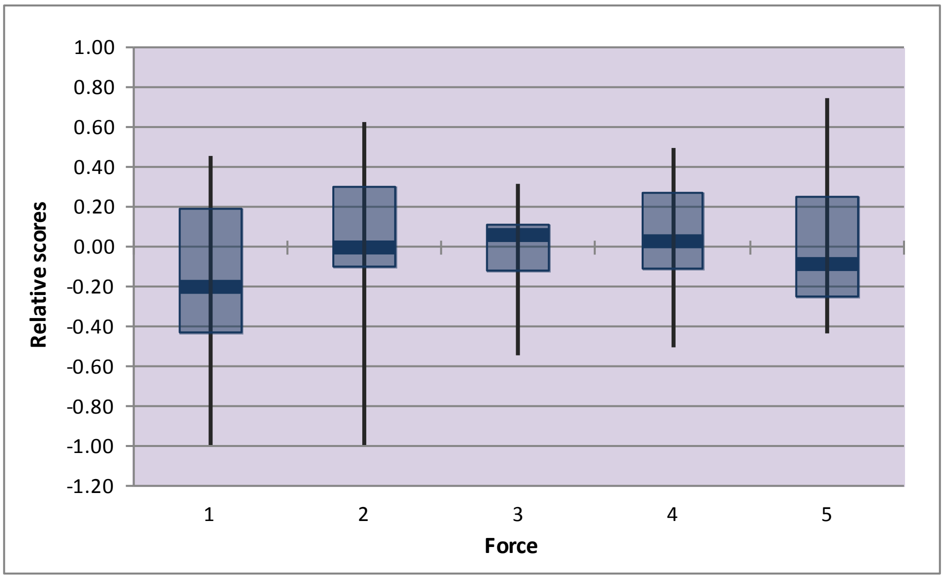
Figure A.2.1: Overall Assessment - Boxplot of Force Scores per Expert



2. To compare each expert's opinion of the impact of individual forces

Each column in Table A.2.5 represents each expert's view of the impact of a particular force on the demographic factor being considered. Taking force 1 as an example, collectively seven of the ten experts consider that the force will have a downward influence on the demographic factor. Expert 2 however, considers that the force will have a relatively strong upward influence and expert 7 considers that the force will have a relatively strong downward influence. The distributions of panel member scores for each force are illustrated in Figure A.2.2.

Figure A.2.2: Overall Assessment - Boxplot of Expert Scores per Force



Forces that display a small distribution around the median value, such as force 3 in Figure A.2.2, indicate a strong agreement between experts regarding the magnitude of the influence of the force. Large positive and negative distributions suggest disparity and uncertainty within the group as to the influence of the force; whereas a one-sided distribution may suggest agreement of the direction of influence but not the magnitude.

Comparison of results between forces provides a visual representation of the group's opinion of the relative strength, direction and overall confidence in the influence of the forces.

3. *To determine the overall view of each expert of the effect of the combined forces on the demographic factor*

The overall assessment scores in Table A.2.5 also include a column for the sum of all force scores. Lutz (2009, p.19) describes the sum column as "…the final quantitative result of the argumentation exercise for each expert". The final quantitative results are derived by summing the overall assessment scores for each force as the overall impact of all forces will be additive over all forces. The combined forces can work together in a reinforcing manner to result in a large positive or large negative outcome. Alternatively, the forces can counteract each other, resulting in either a weak positive or negative influence or no influence at all.

The sum over all forces for each expert gives an indication of each expert's view of the overall effect of the combined forces on the demographic component – both its overall direction and overall magnitude. Theoretically these combined scores could range from +1.0 to -1.0 [51] implying either an extreme positive change in the demographic factor or an extreme negative change. At this stage this change is relative and abstract, as the respondents' estimates of the actual change in the demographic factor have not been factored into the analysis.

4. *To determine the group opinion of the impact of each force on the demographic factor*

The average for each force over all experts (the bottom row of Table A.2.5) can be considered to be the group opinion of the influence of each force. In this example, the group considers forces 1, 2 and 3 to have a small downward influence on the demographic factor. Force 5 has a small upward influence and force 4 has no influence over the demographic factor. This simple average assumes that all experts are given the same weight – that is their opinions are all equally valid. If there is reason to believe that particular experts have greater experience or more insight into particular forces that relate to the demographic factor of concern, then there may be an argument to weight each expert differently which would result in different average scores.

[51] These theoretical limits relate to the limits for the constituent parts of the sum over all forces as follows:

1. Limits for each argument: +1, -1
2. Limits for WAVE for each force: $\frac{\pm 1 * (\text{number of arguments})}{\text{number of arguments}} = \pm 1$
3. Relative Importance (RI) Scores sum to 100 per cent, therefore:
4. Limit of sum of force scores: (RI for force 1 * WAVE for force 1) + (RI for force 2 * WAVE for force 2) + … +(RI for force n * WAVE for force n) = ±1

5. *To determine the group opinion of the combined effect of all forces on the demographic factor*

The final statistic in Table A.2.5 is the average of each expert's sum of forces – the bottom right hand cell in the table. This overall sum can be considered to be the group's opinion of the most likely future trajectory for the demographic factor of concern. This statistic is of particular importance in the overall argumentation exercise and warrants substantial discussion and review to develop a sound understanding of its meaning and limitations. For the purposes of this study, the argument-based approach is modified to generate several overall sums that are used as a comparative metric within the conceptual framework for this study. This approach is considered in detail in Chapter three.

<u>Step 10</u>: *Determine the expert's and the group's "best guess" for the most likely value; the range of values; and the societal changes required to achieve the most likely value or the extreme ranges, for the demographic factor of concern*

Up to this point the actual change in the demographic factor has not been considered. The group of experts is not asked for their opinions on the actual change until they have responded to the argument and force components of the exercise. This was done purposely "... in order to avoid the expression of a premature and argumentatively unfounded statement about the end result of the process which would only reflect personal opinion" (Lutz, 2009, p.19).

The opinion of each expert on the actual numerical future change in the demographic factor was elicited at the end of the questionnaire. The experts were asked to provide the most likely level for the demographic factor and a future range covering 67 per cent of the possible distribution at the end of the projection period[52]. This range provides a confidence interval around the expert's "best guess" – that is, an indication of how confident or certain the expert is in the stated likely future trend. Combining the most likely levels for all experts provides the average best guess for the expert group and combining the ranges provides average upper and lower confidence intervals around this average best guess. Although this process is not statistically rigorous, it does provide an indication of the overall likely levels and confidence in those levels of the group; as well as the level of consistency between experts.

<u>Step 11</u>: *Interpret the overall assessment in terms of relative scores and against the experts' best guesses and ranges; and the group's best guess and ranges*

The aim of the argument-based approach is to provide "…a more scientific basis for defining assumptions for population projections …" (Lutz, 2009, p.21). The process as outlined has followed two themes: a structured approach to identifying the *relative* impact and validity of arguments and forces as determined by a group of experts; and a relatively subjective approach

[52] In probability theory, 67 percent is roughly equivalent to one standard deviation providing a statistical benchmark for the variance around the opinions of individual experts.

to eliciting the expert group's opinion of the likely and possible levels of each demographic factor and the confidence of the group in these levels. The structured stage of the analysis alone provides some important and relevant information on the expert group's views of the future. The views of the group for the most likely and possible levels provide direct estimates of the possible trends in the demographic factors; this element of the process is a method of obtaining the opinion of the panel members with range and the average of the group's opinions providing a group mean and confidence interval.

The following is a summary (author's interpretation) of the relevance and benefits of the argument-based approach as argued by Lutz (2009, p.21-22):

- It is directly responsive to the needs and priorities of the population projection fraternity
- It attempts to facilitate a more systematic review of the substantive arguments behind the assumptions which can involve many experts
- The approach is not limited to the demographic factors of fertility, mortality and migration and can be applied to other demographic dimensions such as education, health status or household status
- It can go beyond simple and ad hoc scenarios to explore the substantive forces that are likely to determine demographic transitions in the future
- The inclusion of a broad range of experts from different backgrounds and disciplines may introduce more unconventional but relevant information and views than 'traditional' experts in the field
- The inclusion of a broad range of experts may create broader public interest and ownership of population projections and will inform better on what is known and what is not known about future demographic trends
- It helps to prioritise the importance and relevance of the forces that may lead to future demographic change
- It helps to understand the link between the underlying forces and the likely direction and strength of demographic change
- It helps to understand the relative importance of the factors that influence the underlying forces
- The better understanding and additional knowledge of the factors and forces that determine demographic change provided by the argument-based approach can be used in both population forecasting and in developing government policy
- The overall assessment scores that result from the structured approach can be "mapped" to the respondents' estimates of actual change in the demographic factor. For example, the overall average score for all experts and all forces can be equated to the average actual change in the demographic factor as estimated by the expert group; and the average score over each force can be equated to the proportional contribution of each force to the average actual change.

A 3: Validity Scores

	Panel Member								
Argument	1	2	3	4	5	6	7	8	9
1	1	0.25	0.75	0.75	1	0.25	0.75	0.75	0.75
2	0.75	0.75	0.75	0.25	0.5	0.75	0.5	0.75	1
3	1	0.75	0.25	0.25	1	0.75	0.25	0.5	0.75
4	1	0.75	0.75	0.25	0.25	0.25	0.75	0.75	0.75
5	0.75	0.5	0.75	1	1	0.5	0.25	0.75	0.75
6	0	0.75	0.5	0.5	0.5	1	0.25	0.25	0.5
7	0.75	0.75	0.25	0.25	0.25	0.25	0.5	0.25	0.75
8	0.75	0.75	0.5	0.25	1	0.75	0.25	0.75	0.75
9	0.25	0.75	0.75	0.75	0.75	0.75	1	0.5	1
10	0.25	0.75	0.75	0.75	0.25	1	0.75	0.5	1
11	0.25	0.75	0.75	0.75	1	0.75	0.75	0.75	0.75
12	0.25	0.5	0.5	0.5	0.25	0.25	0.75	0.5	0.25
13	0.25	0.75	0.25	0.75	0.25	1	0.75	0.25	0.75
14	0.25	0.5	0.75	0.75	0.25	0.5	0.5	0.25	0.25
15	0.25	0.5	0.5	0.25	1	0.5	0.5	0.5	0.75
16	0.25	0.5	0.75	0.75	1	0.5	0.5	0.75	0.75
17	0.5	0.75	0.75	1	1	1	0.75	0.75	1
18	0.25	0.25	0.5	0.5	0.25	0.5	0.5	0.25	0.75
19	0.5	0.5	0.5	1	1	1	1	0.75	0.75
20	0.25	0.5	0.75	0.75	0.5	0.5	0.5	0.25	0.75
21	0.5	0.5	0.5	0.5	0	0	0.25	0.25	0
22	0.25	0.25	0.5	0.5	0	0.25	0.25	0.25	0.25
23	0.25	0.75	0.75	0.25	1	0.5	0.75	0.75	0.75
24	0.5	0.25	0.75	0.25	1	0.75	0	0.5	0.25
25	0.5	0.75	0.5	0.5	0.25	0.75	0.5	0.25	0.25
26	0.25	0.5	0.5	0.75	0.25	0.25	0.5	0.5	0.25
27	0.75	0.75	0.75	0.75	1	1	0.5	1	0.75
28	0	0.5	0.5	0.25	0	0.25	0	0	0.75
29	0	0.25	0.25	0	0.25	0.5	0.5	0.5	0.75
30	0	0.5	0.25	0	0	0.25	0.25	0.25	0.25
31	0.75	0.5	0.5	0	0	0.25	0	0.5	0.75
32	0	0.5	0.5	0	0	0	0	0.25	0.25
33	0.5	0.75	0.5	0.75	0.75	0.25	0.5	0.5	0.75
34	0.25	0.75	0.75	0.75	0.75	0.5	0.5	0.75	0.75
35	0.25	0.75	0.75	1	1	0.75	0.5	0.75	0.75
36	0.75	0.75	0.25	0.5	0.25	0.75	0.75	0.5	0.75
37	0.25	1	0.75	0.25	0.75	1	0.5	1	0.75
38	0.25	0.25	0.5	0.25	1	0.75	0.5	0.75	1
39	0.25	0.5	0.25	0.25	0	0.75	0.25	0.25	0.75
40	0.75	0.5	0.25	0.25	0	0.25	0	0.5	0.5
41	0.75	0.75	0.25	0	0.75	0.25	0.25	0.25	1
42	1	0.75	0	0	0.25	0.75	0.25	0.25	1
43	0.75	0.75	0.25	0	0.25	0.25	0	0.25	0.75
44	1	0.25	0.75	0.75	0.75	0.75	0.75	0.75	1
45	0.5	0.25	0.25	0.5	0	0.75	0.5	0	0.25
46	0.5	0	0.75	0.25	0	0.75	0.5	0.5	0.75
47	1	1	0.5	0.5	0.25	0	0	0.75	0.25
48	0	0.75	0.75	0.75	0	0.25	0.75	0.75	0.75
49	0	0.75	0.75	0.75	0	0.5	0.75	0.25	0.75
50	0	0.5	0.5	0.25	0	0.25	0.5	0.25	0.25
51	1	0.5	0.25	0.25	0.25	0.25	0.5	0.25	0.75
52	0.75	0.5	0.5	0.25	0.25	0.25	0.25	0.5	0.75
53	0.75	0.5	0.25	0.5	0.75	0.25	0	0.75	0.75
54	0	0.25	0.25	0.75	0.25	0.25	0.25	0.75	0.25
55	0	0.25	0.25	0.25	0.25	0	0.25	0.25	0.75

Source: Expert Panel Questionnaire

A 4: Impact Scores

	Panel Member								
Argument	1	2	3	4	5	6	7	8	9
1	1	1	0.75	0.75	1	1	0.75	0.75	1
2	1	1	0.75	0.25	0.5	0.75	0.75	0.75	1
3	1	1	0.75	0.25	1	1	0.75	0.75	0.75
4	1	0.75	0.75	0.25	0.75	1	0.75	0.75	1
5	1	0.75	0.75	0.75	1	0.75	0.75	0.75	0.75
6	0	0.5	0.5	0.5	0.5	0.25	0.5	0.75	0.75
7	0.75	0.5	0.75	0.25	0.75	0.75	0.5	0.25	0.75
8	0.75	0.5	0.5	0.25	1	1	0.75	0.75	1
9	0	0.75	0.75	0.75	1	0.75	0.75	0.75	1
10	0	0.75	0.75	0.75	0.75	1	0.75	0.5	1
11	0.5	0.5	0.75	0.75	0.75	0.75	0.75	0.75	0.75
12	0.25	0.75	0.5	0.5	0.5	1	0.75	0.75	0.25
13	0.25	0.5	0.75	0.75	0.75	1	0.75	0.75	0.75
14	0	0.75	0.75	0.75	0.5	0.5	0.5	0.75	0.75
15	0	0.75	0.5	0.25	0.75	0.5	0.75	0.5	1
16	0.25	0.5	0.5	0.75	1	0.75	0.5	0.75	1
17	0.25	0.5	0.75	1	0.75	0.75	0.75	0.75	0.75
18	0	0.25	0.5	0.5	0.5	0.75	0.5	0.25	0.75
19	0.25	0.25	0.5	0.75	1	0.5	0.5	0.75	0.75
20	0	0.75	0.75	0.75	0.5	1	0.75	0.25	0.75
21	0.25	0	0.5	0.5	0.25	0.5	0.25	0.25	0
22	0	0	0.5	0.5	0.25	1	0.5	0.75	0.25
23	0.25	0.75	0.75	0.25	1	1	0.75	1	1
24	0.75	0.5	0.75	0.25	1	1	1	0.75	0.75
25	0.25	0.5	0.5	0.5	0.75	1	0.25	0.75	0.75
26	0	0.5	0.5	0.75	0.5	0	0	0.75	0.75
27	0.25	0.75	0.75	0.75	1	1	1	1	1
28	0	0.5	0.5	0.25	0.25	1	1	0.75	1
29	0	0.25	0.25	0	0.25	1	0.5	0.5	0.75
30	0	0.25	0.25	0	0	1	0.5	0.25	1
31	0.25	0.75	0.5	0	0.75	1	0.75	0.75	1
32	0	0.25	0.5	0	0.25	1	0.25	0.75	0.75
33	0.75	0.5	0.5	0.75	0.75	1	0.75	0.5	1
34	0	0.5	0.75	1	0.5	0.5	0.25	0.75	0.75
35	0.25	0.75	0.75	1	1	1	0.75	0.75	1
36	0.75	0.5	0.25	0.5	0.5	0.25	0.5	0.75	1
37	0.25	0.75	0.75	0.25	1	0.25	0.75	1	0.75
38	0.25	0	0.5	0.25	1	0.25	0.75	0.75	1
39	0.25	0	0.25	0.25	0.25	0.25	0.5	0.25	0.75
40	0	0.75	0.25	0.25	1	0.25	0.75	0.25	0.75
41	0.5	0.5	0.25	0	0.75	0.5	0.75	0.25	1
42	0.25	0.75	0	0	0.5	0.5	0.5	0.25	1
43	0.25	0.25	0.25	0.25	0.5	0.5	0.5	0.25	0.75
44	0.5	0.75	0.75	1	1	0.25	0.75	0.75	1
45	0.5	1	0.25	0.5	1	0.25	0.5	0	0.75
46	0.75	1	0.75	0.25	0.75	0	0.25	0.25	0.75
47	0	0.5	0	0.5	0.25	0	0.25	0.75	0.25
48	0.25	0.75	0.75	0.75	0.75	1	0.75	0.75	0.75
49	0	0.75	0.75	0.75	0.75	0.75	0.75	0.25	1
50	0	0.75	0.5	0.25	0.5	0.75	0.75	0.25	0.75
51	0	0.75	0.25	0.25	0.75	0.75	0.75	0.25	0.75
52	0.25	0.5	0.5	0.25	0.75	0.75	0.75	0.25	0.75
53	0	0.5	0.25	0.5	0.75	0.75	0.25	0.75	0.25
54	0.25	0	0.25	0.75	0.5	0.75	0.25	0.75	0.75
55	0.25	0.25	0.25	0.25	0.5	0.75	0.25	0.25	0.75

Source: Expert Panel Questionnaire

A 5: Validity by Impact Scores

	Expert								
Argument	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	1	0.25	0.5625	0.5625	1	0.25	0.5625	0.5625	0.75
2	0.75	0.75	0.5625	0.0625	0.25	0.5625	0.375	0.5625	1
3	1	0.75	0.1875	0.0625	1	0.75	0.1875	0.375	0.5625
4	1	0.5625	0.5625	0.0625	0.1875	0.25	0.5625	0.5625	0.75
5	0.75	0.375	0.5625	0.75	1	0.375	0.1875	0.5625	0.5625
6	0	0.375	0.25	0.25	0.25	0.25	0.125	0.1875	0.375
7	0.5625	0.375	0.1875	0.0625	0.1875	0.1875	0.25	0.0625	0.5625
8	0.5625	0.375	0.25	0.0625	1	0.75	0.1875	0.5625	0.75
9	0	0.5625	0.5625	0.5625	0.75	0.5625	0.75	0.375	1
10	0	0.5625	0.5625	0.5625	0.1875	1	0.5625	0.25	1
11	0.125	0.375	0.5625	0.5625	0.75	0.5625	0.5625	0.5625	0.5625
12	0.0625	0.375	0.25	0.25	0.125	0.25	0.5625	0.375	0.0625
13	0.0625	0.375	0.1875	0.5625	0.1875	1	0.5625	0.1875	0.5625
14	0	0.375	0.5625	0.5625	0.125	0.25	0.25	0.1875	0.1875
15	0	0.375	0.25	0.0625	0.75	0.25	0.375	0.25	0.75
16	0.0625	0.25	0.375	0.5625	1	0.375	0.25	0.5625	0.75
17	0.125	0.375	0.5625	1	0.75	0.75	0.5625	0.5625	0.75
18	0	0.0625	0.25	0.25	0.125	0.375	0.25	0.0625	0.5625
19	0.125	0.125	0.25	0.75	1	0.5	0.5	0.5625	0.5625
20	0	0.375	0.5625	0.5625	0.25	0.5	0.375	0.0625	0.5625
21	0.125	0	0.25	0.25	0	0	0.0625	0.0625	0
22	0	0	0.25	0.25	0	0.25	0.125	0.1875	0.0625
23	0.0625	0.5625	0.5625	0.0625	1	0.5	0.5625	0.75	0.75
24	0.375	0.125	0.5625	0.0625	1	0.75	0	0.375	0.1875
25	0.125	0.375	0.25	0.25	0.1875	0.75	0.125	0.1875	0.1875
26	0	0.25	0.25	0.5625	0.125	0	0	0.375	0.1875
27	0.1875	0.5625	0.5625	0.5625	1	1	0.5	1	0.75
28	0	0.25	0.25	0.0625	0	0.25	0	0	0.75
29	0	0.0625	0.0625	0	0.0625	0.5	0.25	0.25	0.5625
30	0	0.125	0.0625	0	0	0.25	0.125	0.0625	0.25
31	0.1875	0.375	0.25	0	0	0.25	0	0.375	0.75
32	0	0.125	0.25	0	0	0	0	0.1875	0.1875
33	0.375	0.375	0.25	0.5625	0.5625	0.25	0.375	0.25	0.75
34	0	0.375	0.5625	0.75	0.375	0.25	0.125	0.5625	0.5625
35	0.0625	0.5625	0.5625	1	1	0.75	0.375	0.5625	0.75
36	0.5625	0.375	0.0625	0.25	0.125	0.1875	0.375	0.375	0.75
37	0.0625	0.75	0.5625	0.0625	0.75	0.25	0.375	1	0.5625
38	0.0625	0	0.25	0.0625	1	0.1875	0.375	0.5625	1
39	0.0625	0	0.0625	0.0625	0	0.1875	0.125	0.0625	0.5625
40	0	0.375	0.0625	0.0625	0	0.0625	0	0.125	0.375
41	0.375	0.375	0.0625	0	0.5625	0.125	0.1875	0.0625	1
42	0.25	0.5625	0	0	0.125	0.375	0.125	0.0625	1
43	0.1875	0.1875	0.0625	0	0.125	0.125	0	0.0625	0.5625
44	0.5	0.1875	0.5625	0.75	0.75	0.1875	0.5625	0.5625	1
45	0.25	0.25	0.0625	0.25	0	0.1875	0.25	0	0.1875
46	0.375	0	0.5625	0.0625	0	0	0.125	0.125	0.5625
47	0	0.5	0	0.25	0.0625	0	0	0.5625	0.0625
48	0	0.5625	0.5625	0.5625	0	0.25	0.5625	0.5625	0.5625
49	0	0.5625	0.5625	0.5625	0	0.375	0.5625	0.0625	0.75
50	0	0.375	0.25	0.0625	0	0.1875	0.375	0.0625	0.1875
51	0	0.375	0.0625	0.0625	0.1875	0.1875	0.375	0.0625	0.5625
52	0.1875	0.25	0.25	0.0625	0.1875	0.1875	0.1875	0.125	0.5625
53	0	0.25	0.0625	0.25	0.5625	0.1875	0	0.5625	0.1875
54	0	0	0.0625	0.5625	0.125	0.1875	0.0625	0.5625	0.1875
55	0	0.0625	0.0625	0.0625	0.125	0	0.0625	0.0625	0.5625
Sum	**10.5625**	**18.125**	**17.1875**	**16.5**	**20.875**	**18.9375**	**15.3125**	**18.25**	**30.5**
Count <> 0	**32**	**49**	**53**	**48**	**42**	**49**	**46**	**53**	**54**
Average <>	**0.33007**	**0.36989**	**0.32429**	**0.34375**	**0.497024**	**0.38648**	**0.33288**	**0.34434**	**0.564815**

Source: Expert Panel Questionnaire

A 6: WAVE Outcomes for Arguments Positive for BAU Scenario (incl. Expert Opinion of Force)

	Expert								
Argument	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	2.67	0.83	1.31	1.13	5.33	0.42	1.13	1.88	2.50
2	2.00	2.50	1.31	0.13	1.33	0.94	0.75	1.88	3.33
3	2.67	2.50	0.44	0.13	5.33	1.25	0.38	1.25	1.88
4	1.30	0.24	0.61	0.08	0.12	0.22	0.61	0.24	0.98
5	0.98	0.16	0.61	0.98	0.65	0.33	0.20	0.24	0.73
6	0.00	1.00	0.67	0.78	0.09	0.93	0.40	0.63	0.58
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	1.86	0.54	0.52	0.21	0.85	1.78	0.49	1.65	1.73
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.17	1.88	1.31	0.13	5.33	0.83	1.13	2.50	2.50
24	1.49	0.47	1.92	0.21	5.99	1.90	0.00	1.41	0.87
25	0.07	0.63	0.42	0.28	0.03	1.67	0.21	0.16	0.10
26	0.00	0.11	0.27	0.73	0.08	0.00	0.00	0.16	0.24
27	0.10	0.94	0.94	0.63	0.17	2.22	0.83	0.83	0.42
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0.03	0.94	0.94	1.11	0.17	1.67	0.63	0.47	0.42
36	1.50	1.25	0.15	0.50	0.67	0.31	0.75	1.25	2.50
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.17	0.00	0.58	0.13	5.33	0.31	0.75	1.88	3.33
39	0.21	0.00	0.13	0.21	0.00	0.44	0.32	0.18	1.30
40	0.00	0.16	0.07	0.08	0.00	0.05	0.00	0.05	0.49
41	1.00	1.25	0.15	0.00	3.00	0.21	0.38	0.21	3.33
42	0.33	0.24	0.00	0.00	0.08	0.33	0.14	0.03	1.30
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.65	0.08	0.61	0.98	0.49	0.16	0.61	0.24	1.30
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.83	0.00	0.28	0.01	0.00	0.00	0.47	0.03
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Count <> 0	17	19	19	19	19	19	17	21	21
Average<>	1.01	0.87	0.68	0.46	1.85	0.84	0.57	0.84	1.42

Source: Expert Panel Questionnaire

A 7: WAVE Outcomes for Arguments Positive for TODs Scenario (incl. Expert Opinion of Force)

	Expert								
Argument	1	2	3	4	5	6	7	8	9
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	1.88	1.31	1.13	4.00	0.94	1.50	1.25	3.33
10	0.00	0.24	0.61	0.73	0.12	0.87	0.61	0.11	1.30
11	0.23	0.79	1.55	1.36	0.61	1.74	1.55	0.71	1.05
12	0.13	0.38	0.25	0.50	0.03	0.38	0.84	0.94	0.06
13	0.03	0.63	0.31	0.63	0.03	2.22	0.94	0.16	0.31
14	0.00	0.38	0.56	1.13	0.03	0.38	0.38	0.47	0.19
15	0.00	0.16	0.27	0.08	0.49	0.22	0.41	0.11	0.98
16	0.08	0.11	0.41	0.73	0.65	0.33	0.27	0.24	0.98
17	0.16	0.16	0.61	1.30	0.49	0.65	0.61	0.24	0.98
18	0.00	0.06	0.25	0.50	0.03	0.56	0.38	0.16	0.56
19	0.16	0.05	0.27	0.98	0.65	0.43	0.54	0.24	0.73
20	0.00	0.16	0.61	0.73	0.16	0.43	0.41	0.03	0.73
21	0.07	0.00	0.42	0.28	0.00	0.00	0.10	0.05	0.00
22	0.00	0.00	0.42	0.28	0.00	0.56	0.21	0.16	0.03
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.14	0.42	0.10	0.28	0.00	0.42	0.42	0.00	0.10
46	1.21	0.00	2.25	0.19	0.00	0.00	0.46	0.52	2.19
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.38	0.25	0.13	0.00	0.28	0.56	0.16	0.19
51	0.00	0.16	0.07	0.08	0.12	0.16	0.41	0.03	0.73
52	0.98	1.50	1.25	0.32	1.07	1.01	0.97	0.83	2.75
53	0.00	1.36	0.32	1.10	3.46	0.89	0.00	2.59	0.97
54	0.00	0.00	0.10	0.63	0.02	0.42	0.10	0.47	0.10
55	0.00	0.21	0.15	0.13	0.67	0.00	0.13	0.21	1.88
Count <> 0	10	18	22	22	17	19	21	21	21
Average<>	0.32	0.50	0.56	0.60	0.74	0.68	0.56	0.46	0.96

Source: Expert Panel Questionnaire

A 8: WAVE Outcomes for Arguments Positive for City Scenario (incl. Expert Opinion of Force)

	Expert								
Argument	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	1.88	1.31	1.13	4.00	0.94	1.50	1.25	3.33
10	0.00	0.24	0.61	0.73	0.12	0.87	0.61	0.11	1.30
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.13	0.38	0.25	0.50	0.03	0.38	0.84	0.94	0.06
13	0.03	0.63	0.31	0.63	0.03	2.22	0.94	0.16	0.31
14	0.00	0.38	0.56	1.13	0.03	0.38	0.38	0.47	0.19
15	0.00	0.16	0.27	0.08	0.49	0.22	0.41	0.11	0.98
16	0.08	0.11	0.41	0.73	0.65	0.33	0.27	0.24	0.98
17	0.16	0.16	0.61	1.30	0.49	0.65	0.61	0.24	0.98
18	0.00	0.06	0.25	0.50	0.03	0.56	0.38	0.16	0.56
19	0.16	0.05	0.27	0.98	0.65	0.43	0.54	0.24	0.73
20	0.00	0.16	0.61	0.73	0.16	0.43	0.41	0.03	0.73
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Count <> 0	5	11	11	11	11	11	11	11	11
Average<>	0.11	0.38	0.50	0.77	0.61	0.67	0.63	0.36	0.92

Source: Expert Panel Questionnaire

A 9: WAVE Outcomes for Arguments Positive for Infill Scenario (incl. Expert Opinion of Force)

	Expert								
Argument	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	2.67	2.50	0.44	0.13	5.33	1.25	0.38	1.25	1.88
4	1.30	0.24	0.61	0.08	0.12	0.22	0.61	0.24	0.98
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	1.88	1.31	1.13	4.00	0.94	1.50	1.25	3.33
10	0.00	0.24	0.61	0.73	0.12	0.87	0.61	0.11	1.30
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.03	0.63	0.31	0.63	0.03	2.22	0.94	0.16	0.31
14	0.00	0.38	0.56	1.13	0.03	0.38	0.38	0.47	0.19
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.06	0.25	0.50	0.03	0.56	0.38	0.16	0.56
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.07	0.00	0.42	0.28	0.00	0.00	0.10	0.05	0.00
22	0.00	0.00	0.42	0.28	0.00	0.56	0.21	0.16	0.03
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	1.88	1.31	1.13	0.00	0.42	1.13	1.88	1.88
49	0.00	0.24	0.61	0.73	0.00	0.33	0.61	0.03	0.98
50	0.00	0.38	0.25	0.13	0.00	0.28	0.56	0.16	0.19
51	0.00	0.16	0.07	0.08	0.12	0.16	0.41	0.03	0.73
52	0.98	1.50	1.25	0.32	1.07	1.01	0.97	0.83	2.75
53	0.00	1.36	0.32	1.10	3.46	0.89	0.00	2.59	0.97
54	0.00	0.00	0.10	0.63	0.02	0.42	0.10	0.47	0.10
55	0.00	0.21	0.15	0.13	0.67	0.00	0.13	0.21	1.88
Count <> 0	5	14	17	17	12	15	16	17	16
Average<>	1.01	0.83	0.53	0.54	1.25	0.70	0.56	0.59	1.13

Source: Expert Panel Questionnaire

A 10: WAVE Outcomes for Arguments Positive for Fringe Scenario (incl. Expert Opinion of Force)

	Expert								
Index	1	2	3	4	5	6	7	8	9
1	2.67	0.83	1.31	1.13	5.33	0.42	1.13	1.88	2.50
2	2.00	2.50	1.31	0.13	1.33	0.94	0.75	1.88	3.33
3	2.67	2.50	0.44	0.13	5.33	1.25	0.38	1.25	1.88
4	1.30	0.24	0.61	0.08	0.12	0.22	0.61	0.24	0.98
5	0.98	0.16	0.61	0.98	0.65	0.33	0.20	0.24	0.73
6	0.00	1.00	0.67	0.78	0.09	0.93	0.40	0.63	0.58
7	1.05	0.79	0.52	0.15	0.15	0.58	0.69	0.08	1.05
8	1.86	0.54	0.52	0.21	0.85	1.78	0.49	1.65	1.73
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.17	1.88	1.31	0.13	5.33	0.83	1.13	2.50	2.50
24	1.49	0.47	1.92	0.21	5.99	1.90	0.00	1.41	0.87
25	0.07	0.63	0.42	0.28	0.03	1.67	0.21	0.16	0.10
26	0.00	0.11	0.27	0.73	0.08	0.00	0.00	0.16	0.24
27	0.10	0.94	0.94	0.63	0.17	2.22	0.83	0.83	0.42
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	0.03	0.94	0.94	1.11	0.17	1.67	0.63	0.47	0.42
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.17	2.50	1.31	0.13	4.00	0.42	0.75	3.33	1.88
38	0.17	0.00	0.58	0.13	5.33	0.31	0.75	1.88	3.33
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.65	0.08	0.61	0.98	0.49	0.16	0.61	0.24	1.30
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Count <> 0	15	16	17	17	17	16	15	17	17
Average<>0	1.02	1.01	0.84	0.46	2.09	0.98	0.64	1.11	1.40

Source: Expert Panel Questionnaire

A 11: WAVE Outcomes for Arguments Negative for BAU Scenario (incl. Expert Opinion of Force)

	Expert								
Argument	1	2	3	4	5	6	7	8	9
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	1.88	1.31	1.13	4.00	0.94	1.50	1.25	3.33
10	0.00	0.24	0.61	0.73	0.12	0.87	0.61	0.11	1.30
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.13	0.38	0.25	0.50	0.03	0.38	0.84	0.94	0.06
13	0.03	0.63	0.31	0.63	0.03	2.22	0.94	0.16	0.31
14	0.00	0.38	0.56	1.13	0.03	0.38	0.38	0.47	0.19
15	0.00	0.16	0.27	0.08	0.49	0.22	0.41	0.11	0.98
16	0.08	0.11	0.41	0.73	0.65	0.33	0.27	0.24	0.98
17	0.16	0.16	0.61	1.30	0.49	0.65	0.61	0.24	0.98
18	0.00	0.06	0.25	0.50	0.03	0.56	0.38	0.16	0.56
19	0.16	0.05	0.27	0.98	0.65	0.43	0.54	0.24	0.73
20	0.00	0.16	0.61	0.73	0.16	0.43	0.41	0.03	0.73
21	0.07	0.00	0.42	0.28	0.00	0.00	0.10	0.05	0.00
22	0.00	0.00	0.42	0.28	0.00	0.56	0.21	0.16	0.03
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.25	0.25	0.13	0.00	0.38	0.00	0.00	0.75
29	0.00	0.03	0.07	0.00	0.04	0.43	0.27	0.11	0.73
30	0.00	0.21	0.10	0.00	0.00	0.56	0.21	0.05	0.14
31	0.10	0.63	0.42	0.00	0.00	0.56	0.00	0.31	0.42
32	0.00	0.21	0.42	0.00	0.00	0.00	0.00	0.16	0.10
33	0.75	0.38	0.25	1.13	0.11	0.38	0.56	0.63	0.75
34	0.00	0.16	0.61	0.98	0.24	0.22	0.14	0.24	0.73
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.14	0.42	0.10	0.28	0.00	0.42	0.42	0.00	0.10
46	1.21	0.00	2.25	0.19	0.00	0.00	0.46	0.52	2.19
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	1.88	1.31	1.13	0.00	0.42	1.13	1.88	1.88
49	0.00	0.24	0.61	0.73	0.00	0.33	0.61	0.03	0.98
50	0.00	0.38	0.25	0.13	0.00	0.28	0.56	0.16	0.19
51	0.00	0.16	0.07	0.08	0.12	0.16	0.41	0.03	0.73
52	0.98	1.50	1.25	0.32	1.07	1.01	0.97	0.83	2.75
53	0.00	1.36	0.32	1.10	3.46	0.89	0.00	2.59	0.97
54	0.00	0.00	0.10	0.63	0.02	0.42	0.10	0.47	0.10
55	0.00	0.21	0.15	0.13	0.67	0.00	0.13	0.21	1.88
Count <> 0	11	26	30	26	19	26	26	28	29
Average<>	0.35	0.47	0.49	0.61	0.65	0.55	0.51	0.44	0.88

Source: Expert Panel Questionnaire

A 12: WAVE Outcomes for Arguments Negative for TODs Scenario (incl. Expert Opinion of Force)

	Expert								
Argument	1	2	3	4	5	6	7	8	9
1	2.67	0.83	1.31	1.13	5.33	0.42	1.13	1.88	2.50
2	2.00	2.50	1.31	0.13	1.33	0.94	0.75	1.88	3.33
3	2.67	2.50	0.44	0.13	5.33	1.25	0.38	1.25	1.88
4	1.30	0.24	0.61	0.08	0.12	0.22	0.61	0.24	0.98
5	0.98	0.16	0.61	0.98	0.65	0.33	0.20	0.24	0.73
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	1.86	0.54	0.52	0.21	0.85	1.78	0.49	1.65	1.73
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.17	1.88	1.31	0.13	5.33	0.83	1.13	2.50	2.50
24	1.49	0.47	1.92	0.21	5.99	1.90	0.00	1.41	0.87
25	0.07	0.63	0.42	0.28	0.03	1.67	0.21	0.16	0.10
26	0.00	0.11	0.27	0.73	0.08	0.00	0.00	0.16	0.24
27	0.10	0.94	0.94	0.63	0.17	2.22	0.83	0.83	0.42
28	0.00	0.25	0.25	0.13	0.00	0.38	0.00	0.00	0.75
29	0.00	0.03	0.07	0.00	0.04	0.43	0.27	0.11	0.73
30	0.00	0.21	0.10	0.00	0.00	0.56	0.21	0.05	0.14
31	0.10	0.63	0.42	0.00	0.00	0.56	0.00	0.31	0.42
32	0.00	0.21	0.42	0.00	0.00	0.00	0.00	0.16	0.10
33	0.75	0.38	0.25	1.13	0.11	0.38	0.56	0.63	0.75
34	0.00	0.16	0.61	0.98	0.24	0.22	0.14	0.24	0.73
35	0.03	0.94	0.94	1.11	0.17	1.67	0.63	0.47	0.42
36	1.50	1.25	0.15	0.50	0.67	0.31	0.75	1.25	2.50
37	0.17	2.50	1.31	0.13	4.00	0.42	0.75	3.33	1.88
38	0.17	0.00	0.58	0.13	5.33	0.31	0.75	1.88	3.33
39	0.21	0.00	0.13	0.21	0.00	0.44	0.32	0.18	1.30
40	0.00	0.16	0.07	0.08	0.00	0.05	0.00	0.05	0.49
41	1.00	1.25	0.15	0.00	3.00	0.21	0.38	0.21	3.33
42	0.33	0.24	0.00	0.00	0.08	0.33	0.14	0.03	1.30
43	0.24	0.08	0.07	0.00	0.08	0.11	0.00	0.03	0.73
44	0.65	0.08	0.61	0.98	0.49	0.16	0.61	0.24	1.30
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Count <> 0	21	26	27	21	22	26	21	27	28
Average<>	0.88	0.74	0.58	0.47	1.79	0.70	0.53	0.79	1.27

Source: Expert Panel Questionnaire

A 13: WAVE Outcomes for Arguments Negative for City Scenario (incl. Expert Opinion of Force)

	Expert								
Argument	1	2	3	4	5	6	7	8	9
1	2.67	0.83	1.31	1.13	5.33	0.42	1.13	1.88	2.50
2	2.00	2.50	1.31	0.13	1.33	0.94	0.75	1.88	3.33
3	2.67	2.50	0.44	0.13	5.33	1.25	0.38	1.25	1.88
4	1.30	0.24	0.61	0.08	0.12	0.22	0.61	0.24	0.98
5	0.98	0.16	0.61	0.98	0.65	0.33	0.20	0.24	0.73
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	1.86	0.54	0.52	0.21	0.85	1.78	0.49	1.65	1.73
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.07	0.00	0.42	0.28	0.00	0.00	0.10	0.05	0.00
22	0.00	0.00	0.42	0.28	0.00	0.56	0.21	0.16	0.03
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.25	0.25	0.13	0.00	0.38	0.00	0.00	0.75
29	0.00	0.03	0.07	0.00	0.04	0.43	0.27	0.11	0.73
30	0.00	0.21	0.10	0.00	0.00	0.56	0.21	0.05	0.14
31	0.10	0.63	0.42	0.00	0.00	0.56	0.00	0.31	0.42
32	0.00	0.21	0.42	0.00	0.00	0.00	0.00	0.16	0.10
33	0.75	0.38	0.25	1.13	0.11	0.38	0.56	0.63	0.75
34	0.00	0.16	0.61	0.98	0.24	0.22	0.14	0.24	0.73
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	1.50	1.25	0.15	0.50	0.67	0.31	0.75	1.25	2.50
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.17	0.00	0.58	0.13	5.33	0.31	0.75	1.88	3.33
39	0.21	0.00	0.13	0.21	0.00	0.44	0.32	0.18	1.30
40	0.00	0.16	0.07	0.08	0.00	0.05	0.00	0.05	0.49
41	1.00	1.25	0.15	0.00	3.00	0.21	0.38	0.21	3.33
42	0.33	0.24	0.00	0.00	0.08	0.33	0.14	0.03	1.30
43	0.24	0.08	0.07	0.00	0.08	0.11	0.00	0.03	0.73
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Count <> 0	15	18	21	15	14	20	17	21	21
Average<>	1.06	0.65	0.42	0.42	1.66	0.49	0.43	0.59	1.32

Source: Expert Panel Questionnaire

A 14: WAVE Outcomes for Arguments Negative for Infill Scenario (incl. Expert Opinion of Force)

	Expert								
Argument	1	2	3	4	5	6	7	8	9
1	2.67	0.83	1.31	1.13	5.33	0.42	1.13	1.88	2.50
2	2.00	2.50	1.31	0.13	1.33	0.94	0.75	1.88	3.33
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	1.05	0.79	0.52	0.15	0.15	0.58	0.69	0.08	1.05
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.16	0.27	0.08	0.49	0.22	0.41	0.11	0.98
16	0.08	0.11	0.41	0.73	0.65	0.33	0.27	0.24	0.98
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.17	1.88	1.31	0.13	5.33	0.83	1.13	2.50	2.50
24	1.49	0.47	1.92	0.21	5.99	1.90	0.00	1.41	0.87
25	0.07	0.63	0.42	0.28	0.03	1.67	0.21	0.16	0.10
26	0.00	0.11	0.27	0.73	0.08	0.00	0.00	0.16	0.24
27	0.10	0.94	0.94	0.63	0.17	2.22	0.83	0.83	0.42
28	0.00	0.25	0.25	0.13	0.00	0.38	0.00	0.00	0.75
29	0.00	0.03	0.07	0.00	0.04	0.43	0.27	0.11	0.73
30	0.00	0.21	0.10	0.00	0.00	0.56	0.21	0.05	0.14
31	0.10	0.63	0.42	0.00	0.00	0.56	0.00	0.31	0.42
32	0.00	0.21	0.42	0.00	0.00	0.00	0.00	0.16	0.10
33	0.75	0.38	0.25	1.13	0.11	0.38	0.56	0.63	0.75
34	0.00	0.16	0.61	0.98	0.24	0.22	0.14	0.24	0.73
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.17	2.50	1.31	0.13	4.00	0.42	0.75	3.33	1.88
38	0.17	0.00	0.58	0.13	5.33	0.31	0.75	1.88	3.33
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.65	0.08	0.61	0.98	0.49	0.16	0.61	0.24	1.30
45	0.14	0.42	0.10	0.28	0.00	0.42	0.42	0.00	0.10
46	1.21	0.00	2.25	0.19	0.00	0.00	0.46	0.52	2.19
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Count <> 0	15	20	22	18	16	19	17	20	22
Average<>0	0.72	0.66	0.71	0.45	1.86	0.68	0.56	0.84	1.15

Source: Expert Panel Questionnaire

A 15: Weighted Average Outcomes for Arguments Negative for Fringe Scenario

	Expert								
Argument	1	2	3	4	5	6	7	8	9
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	1.88	1.31	1.13	4.00	0.94	1.50	1.25	3.33
10	0.00	0.24	0.61	0.73	0.12	0.87	0.61	0.11	1.30
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.13	0.38	0.25	0.50	0.03	0.38	0.84	0.94	0.06
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.38	0.56	1.13	0.03	0.38	0.38	0.47	0.19
15	0.00	0.16	0.27	0.08	0.49	0.22	0.41	0.11	0.98
16	0.08	0.11	0.41	0.73	0.65	0.33	0.27	0.24	0.98
17	0.16	0.16	0.61	1.30	0.49	0.65	0.61	0.24	0.98
18	0.00	0.06	0.25	0.50	0.03	0.56	0.38	0.16	0.56
19	0.16	0.05	0.27	0.98	0.65	0.43	0.54	0.24	0.73
20	0.00	0.16	0.61	0.73	0.16	0.43	0.41	0.03	0.73
21	0.07	0.00	0.42	0.28	0.00	0.00	0.10	0.05	0.00
22	0.00	0.00	0.42	0.28	0.00	0.56	0.21	0.16	0.03
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.25	0.25	0.13	0.00	0.38	0.00	0.00	0.75
29	0.00	0.03	0.07	0.00	0.04	0.43	0.27	0.11	0.73
30	0.00	0.21	0.10	0.00	0.00	0.56	0.21	0.05	0.14
31	0.10	0.63	0.42	0.00	0.00	0.56	0.00	0.31	0.42
32	0.00	0.21	0.42	0.00	0.00	0.00	0.00	0.16	0.10
33	0.75	0.38	0.25	1.13	0.11	0.38	0.56	0.63	0.75
34	0.00	0.16	0.61	0.98	0.24	0.22	0.14	0.24	0.73
35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	1.88	1.31	1.13	0.00	0.42	1.13	1.88	1.88
49	0.00	0.24	0.61	0.73	0.00	0.33	0.61	0.03	0.98
50	0.00	0.38	0.25	0.13	0.00	0.28	0.56	0.16	0.19
51	0.00	0.16	0.07	0.08	0.12	0.16	0.41	0.03	0.73
52	0.98	1.50	1.25	0.32	1.07	1.01	0.97	0.83	2.75
53	0.00	1.36	0.32	1.10	3.46	0.89	0.00	2.59	0.97
54	0.00	0.00	0.10	0.63	0.02	0.42	0.10	0.47	0.10
55	0.00	0.21	0.15	0.13	0.67	0.00	0.13	0.21	1.88
Count <> 0	8	24	27	23	18	24	23	26	26
Average<>0	0.30	0.47	0.45	0.65	0.69	0.49	0.49	0.45	0.88

Source: Expert Panel Questionnaire

A 16: Weighted Average Outcomes for Positive Arguments (incl. Expert Opinion of Force)

	Expert									
Scenario	1	2	3	4	5	6	7	8	9	Sum
BAU	1.01	0.87	0.68	0.46	1.85	0.84	0.57	0.84	1.42	8.54
TODs	0.32	0.50	0.56	0.60	0.74	0.68	0.56	0.46	0.96	5.38
CCL	0.11	0.38	0.50	0.77	0.61	0.67	0.63	0.36	0.92	4.95
Infill	1.01	0.83	0.53	0.54	1.25	0.70	0.56	0.59	1.13	7.14
Fringe	1.02	1.01	0.84	0.46	2.09	0.98	0.64	1.11	1.40	9.54

Source: Expert Panel Questionnaire

A 17: Weighted Average Outcomes for Negative Arguments (incl. Expert Opinion of Force)

	Expert									
Scenario	1	2	3	4	5	6	7	8	9	Sum
BAU	-0.35	-0.47	-0.49	-0.61	-0.65	-0.55	-0.51	-0.44	-0.88	-4.96
TODs	-0.88	-0.74	-0.58	-0.47	-1.79	-0.70	-0.53	-0.79	-1.27	-7.76
CCL	-1.06	-0.65	-0.42	-0.42	-1.66	-0.49	-0.43	-0.59	-1.32	-7.04
Infill	-0.72	-0.66	-0.71	-0.45	-1.86	-0.68	-0.56	-0.84	-1.15	-7.64
Fringe	-0.30	-0.47	-0.45	-0.65	-0.69	-0.49	-0.49	-0.45	-0.88	-4.87

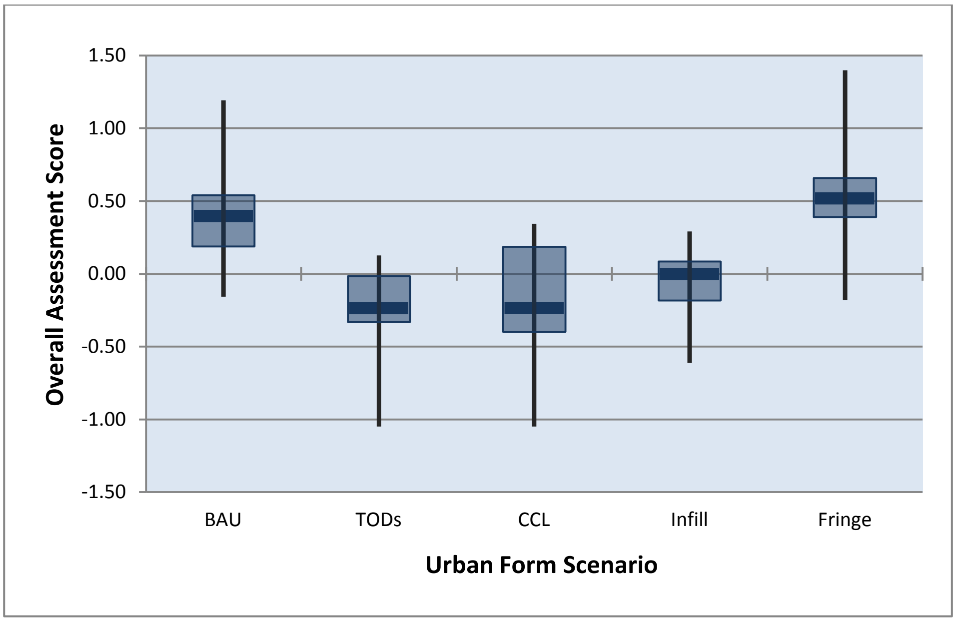
Source: Expert Panel Questionnaire

A 18: WAVE Outcomes Positive and Negative Arguments Combined (incl. Expert Opinion of Force)

	Expert									
Scenario	1	2	3	4	5	6	7	8	9	Sum
BAU	0.66	0.40	0.19	-0.16	1.19	0.29	0.06	0.40	0.54	3.58
TODs	-0.56	-0.24	-0.02	0.13	-1.05	-0.02	0.03	-0.33	-0.31	-2.37
CCL	-0.94	-0.26	0.07	0.34	-1.05	0.19	0.19	-0.24	-0.40	-2.09
Infill	0.29	0.17	-0.18	0.09	-0.61	0.02	0.00	-0.25	-0.03	-0.50
Fringe	0.72	0.54	0.39	-0.18	1.40	0.49	0.14	0.66	0.52	4.67

Source: Expert Panel Questionnaire

A 19: Distribution of Weighted Average Outcomes Positive and Negative Combined



Source: Expert Panel Questionnaire

A 20: The Housing Allocation Model Explained

The suite of models used to produce population projections for South Australia were discussed at length in Chapter two. The Housing Allocation Model (HAM) was used in this study to produce total population projections for each of the five urban form scenarios in Chapter six. This Appendix explains HAM, its inputs and parameter requirements. Population outcomes for each urban form scenario are then presented.

HAM Parameters

The HAM application distributes the future number of dwellings across Statistical Local Areas (SLA) using a shift-share approach to transition development from existing growth areas to greenfield sites. The total number of dwellings required to accommodate the total population projected for the Greater Adelaide Region (GAR) for each of the projection years is estimated using a household propensity model based on the propensity to form households by living arrangements. Table A20.1 shows the 2006 propensities by living arrangements used in HAM. These propensities are applied to the age-sex structure of the GAR population for each projection year. The result is a total number of households that is consistent with the total population projection.

The household propensity approach used in HAM is equivalent to the method currently used by the Australian Bureau of Statistics to produce their household projections (Australian Bureau of Statistics, 2004).

The HAM application requires two inputs to parameterise the transition from areas of current growth to new greenfield growth areas. Table A20.2 is the parameter input worksheet for HAM. The ‘Shift-Share period for transition …’ is the number of years over which the transition from current growth areas to greenfield growth areas will occur. The ‘Assumed years supply of dwelling sites relative to demand’ is the estimated number of years supply remaining in an SLA that triggers the transition to greenfield growth areas. The smaller the number of years for both parameters, the sooner the transition occurs.

Table A.20.1: Household Propensities by Living Arrangements, 2006

Living Arrangements	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
Partner in a couple family with children	0.0	0.0	0.0	0.4	5.3	21.7	45.3	58.7	61.4	57.3	43.3	27.2	17.5	11.8	7.1	4.5	2.6	1.8
Child in a couple family	83.3	77.8	75.4	64.7	37.5	14.3	5.8	3.0	1.6	0.9	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0
Other related person in a couple family with children	0.0	0.0	0.0	0.5	0.4	0.3	0.2	0.1	0.1	0.2	0.2	0.3	0.4	0.7	0.8	1.1	1.4	1.8
Partner in a couple family without children	0.0	0.0	0.0	1.3	13.2	26.4	18.5	10.7	9.3	15.4	31.3	48.3	57.0	59.4	56.6	48.1	35.6	16.5
Other related person in a couple family without children	0.0	0.0	0.0	0.5	0.5	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.5	1.0	2.2
Male lone parent in a one-parent family	0.0	0.0	0.0	0.1	0.1	0.4	0.7	1.2	1.8	2.0	1.7	1.1	0.9	0.8	0.7	0.6	0.9	0.9
Female lone parent in a one-parent family	0.0	0.0	0.0	0.5	2.6	4.7	6.3	7.8	8.6	7.5	5.3	3.4	2.9	2.7	2.9	3.2	3.4	3.8
Child in a one-parent family	16.6	22.1	24.3	20.4	10.6	4.7	2.8	2.2	1.9	1.7	1.4	1.1	0.7	0.3	0.1	0.0	0.0	0.0
Other related person in a one-parent family	0.0	0.0	0.0	0.4	0.4	0.3	0.2	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.6
Related person living in another family	0.0	0.0	0.0	2.2	4.2	2.5	1.3	0.8	0.6	0.6	0.5	0.5	0.6	0.7	0.9	1.1	1.2	1.1
Unrelated individual living in a family household	0.0	0.0	0.0	1.7	2.5	1.7	1.0	0.7	0.6	0.5	0.4	0.3	0.2	0.2	0.1	0.2	0.2	0.2
Group household member	0.0	0.0	0.0	3.4	13.3	9.6	4.9	2.7	2.1	2.0	1.9	1.8	1.6	1.4	1.3	1.1	1.0	1.0
Male lone person	0.0	0.0	0.0	0.9	4.1	7.4	7.9	7.4	7.2	6.3	6.0	6.2	6.2	6.3	6.8	7.8	9.0	7.6
Female lone person	0.0	0.0	0.0	0.9	3.6	4.7	4.2	3.7	3.9	4.7	6.5	8.4	10.5	13.9	19.4	26.4	31.4	29.9
Usual resident of a non-private dwelling	0.1	0.1	0.3	2.0	1.6	1.0	0.8	0.8	0.7	0.7	0.7	0.8	0.9	1.2	2.4	4.9	11.9	32.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table A.20.2: Parameter Sheet for HAM

Enter Parameters for SLA Projection Scenarios

		Low Scenario
SLA Projection Scenario		**1**
Shift-Share period for transition from dwelling change share to remaining land share (ShPeriod)		10
Assumed years supply of dwelling sites relative to demand (YrSupply) Buffer		10
Projection Year to be reported in summary below (RepYr)		2036
Land Supply Categories (to be included or excluded in a scenario)	***Potential Dwelling Sites***	
Count of vacant lots only (VacLots)	16473	Yes
Yield of vacant lots (VacLotYield in ASD, VacLots in OASD)	16473	No
Yield of staged and unstaged development areas (BaStaged(I to 17))	62889	Yes
Yield of residual residential broadacre (BaResLots)	24577	Yes
Yield from 30YP growth areas 0 - 15 yrs (ga15yrs)	35476	No
Yield from 30YP growth areas 16 - 30 yrs (ga16_30yrs)	41241	No
Total minor redev CV/SV of >1 and <=1.3 (PAR(i,1) ASD only)	49207	No
Total minor redev CV/SV of >1.3 and <=2 (PAR(i,2) ASD only)	89189	No
Total minor redev CV/SV of >2 (PAR(i,3) ASD only)	40055	No
Total minor redev CV/SV of >3 (PAR(i,4) ASD only) - not used	0	No
Discounted minor redev 1 - 1.3 (UserDwgSites1)	0	Yes
Discounted minor redev 1.3 - 2 (UserDwgSites2)	26757	Yes
Discounted minor redev 2 + (UserDwgSites3)	8011	No
Yield from 30YP infill scenario 1 (UserDwgSites4)	151000	No
Yield from 30YP infill scenario 2 (UserDwgSites5)	0	No
Redevelopment take-up assumptions (%)		
Number of SLA's to be processed, excluding overflow SLA (NumSLA)		67
Start Year (StYr)	2009	2009
Population Scenario		SALow
ABS Household Propensity Rates		SA series 2
Proportion of SA Population in Adelaide Region in **2031**		84.3300

Select an SLA Projection Scenario and Run the Scenario

Choose scenario -> . 1

Run the selected SLA projection scenario .

Land Supply Assumptions

The critical input required for HAM is the assumed land supply opportunities available for future residential development. The metric used is the number of dwelling opportunities available for each SLA. Dwelling opportunities are determined primarily by the zoning regulations for an area. If zoned for a single dwelling, then there is no opportunity to develop medium to high density dwellings. If zoned for five storeys, then the number of dwelling opportunities is scaled up to be consistent with the higher zoning regulation.

Table A20.3 is an abridged version of the dwelling opportunities input worksheet for HAM for the Infill Scenario. Dwelling opportunities are determined by land supply categories, including vacant land and programmed development. The key to calibrating HAM for each urban form scenario, are the 'UserDef#' user defined categories which allow for the manual input of additional dwelling opportunities for each SLA. In the case of the Infill Scenario, additional opportunities are made available in middle-ring SLAs, such as Charles Sturt (C) – North East. When the model is run, additional dwellings are distributed to the inner-ring SLAs, resulting in the Infill Scenario.

Population Outcomes

The total population associated with the dwelling distribution across SLAs is achieved by applying the average household size for each SLA to the projected number of dwellings. For each of the five scenarios, the number of dwelling opportunities and, therefore, the number of dwellings projected, differs for each SLA over the projection period. Given this, the total population for each SLA in each scenario also differs. The result is a population distribution that reflects the underlying principles for each urban form scenario. Table A20.4 shows the total population outcomes for each SLA under each urban form scenario at 2026, and illustrates the different population outcomes for each scenario.

Table A.20.3: HAM Dwelling Opportunities Input Data

Sla06_name	Dwell_09	Growth Areas 15yra	A0910	A1011	A1112	proglots	LE13	DWELL07	DWELL09	UserDef 1	UserDef 2	UserDef 3	UserDef 4	alldwgsites
Gawler (M)	8759	0	76	64	218	7552	227	8453	8759	114	376	232	0	8500
Playford (C) - East Central	7639	0	25	303	250	1328	182	7421	7639	91	110	301	0	2012
Playford (C) - Elizabeth	11395	0	25	142	178	379	102	11368	11395	51	963	484	2000	3979
Playford (C) - Hills	1169	0	60	70	188	4874	19	1155	1169	10	1	2	0	4905
Playford (C) - West	3889	16982	188	556	638	9267	425	3152	3889	213	40	29	0	9974
Playford (C) - West Central	5802	0	343	303	375	2303	120	5429	5802	60	48	182	0	2714
Port Adel. Enfield (C) - East	14812	0	302	307	157	2148	1550	14289	14812	775	1088	257	0	5818
Port Adel. Enfield (C) - Inner	9465	0	0	22	130	679	1100	9199	9465	550	1011	73	0	3413
Salisbury (C) - Central	11236	0	84	125	101	532	333	10887	11236	167	1239	75	1000	3345
Salisbury (C) - Inner North	9536	0	35	63	27	144	166	9291	9536	83	689	104	0	1186
Salisbury (C) - North-East	9150	0	0	8	16	32	117	9110	9150	59	887	133	0	1228
Salisbury (C) - South-East	14500	0	20	11	0	31	729	14398	14500	365	1694	197	0	3016
Salisbury (C) Bal	6293	0	292	337	138	992	87	4954	6293	44	12	58	500	1692
Tea Tree Gully (C) - Central	9944	0	0	0	11	22	1086	9912	9944	543	1640	131	0	3422
Tea Tree Gully (C) - Hills	4726	0	150	295	85	530	1264	4682	4726	632	721	41	0	3189
Tea Tree Gully (C) - North	10140	0	0	50	95	163	203	10075	10140	102	511	201	0	1180
Tea Tree Gully (C) - South	13152	0	0	0	20	870	1736	12995	13152	868	1861	274	500	6109
Charles Sturt (C) - Coastal	14489	0	0	48	95	143	2761	14225	14489	1381	425	12	1000	5721
Charles Sturt (C) - Inner East	9868	0	8	35	87	369	1823	9791	9868	912	644	21	1500	5269
Charles Sturt (C) - Inner West	10923	0	52	43	75	212	2294	10770	10923	1147	527	32	500	4712
Charles Sturt (C) - North-East	11761	0	147	261	194	3252	868	11668	11761	434	545	61	4000	9160
Port Adel. Enfield (C) - Coast	12926	0	0	61	182	1460	1071	12387	12926	536	938	92	500	4596
Port Adel. Enfield (C) - Park	6934	0	30	35	36	311	1462	6663	6934	731	405	53	0	2962
Port Adel. Enfield (C) - Port	5214	0	0	34	11	468	485	5063	5214	243	277	30	1000	2503
West Torrens (C) - East	12234	0	20	62	42	124	2580	12100	12234	1290	519	17	2000	6530
West Torrens (C) - West	13565	0	0	0	60	120	2441	13381	13565	1221	251	12	500	4544

Table A.20.4: Population Outcomes for Five Scenarios at 2026

SLA_Name	BAU	CC	Fringe	TODs	Infill
Gawler (M)	36129	30179	33901	35323	32490
Playford (C) - East Central	25536	25286	25171	25369	27275
Playford (C) - Elizabeth	27435	28171	25667	29069	30527
Playford (C) - Hills	15755	9935	13894	15405	10367
Playford (C) - West	36968	29841	69763	36772	31036
Playford (C) - West Central	19197	19027	19010	19164	20082
Port Adel. Enfield (C) - East	40667	40259	38559	38854	44260
Port Adel. Enfield (C) - Inner	24213	23851	22395	22563	26569
Salisbury (C) - Central	32625	33613	30008	32252	35936
Salisbury (C) - Inner North	27877	28096	26283	26481	30465
Salisbury (C) - North-East	23951	23305	22267	22438	25854
Salisbury (C) - South-East	40189	39049	36820	37097	44151
Salisbury (C) Bal	17485	18582	27399	18477	18140
Tea Tree Gully (C) - Central	29563	27888	26265	26543	32969
Tea Tree Gully (C) - Hills	16214	14533	14505	14854	17150
Tea Tree Gully (C) - North	29512	28807	28303	28580	31079
Tea Tree Gully (C) - South	39078	37271	35419	36683	43193
Charles Sturt (C) - Coastal	34030	34816	33166	35072	35868
Charles Sturt (C) - Inner East	25454	25541	24098	26822	26436
Charles Sturt (C) - Inner West	28049	27672	26991	28060	29396
Charles Sturt (C) - North-East	33471	33945	31703	38871	32372
Port Adel. Enfield (C) - Coast	33263	34310	31454	32583	36739
Port Adel. Enfield (C) - Park	18562	18700	17727	17860	20684
Port Adel. Enfield (C) - Port	12214	13028	11709	13372	13049
West Torrens (C) - East	27659	28581	26713	29875	28999
West Torrens (C) - West	31483	31789	30920	31980	32763
Adelaide (C)	22868	115697	22767	35441	22830
Adelaide Hills (DC) - Central	13451	13359	13362	13488	13252
Adelaide Hills (DC) - Ranges	11088	10832	10960	11107	10759
Burnside (C) - North-East	22499	22266	22060	22276	22839
Burnside (C) - South-West	22900	22429	22399	22673	22975
Campbelltown (C) - East	32299	31252	31155	31473	33730
Campbelltown (C) - West	22185	22350	21743	21906	23682
Norw. P'ham St Ptrs (C) East	17035	17113	16792	16919	17419
Norw. P'ham St Ptrs (C) West	18781	20194	18529	20915	19235
Prospect (C)	22695	22746	21811	23758	23115
Unley (C) - East	20590	21698	20221	21283	21775
Unley (C) - West	17748	19396	17495	20778	17925
Walkerville (M)	7884	7981	7615	8531	7914
Holdfast Bay (C) - North	20681	22607	20339	23332	21730
Holdfast Bay (C) - South	16306	16450	15721	15839	18027
Marion (C) - Central	39036	41998	38378	43625	41963
Marion (C) - North	28714	29679	28155	30644	30313
Marion (C) - South	24973	24528	23918	24103	28050
Mitcham (C) - Hills	28650	27400	27581	27981	29487
Mitcham (C) - North-East	16964	16533	16376	16576	17485
Mitcham (C) - West	23993	23997	23545	23724	24628
Onkaparinga (C) - Hackham	19495	18355	18508	18689	21002
Onkaparinga (C) - Hills	18192	16057	17308	17813	17313
Onkaparinga (C) - Morphett	25038	24073	23147	23405	29280
Onkaparinga (C) - North Coast	21369	22314	19550	22966	24436
Onkaparinga (C) - Reservoir	27761	27456	26380	26579	33133

Onkaparinga (C) - South Coast	42159	42356	40732	40463	50052
Onkaparinga (C) - Woodcroft	38112	37216	36368	36669	44162
Barossa (DC) - Angaston	12925	11885	12703	12937	11931
Barossa (DC) - Barossa	10303	10272	15063	10334	10210
Barossa (DC) - Tanunda	5183	5232	5532	5199	5179
Light (DC)	17964	21199	64201	25495	17309
Mallala (DC)	10252	9877	16061	10277	9856
Adelaide Hills (DC) - North	7303	7293	7267	7325	7237
Adelaide Hills (DC) Bal	10062	10035	10014	10092	9966
Mount Barker (DC) - Central	24234	24430	24127	24308	24196
Mount Barker (DC) Bal	12211	11194	22887	12210	11215
Alexandrina (DC) - Coastal	16205	16308	22684	16254	16167
Alexandrina (DC) - Strathalbyn	15602	12344	15762	12290	14771
Victor Harbor (DC)	19225	18123	20653	19265	18162
Yankalilla (DC)	7165	6341	7339	7156	6382

References

Aalborg plus 10 2004, *Inspiring Futures Final Commitments*, viewed 4 August 2012, <www.aalborgplus10.dk/media/pdf2004/finaldraftaalborgcommitments.pdf>.

—— 2012, *Aalborg Commitment Signing Website*, Aalborg, Denmark, viewed 4 August 2012, <www.aalborgplus10.dk/>.

Alho, JM 1997, 'Scenarios, Uncertainty and Conditional Forecasts of the World Population', *Journal of the Royal Statistical Society. Series A (Statistics in Society)*, vol. 160, no. 1, pp. 71-85.

Alonso, W 1964, *Location and land use: Toward a general theory of land rent*, Harvard University Press, MA.

Allen, C and Blandy, S 2004, *The Future of City Centre Living: Implications for Urban Policy (Final Report)*, report prepared for the Department of Communities and Local Government, Sheffield, UK.

American Planning Association 2012, *Policy Guide on Smart Growth*, <http://www.planning.org/policy/guides/adopted/smartgrowth.htm>.

Andelin, J and Simpson, L 2005, *POPGROUP Population Estimation and Forecasting System Reference Manual*, University of Manchester.

Anderson, WP, Kanaroglou, PS and Miller, EJ 1996, 'Urban Form, Energy and the Environment: A Review of Issues, Evidence and Policy', *Urban Studies*, vol. 33, no. 1, pp. 7-35.

Applied Economics (with assistance from Alistair Robson) 2010, *Residential Building Activity in Sydney: An Overview and Seven Case Studies*, NSW Treasury.

Armstrong, JS 2001, 'Standards and practices for forecasting', in JS Armstrong (ed.), *Principles of Forecasting: A Handbook for Researchers and Practitioners*, Springer Science and Business Media Inc.

Ashton, P 1993, *The accidental city: planning Sydney since 1788*, Hale and Iremonger, Sydney NSW.

Atkinson, R and Jacobs, K 2008, ‘Public Housing in Australia: Stigma, Home and Opportunity’, *Paper no.1, Housing and Community Research Unit*, University of Tasmania.

Atkinson-Palombo, C 2010, 'New housing construction in Phoenix: Evidence of “new suburbanism”?', *Cities*, vol. 27, pp. 77-86.

Australian Bureau of Statistics, 1995, Australian Social Trends, catalogue no. 4102.0, Commonwealth of Australia.

—— 2001, Western Australia Statistical Indicators, Dec., Special Article – A View of Housing Density in Perth, *Catalogue Number 1367.5*, Commonwealth of Australia.

—— 2003, Baby Boomers and the 2001 Census, *Catalogue Number. 4914.0.55.001*, Commonwealth of Australia.

—— 2004, Household and Family Projections, Australia, 2001 to 2026, *Catalogue Number. 3236.0*, Commonwealth of Australia.

—— 2008a, Australian Social Trends, *Catalogue Number. 4102.0*, Commonwealth of Australia.

—— 2008b, *Catalogue Number 3222.0, 2006 to 2101 Population Projections Australia*, Commonwealth of Australia.

—— 2011a, *Catalogue Number 3218.0 – Regional Population Growth Australia, 2011*, viewed 12 February 2013 <www.abs.gov.au>.

—— 2011b, *Catalogue Number 3222.0 - Population Projections, Australia, 2006 to 2101*, Government of Australia, Canberra.

—— 2011c, 2011 Census of Population and Housing, Commonwealth Government of Australia, Canberra. Viewed 25 September 2013, www.censusdata.abs.gov.au.

—— 2012a, *Catalogue No. 3101.0*, *Australian Demographic Statistics,* Government of Australia.

—— 2012b, *Catalogue. No*. *2071.0*, *Reflecting a Nation: Stories from the 2011 Census, 2012–2013,* Commonwealth of Australia.

—— 2013, *Catalogue. No*. *3101.0*, *Australian Demographic Statistics, Dec 2013,* Commonwealth of Australia.

—— 2014, *Customised tables based on the 2011 Census of Population and Housing,* Commonwealth of Australia.

Australian Government, 2000, Commonwealth and State Housing Agreement Act 1945, Canberra, viewed 9 October 2013 at www.comlaw.gov.au/Details/C2004C00438.

Australian Government 2012, *The Outlook for Net Overseas Migration, September 2012*, the Department of Immigration and Citizenship, Australia.

Australian Public Service Commission 2007, *Tackling Wicked Problems: A Public Policy Perspective*, viewed 2 February 2013, <http://www.apsc.gov.au/publications-and-media/archive/publications-archive/tackling-wicked-problems>.

Bagnall, D 1998, 'Australian American Graffiti', *Bulletin with Newsweek*, Vol. 117, Issue 6131

Banzhaf, HS and Walsh, RP 2008, 'Do People Vote with Their Feet? An Empirical Test of Tiebout's Mechanism', *American Economic Review*, vol. 98, no. 3, pp. 843–863.

Bates, L 2006, "Does neighbourhood really matter? Comparing historically defined neighbourhood boundaries with housing submarkets", *Journal of Planning Education and Research*, vol. 26, no. 1, pp. 5-17

Batty, M 2007, *Complexity in City Systems: Understanding, Evolution, and Design*, *Working Papers Series Paper 117*, UCL Centre for Advanced Spatial Analysis.

—— 2012, 'Building a science of cities', *Cities*, vol. 29, pp. S9-S16.

Baynes, TM 2009, 'Complexity in Urban Development and Management: Historical Overview and Opportunities', *Journal of Industrial Ecology*, vol. 13, no. 2, pp. 214-227.

Bayoh, I, Irwin, E and Haab, T 2006, 'Determinants of Residential Location Choice: How Important are Local Public Goods in Attracting Homeowners to Central City Locations?', *Journal of Regional Science*, vol. 46, no. 1, pp. 97–120.

Bell, M 1997, *Small Area Forecasting for Infrastructure Planning: Towards Better Practice*, Department of Industry, Science and Tourism, Canberra

Bell, M, Wilson, T and Charles-Edwards, E 2011, 'Australia's Population Future: Probabilistic Forecasts Incorporating Expert Judgement', *Geographical Research, Special Issue: Australian*

Population Debate, vol. 49, no. 3, pp. 261-275.

Bengston, D, Fletcher, J and Nelson, K 2003, 'Public policies for managing urban growth and protecting open space: policy instruments and lessons learned in the United States', *Landscape and Urban Planning*, vol. 69, pp. 271–286.

—— 2004, 'Public policies for managing urban growth and protecting open space: policy instruments and lessons learned in the United States', *Landscape and Urban Planning*, vol. 69, pp. 271– 286.

Bengston, D, Kubik, GH and Bishop, PC 2012, 'Strengthening environmental foresight: potential contributions of futures research', *Ecology and Society*, vol.17, no.2, pp.10.

Bengston, D and Youn, Y-C 2006, 'Urban Containment Policies and the Protection of Natural Areas: The Case of Seoul's Greenbelt', *Ecology and Society*, vol. 11, no. 1.

Berger, H and Nitsch, V 2008, 'Too many Cooks? Committees in Monetary Policy', *CESifo Working Paper,* No. 2274, ifo Institute for Economic Research

Berger, MC and Blomquist, GC 1992, 'Mobility and destination in migration decisions: The roles of earnings, quality of life, and housing prices', *Journal of Housing Economics*, vol. 2, no. 1, pp. 37-59.

Bergman, MM 2011, 'The Good, the Bad, and the Ugly in Mixed Methods Research and Design', *Journal of Mixed Methods Research*, vol. 5, no. 4, pp. 271-275.

Berry, M 2006, *Housing affordability and the economy: A review of labour market impacts and policy issues*, National Reserch Venture 3: Houisng Affordability for Lower Income Australians, Research Paper 5 for the Australian Housing and Urban Research Centre, RMIT-NATSEM research centre

Berry, M And Huxley, M 1992, 'Big Build: Property Capital, the State and Urban Change in Australia', International Journal of Urban and Regional Research, Vol. 16, Issue 1, pp.35-39.

Bertalanffy, LV 1972, *General systems theory*, Penguin, Harmondsworth, UK.

Bewley, TF 1981, 'A Critique of Tiebout's Theory of Local Public Expenditures', *Econometrica*, vol. 49, no. 3.

Bhat, C and Guo, J 2007, 'A comprehensive analysis of built environment characteristics on household residential choice and auto ownership levels', *Transportation Research Part B*, vol. 41, pp. 506–526.

Blais, P 1996, *The Economics of Urban Form, Report Prepared for the Greater Toronto Area Task Force*, Report Prepared for the Greater Toronto Area Task Force, Toronto, Canada.

Blomquist, G 2006, 'Measuring quality of life', in R Arnott and D McMillen (eds), *A Companion to Urban Economics*, Wiley–Blackwell, Malden pp. 480–501.

Blomquist, GC, Berger, MC and Hoehn, JP 1988, 'New estimates of quality of life in urban areas', *American Economic Review*, vol. 78, no. 1, pp. 89–107.

Bögenhold, D 2001, 'Social Inequality and the Sociology of Life Style: Material and Cultural Aspects of Social Stratification', *American Journal of Economics and Sociology*, vol. 60, no. 4, pp. 829-847.

Booth, H 2006, 'Demographic forecasting: 1980 to 2005 in review', *International Journal of Forecasting*, vol. 22, no. 3, pp. 547-581

Bowen, GA, 2008, ‘Naturalistic inquiry and the saturation concept: A research note’, *Qualitative Research*, Vol.8, Iaa.1, pp. 137-152

Box, GEP and Draper, NR 1987, *Empirical Model-Building and Response Surfaces*, Wiley, United States.

Boylan, TA and O'Gorman, PF 2003, 'Pragmatism in Economic Methodology: The Duhem-Quine Thesis Revisited', *Foundations of Science*, vol. 8, no. 1, pp. 3-21.

Braude, L 1970, ‘“Park and Burgess”: An Appreciation’, *American Journal of Sociology*, vol 7, no 1, pp. 1-10

Budge, T 2013, ‘Is Food a Missing Ingredient in Australia’s Metropolitan Planning Strategies?’ in Farmar-Bowers, Q., Higgins, V. and Millar, J., (eds) *Food Security in Australia: Challenges and Prospects for the Future*, Springer, New York

Bukenya, J, Gebremedhin, T and Schaeffer, P 2003, 'of quality of life and rural development: evidence from West Virginia data', *Growth Change*, vol. 34, no. 2, pp. 202–218.

Bunker, R 1985, 'City Profile: Adelaide', *CITIES, November 1985*, pp. 307-315.

Bunker, R, Holloway, D and Randolph, B 2005, ‘Building the connection between housing needs and metropolitan planning in Sydney, Australia’ in Housing Studies, vol. 20, no.5 (1st), pp.771-794

Burgess, R and Skeltys, N 1992, *Findings from the Housing and Location Choice Survey: an overview* Housing and Urban Development Division and Department of Health Housing and Community Services, Australian Government Publishing Service.

Burnell, JD 2010, 'Urban Economics', in RC Free (ed.), *21st century economics : a reference handbook*, vol. 2, Sage Publications, Inc., pp. 665-676.

Button, K 1998, 'Where did the ‘New Urban Economics’ go after 25 years?', paper presented at the 38th Congress of the European Regional Science Association, Vienna, 28 August-1 September 1998.

Buxton, M and Tieman, G 2005, 'Patterns of Urban Consolidation in Melbourne: Planning Policy and the Growth of Medium Density Housing', *Urban Policy and Research*, vol. 23, no. 2, pp. 137-157.

Capella, R and Nijkamp, P 2004, 'The Theoretical and Methodological Toolbox of Urban Economics: From and Towards Where? ', in R Capella and P Nijkamp (eds), *Urban Dynamics and Growth - Advances in urban Economics*, vol. 266 (Contributions to Economic Analysis), Elsevier, The Netherlands.

Carr, B 2012, *Proposals to achieve the early development of Roseworthy Garden Town, Light Regional Council*, viewed 20 February 2012, <Proposals to achieve the early development of Roseworthy Garden Town, Light Regional Council>.

Carrington, K, McIntosh, A and Walmsley, J 2007, *The social costs and benefits of migration into Australia*, Australian Department of Immigration and Citizenship, Canberra.

Cassel, CM, Sarndal, CE and Wretman, JH 1977, *Foundations of Inference in Survey Sampling*, New York: Wiley

Castells, M, 1983, *The City and the Grassroots: a cross-cultural theory of urban social movements*, Edward Arnold, London

Chandra, L 2006, 'Modelling the impact of urban form and transport provision on transport-related greenhouse gas emissions', Institute for Sustainability and Technology Policy, Masters thesis, Murdoch University.

Charmaz, K 2006, *Constructing grounded theory: A practical guide through qualitative analysis*, Thousand Oaks, CA: Sage

Chen, Y and Rosenthal, SS 2008, 'Local amenities and life-cycle migration: Do people move for jobs or fun?', *Journal of Urban Economics*, vol. 64, no. 3, pp. 519–537.

Cheshire, P and Sheppard, S 1995, 'On the Price of Land and the Value of Amenities', *Economica*, vol. 62, pp. 247-267.

Cho, EJ, Rodriguez, DA and Song, Y 2008, 'The role of employment subcenters in residential location decisions', *Journal of Transport and Land Use*, vol. 1, no. 2, pp. 121–151.

Clement, R T and Winkle, R L 1985, ‘Limits for the precision and value of information from dependent sources’, *Operations Research*, Vol, 33, pp. 427-442

Clement, R T and Winkle, R L 1999, ‘Combining probability distributions from experts in risk analysis’, *Risk Analysis*, Vol.19 pp.187-203

Cole, I 2013, ‘Whose place? Whose history? Contrasting narratives and experiences of neighbourhood change and housing renewal’, *Housing, Theory and Society*, vol.30, no.1, pp.65-83

Cooper, J 2005, *Operations Workbook SAASPPS Population Projections for Statistical Local Areas of South Australia,* Demographics Australia, University of Queensland, Australia.

Clark, TN, Lloyd, R, Wong, KK and Jain, P 2004, 'Amenities Drive Urban Growth: A New Paradigm and Policy Linkages ', in TN Clark (ed.), *The City as an Entertainment Machine, Research in Urban Policy, Volume 9, 291–321*, Amsterdam, Elsevier.

Clark, W, Huang, Y and Withers, S 2003, 'Does commuting distance matter? Commuting tolerance and residential change', *Regional Science and Urban Economics*, vol. 33, pp. 199–221.

Colwell, PF, Dehring, CA and Turnbull, GK 2002, 'Recreation Demand and Residential Location', *Journal of Urban Economics*, vol. 51, no. 3, pp. 418-428.

Commission for Architecture and the Built Environment (CABE) 2005, *What home buyers want: Attitudes and decision making among consumers*, UK, viewed 15 April 2012, <www.cabe.org.uk>.

Cooper, J 2005, *Operations Workbook SAASPPS Population Projections for Statistical Local Areas of South Australia*, Applied Population Research Unit, University of Queensland, Australia.

Cope, M and Elwood, S (eds.) 2009, *Qualitative GIS; a mixed methods approach*, Sage Publications.

Costello, L 2007, 'Going Bush: The implications of urban-rural migration', *Geographical Research*, vol. 45, no. 1, March 2007, pp. 85-94.

Creswell, JW 2009, *Research design: Qualitative, quantitative, and mixed methods approaches*, ed. 3rd, Thousand Oaks: SAGE, CA.

Creswell, JW, Plano, CV, Gutmann, M and Hanson, W 2003, 'Advances in mixed method design', in A Tashakkori and C Teddlie (eds), *Handbook of mixed methods in the social and behavioural sciences*, Thousand Oaks: Sage, CA.

Crooks, VA, Schuurman, N, Cinnamon, J, Castleden, H and Johnston, R 2011, 'Refining a

Location Analysis Model Using a Mixed Methods Approach: Community Readiness as a Key Factor in Siting Rural Palliative Care Services', *Journal of Mixed Methods Research, January*, vol. 5, pp. 77-95.

Davison, G 2008, 'Down the gurgler: Historical influences on Australian domestic water consumption', in P Troy (ed.), *Troubled Waters: Confronting the Water Crisis in Australia's Cities*, ANU Press, Canberra.

Davison, G, Dingle, T and O'Hanlon, S 1995, *The Cream Brick Frontier: Histories of Australian Suburbia*, Monash Publications: Monash University

De Gans, HA 2003, 'The Innovation of Population Forecasting Methodology in the Inter-war Period: The Case of the Netherlands', in J Fleischhacker, HA De Gans and TK Burch (eds), *Populations, Projections, Politics: Critical and Historical Essays on Early Twentieth Century Population Forecasting*, Rozenberg Publishers, Amsterdam.

Deller, S, Tsai, T-H, Marcouiller, D and English, D 2001, 'The Role of Amenities and Quality of Life in Rural Economic Growth', *American Journal of Agricultural Economics and Philosophy*, vol. 83, pp. 352–365.

Department of Immigration and Border Protection, 2014, *Fact Sheet 26 – State Specific Regional Migration*, viewed 29 July 2014 <http://www.immi.gov.au/allforms/travel-documents/new-zealand.htm>

Department of Immigration and Border Protection, 2014, *New Zealand Citizens Entering Australia*, viewed 27 July 2014 <http://www.immi.gov.au/allforms/travel-documents/new-zealand.htm>

Department of Immigration and Border Protection, 2013, *Fact Sheet 17 – New Zealanders in Australia*, viewed 21 October 2010 <http://www.immi.gov.au/media/fact-sheets/17nz.htm>

Department of Immigration and Citizenship, 2013, *Migration to Australia's states and territories 2011-12*, Australian Government

Department of Immigration and Multicultural Affairs, 2007, *Population Flows: Immigration Aspects*, Australian Government

Department of Infrastructure and Transport, 2013, *State of Australian Cities 2013*, Australian Government

Department of Lands, Planning and Environment, 1996, *Central Darwin Planning Concepts and Development Opportunities*, Northern Territory Government, Australia

Department of Planning and Community Services 2008, *2030: a planning update - Melbourne @ 5 million*, Government of Victoria, Australia.

—— 2011, *Planning for Melbourne - A new Melbourne Metropolitan Planning Strategy*, Government of Victoria, Australia.

Department of Sustainability and the Environment 2002, *Melbourne 2030 – Planning for sustainable growth, October 2002*, Government of Victoria, Australia.

Dieleman, FM 2001, 'Modelling Residential Mobility: A Review of Recent Trends in Research', *Journal of Housing and the Built Environment*, vol. 16, no. 2, pp. 249–265.

Dodson, J 2008, 'The wrong place at the wrong time: why the structure of housing markets means urban consolidation can't equitably solve our urban planning challenges', paper presented at the Third Australasian Housing Researchers Conference, RMIT University, Rydges Swanston, Melbourne, 18-20 July.

Douglas, S 1997, 'Estimating relative standard of living in the United States using crossmigration data', *Journal of Regional Science*, pp. 411–436.

Dowding, K, John, P and Biggs, S 1994, 'Tiebout: A Survey of the Empirical Literature', *Urban Studies*, vol. 31, no. 4/5, pp. 767-797.

Dowding, K and Mergoupis, T 2003, 'Fragmentation, Fiscal Mobility, and Efficiency', *The Journal of Politics*, vol. 65, no. 4, pp. 1190–1207.

Downward, P and Mearman, A 2003, 'Critical realism and econometrics: interaction between philosophy and Post Keynesian practice', in P Downward (ed.), *Applied Economics and the Critical Realist Critique*, Routledge, London.

DSEWPC 2011, *Sustainable Australia – Sustainable Communities: A sustainable population strategy for Australia*, Published by the Department of Sustainability, Environment, Water, Population and Communities, Australian Government, Canberra.

Dubin, R 1991, 'Commuting patterns and firm decentralisation', *Land Economics*, vol. 67, no. 1, pp. 15–29.

Dunstan, K 2011, *Experimental Stochastic Population Projections for New Zealand: 2009 (base) – 2111*, Statistics New Zealand Working Paper No 11–01, New Zealand Government, Wellington NZ.

Durus, J 2001, 'Quesadillas with Chinese black bean puree: eating together in 'ethnic' neighbourhoods', *New Formations*, vol. 74, summer, pp.46

Dutton, G and Elder, D 1991, *Colonel William Light: founder of a city* Melbourne University Press, Carlton, Vic.

Elkington, J 1998, *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*, New Society Publishers, BC, Canada.

Environment and Sustainable Development 2011, *Population and residential density in Canberra*, Australian Capital Territory Government

Epstein, JM and Axtell, R 1996, *Growing artificial societies: social science from the bottom up*, The Brookings Institute, Washington DC.

Easthope, H and Tice, A 2011, 'Children in Apartments: Implications for the Compact City', *Urban Policy and Research*, vol. 29, no. 4, pp. 415-434.

Easthope, H, Tice A, and Randolph, B 2009, *The Desirable Apartment Life?*, City Futures Research Centre, University of New South Wales

Easthope, H and Randolph, B 2009, Governing the Compact City: The Challenges of Apartment Living in Sydney, Australia', *Housing Studies*, vol. 24, no. 2, pp. 243-259.

Faulkner, D 2007, 'The older population and changing housing career: Implications for housing provision', *Australasian Journal on Ageing, Review Article*, vol. 26, no. 4, December, pp. 152-156.

Fávero, LPL 2011, 'Buyer information and the hedonic: The impact of a seller disclosure on the implicit price for airport noise', *Journal of Urban Economics*, vol. 63, no. 2, pp. 498-516.

Ferguson, K, Perl, A, Holden, M and Roseland, M 2007, 'Supporting Global Sustainability by Rethinking the City', *Journal of Urban Technology*, vol. 14, no. 2, pp. 3-13.

Ferrell, WR 1985, 'Combining individual judgements', in G Wright (ed.), *Behavioural Decision Making*, pp. 111-145, New York: Plemun

Flatau, P, Hendershott, P, Watson, R and Wood, G 2004, *What drives Australian housing careers? An examination of the role of labour market, social and economic determinants*, Final Report No. 68 for the Australian Housing and Urban Research Centre, Western Australia

Florida, R 2002, 'Bohemia and economic geography', *Journal of Economic Geography*, vol. 2, pp. 55-71.

Flyvbjerg, B 2006, *From Nobel Prize to Project Management: Getting Risks Right*, Aalborg University, Denmark, viewed 14 December 2011, <http://flyvbjerg.plan.aau.dk/Publications2006/Nobel-PMJ2006.pdf>.

Foran, B, Lezen, M and Dey, C 2004, *Balancing Act Triple Bottom Line Analysis of the Australian Economy*, Report for the Department of the Environment and Heritage, Commonwealth of Australia.

Foreign Investment Review Board, *2012-13 Annual Report*, Government of Australia.

Forrester, JW 1969, *Urban Dynamics*, Pegasus Communications, MA, United States.

Forster, CA 1974, 'The journey to work and a satellite town: the cautionary example of Elizabeth', *Australian Geographical Studies*, vol. 12, no. 1, pp. 3-26.

—— 2004, *Australian Cities: Continuity and Change*, 3rd edition, Oxford University Press, Melbourne

—— 2006, 'The Challenge of Change: Australian Cities and Urban Planning in the New Millennium', *Geographical Research*, vol. 44, no. 2, June, pp. 173–182.

Foulkes, P 1976, ‘Theories of Truth’, Proceedings of the Aristotelian Society, New Series, vol. 77 (1976-77), pp. 63-72, Wiley, NJ

Fournier, S, Antes, D and Beaumier, G 1992, 'Nine consumption life-styles', in J.F. Sherry, Jr and B Sternthal (eds), *Advances in Consumer Research*, vol. 19, Association for Consumer Research, Provo, UT pp. 329-337.

Frank, LD 2004, 'Economic Determinants of Urban Form: Resulting Trade-offs Between Active and Sedentary Forms of Travel', *American Journal of Preventive Medicine*, vol. 27(3S), pp. 146–153.

Fuller, R and Crawford, R 2011, 'Impact of past and future residential housing development patterns on energy demand and related emissions', *Journal of Housing and the Built Environment*, vol. 26, pp. 165–183.

Gargett, K and Marsden, S 1996, *Adelaide: A Brief History, Adelaide*, State History Centre in association with Adelaide City Council, South Australia.

Garreau, J 1991, *Edge City: Life on the New Frontier*, Anchor Books, New York.

Gennaio, M-P, Hersperger, A and Matthias, B 2009, 'Containing urban sprawl—Evaluating effectiveness of urban growth boundaries set by the Swiss Land Use Plan', *Land Use Policy*, vol. 26, pp. 224-232.

Gilbert, R 2007, 'Hamilton, Ontario: Towards a Paradigm of Energy-First Planning', *Journal of Urban Technology*, vol. 14, no. 2, pp. 103–121.

Gilboa, I 2009, *Theory of Decision under Uncertainty* Cambridge University Press.

Glaeser, EL and Kahn, ME 2003, *Sprawl and urban growth*, *Harvard Institute of Economic Research discussion paper No. 2004*, Cambridge, Massachusetts.

Glaeser, EL, Kolko, J and Saiz, A 2001, 'Consumer City', *Journal of Economic Geography*, vol. 1, no. 1, pp. 27–51.

Glaser, BG and Strauss, A L 1967, *The discovery of grounded theory: Strategies for qualitative research*, Chicago: Aldine

Gleeson, B 2008, ‘Critical Commentary. Waking from the Dream: An Australian Perspective on Urban Resilience’, *Urban Studies*, vol.45, pp.2653-2668.

—— (ed) 2010, *Lifeboat cities*, UNSW Press, Sydney, NSW.

—— 2013, ‘A New Harvest of the Suburbs’, in Farmar-Bowers, Q., Higgins, V. and Millar, J., (eds) *Food Security in Australia: Challenges and Prospects for the Future*, Springer, New York

Gleeson, B, Darbas, T, Johnson, L and Lawson, S 2004, *What is Metropolitan Planning?*, Urban Policy Program, Research Monograph 1, July, Griffith University.

Godden, L 2008, 'Property in urban water: Private rights and public governance', in P Troy (ed.), *Troubled Waters: Confronting the Water Crisis in Australia's Cities*, ANU Press, Canberra, pp. 157-185.

Government of Australia, 2011, *National Housing Supply Council State of Supply Report*, the Department of Sustainability, Environment, Water, Population and Communities, Canberra ACT, Australia.

Government of South Australia 1990, *Metropolitan Adelaide Development Program 1989-1994*, the Department of Environment and Planning on behalf of the Urban Development Co-ordinating Committee, South Australia.

—— 2003a, *Planning Strategy for Metropolitan Adelaide*, prepared by the Department of Transport and Urban Planning, South Australia.

—— 2003b, *Adelaide Travel Patterns: Travel to/from the City of Adelaide*, December 2003 Research Summary.

—— 2007, *Planning Strategy for Metropolitan Adelaide*, viewed 2 September 2007, <www.planning.sa.gov.au/>.

—— 2009a, *2007 Retail Database*, Planning SA, the Department of Primary Industries and Resources, South Australia, viewed 24 January 2013, <www.sa.gov.au>.

—— 2009b, *2008 Industrial Database*, Planning SA, the Department of Primary Industries and Resources, South Australia, viewed 24 January 2013, <www.sa.gov.au>.

—— 2010a, *The 30 Year Plan for South Australia – A volume of the South Australian Planning Strategy*, Published by the Department of Planning and Local Government, South Australia.

—— 2010b, *Housing and Employment Land Supply Program, Supply Program Report 2010, Greater Adelaide*, Department of Planning and Local Government, South Australia.

—— 2010c, *Population Projections for South Australia and Statistical Divisions, 2006-36, December 2010*, published by the Department of Planning and Local Government, South Australia.

—— 2012a, *Capital City Development Plan Amendment*, Department of Planning, Transport and Infrastructure, South Australia, viewed 2 February 2013, <www.sa.gov.au/subject/CapitalCityamendment>.

—— 2012b, *Inner Metropolitan Growth Project*, Department of Planning, Transport and

Infrastructure, South Australia, viewed 2 February 2013, <www.dpti.sa.gov.au/planning/innermetrogrowth>.

—— 2013a, *Adelaide Hills Council, Barossa Council, Light Regional Council, Onkaparinga (City) Development Plans, BAROSSA VALLEY AND McLAREN VALE REVISED – PROTECTION DISTRICTS, Development Plan Amendment*, the Department of Planning, Transport and Infrastructure, South Australia.

—— 2013b, *Barossa Valley and McLaren Vale revised protection districts amendment*, South Australia, viewed 2 February 2013, <http://www.sa.gov.au/subject/BarossaValleyandMcLarenValerevisedprotectiondistrictsamendment>.

—— 2013c, Integrated Transport and Land Use Plan, viewed 5 November 2013 <www.transportplan.sa.gov.au>.

—— 2014, *South Australian Digital Cadastre Database*, produced by the Land Services Group, South Australia.

Government of Western Australia, 2009 Reducing the Burden – Report of the Red Tape Reduction Group

—— 2010, *Central Metropolitan Perth Sub-regional Strategy – Draft*, viewed 25 September 2012, <www.planning.wa.gov.au/publications/762.asp>.

—— 2014, *Regional classification for Perth – 12 September*, viewed 29 July 2014, <http://www.migration.wa.gov.au/rsms/Pages/RegionalclassificationforPerth-12September.aspx>.

Grafton, Q 2012, 'Challenges and opportunities for Australian unconventional gas production', *Australia's Unconventional Energy Options*, Committee for Economic Development of Australia, Melbourne, pp. 13-26.

Graves, P 1976, 'A reexamination of migration, economic opportunity and the quality of life', *Journal of Regional Science*, vol. 16, pp. 107–112.

—— 1980, 'Migration and climate', *Journal of Regional Science*, vol. 20, pp. 227–237.

Graves, PE and Linneman, PD 1979, 'Household migration: Theoretical and empirical results', *Journal of Urban Economics*, vol. 6, no. 3, July, pp. 383–404.

Gray, R, Gleeson, B and Burke, M 2010, 'Practice Review: Urban Consolidation, Household Greenhouse Emissions and the Role of Planning', *Urban Policy and Research*, vol. 28, no. 3, September, pp. 335–346.

Green, KC, Armstrong, JS and Graefe, A 2007, *Methods to Elicit Forecasts from Groups: Delphi and Prediction Markets Compared*, Monash University Business and Economic Forecasting Unit, Munich Personal RePEc Archive.

Greene, JC, Caracelli, VJ and Graham, WF 1989, 'Toward a Conceptual Framework for Mixed-Method Evaluation Designs', *Educational Evaluation and Policy Analysis*, vol. 11, no. 3, pp. 255-274.

Greenwood, MJ and Hunt, GL 1989, 'Jobs versus amenities in the analysis of metropolitan migration', *Journal of Urban Economics*, vol. 25, no. 1, pp. 1-16.

Group of Eight 2013, The Changing PhD, Discussion Paper, ACT, Australia, viewed 9 November 2013 www.go8.edu.au.

Guba, E 1990, *The Paradigm Dialog*, Sage Publications, CA.

Guest, G, Bunce, A and Johnson, L 2006, ‘How many Interviews are Enough?: Experiment with Data Saturation and Variability’, *Field Methods*, vol. 18, pp.59-82.

Gunasekera, D 2012, 'Climate change in Australia: Implications for population', in J Pincus and GJ Hugo (eds), *A Greater Australia: Population, policies and governance*, Committee for Economic Development of Australia, Melbourne, pp. 96-103.

Guo, JY and Bhat, CR 2007, 'Operationalizing the concept of neighbourhood: Application to residential location choice analysis', *Journal of Transport Geography*, vol. 15, no. 1, pp. 31-45.

Gyourko, J, Kahn, M and Tracy, J 1999, 'Quality of Life and Environmental Comparisons', in ES Mils and P Cheshire (eds), *The Handbook of Regional and Urban Economics*, vol. 3, North-Holland, Amsterdam, pp. 1413-1454.

Hamilton, B 1983, 'Wasteful commuting. Journal of Political Economy', *Journal of Political Economy*, vol. 90, pp. 1035–1053.

Hamilton, C 2003, *Growth Fetish*, Allen and Unwin, Sydney

Handy, S, Cao, X and Mokhtarian, P 2006, 'Self-selection in the relationship between the built environment and walking', *Journal of the American Planning Association*, vol. 72, no. 1, pp. 55–74.

Hansen, H and Winther, L 2010, 'Amenities and Urban and Regional Development: Critique of a New Growth Paradigm', paper presented at Regional Studies Association Annual International Conference 2010, Regional Responses and Global Shifts: Actors, Institutions and Organisations, Pécs, Hungary, 26 May.

Head, L 2008, 'Nature, networks and desire: Changing cultures of water in Australia', in P Troy (ed.), *Troubled Waters: Confronting the Water Crisis in Australia's Cities*, ANU Press, Canberra, pp. 67-80.

Healy, E and Birrell, B 2006, *Housing community in the compact city*, Final Report No. 89 for the Australian Housing and Urban Research Centre, Swinburne-Monash Research Centre, Australia

Hoang, H and Wakely, P 2000, 'Status, Quality and the Other Trade-off: Towards a New Theory of Urban Residential Location', *Urban Studies*, vol. 37, no. 1, pp. 7-35.

Holloway, D and Bunker, R 2005, 'Separating prospects from propaganda in urban consolidation', *State of Australian Cities Conference Proceedings*.

Hooimeijer, P and Heida, H 1994, 'Small area household projections: A multistate demographic design', in P. Hooimeijer, G. A. van der Knaap, J. van Weesep and RI Woods (eds), *Population dynamics in Europe*, Netherlands Geographical Studies 173, Dept of Geography, University of Utrecht, .

Hora, SC 1992, ‘Acquisition of Expert Judgment: Examples from Risk Assessment’, *Journal of Energy Engineering*, vol. 118, no.2, pp. 136-148.

Housing Industry Prospects Forum, SA September 2012, *Housing Industry Prospects Report: Market Trends; Prospects for 2012/13 and 2013/14*, Government of South Australia, South Australia.

Huang, JC 2010, 'Deriving benefit measures with higher precision: A study of economic values of air quality', *Land Economics*, vol. 86, no. 4, pp. 727-745.

Hughes, R 1988, *The Fatal Shore*, Pan, London.

Hugo, G. 2003a, 'Asian Migration to Australia: Changing Trends and Implications', Scottish Geographical Journal, Vol. 119, No. 3, pp.247-264

—— 2003b, 'Australia's ageing population', Australian Planner, Vol. 40, pp.109-118

—— 2008a, 'In and Out of Australia', Asian Population Studies, Vol. 4, Issue 3, pp.267-291

—— 2008b, 'Australia's State-Specific and Regional Migration Scheme: An Assessment of its Impacts in South Australia', Journal of International Migration and Integration, Vol. 9, Issue 2, pp.125-145

—— 2010, *Demographic Change and Liveability Panel Report, An appendix to A Sustainable Population for Australia issues paper, Report commissioned by the Hon Tony Burke MP*, Minister for Sustainability, Environment, Water, Population and Communities.

—— 2011, 'Geography and Population in Australia: A Historical Perspective', *Geographical Research, Special Issue: Australian Population Debate*, vol. 49, no. 3, pp. 242-260.

—— 2012, 'Population distribution and internal migration', in J Pincus and G Hugo (eds), *A Greater Australia: Population, policies and governance*, Committee for Economic Development of Australia, Melbourne, Australia, pp. 72-95.

Hugo, G. and Harris, K. 2012, *Survey of non resident and resident ratepayers of the District Council of the Copper Coast, January 2012*, GISCA, University of Adelaide.

Hugo, G, Luszcz, M, Carson, E, Hinsliff, J, Edwards, P, Barton, C and King, P 2009, *State of Ageing in South Australia*, Department of Families and Communities, Government of South Australia, Adelaide.

Hugo, G, Rudd, D and Harris, K 2003, *Australia's Diaspora: Its Size, Nature and Policy Implications, Committee for Economic Development of Australia*, Information Paper No. 80, Government of Australia

Hulse, K., Milligan, V. and Easthope, H. 2011, *Secure Occupancy in Rental Housing: Conceptual Foundations and Comparative Perspectives*, Final Report no. 170, Australian Housing and Urban Research Institute, Melbourne

Hundley, I 2014, *Submission to the Inquiry into Foreign Investment in Real Estate*, House of Representatives Standing Committee on Economics, Government of Australia.

Hur, M and Morrow-Jones, H 2008, 'Factors That Influence Residents' Satisfaction With Neighborhoods', *Environment and Behavior*, vol. 40, no. 5, September, pp. 619-635.

Infrastructure New South Wales, 2012, *State Infrastructure Strategy*, New South Wales Government

Intergovernmental Panel on Climate Change 2007, *IPCC Fourth Assessment Report, Climate Change 2007: Working Group III: Mitigation of Climate Change*, viewed 30 September 2013 <www.ipcc.ch/publications_and_data/ar4/wg3/en/ch 12s12-2-1.html>

International Institute for Applied Systems Analysis (IIASA) 2011, *Expert Survey*, viewed 31 August 2011, <www.iiasa.ac.at/Research/POP/ExpertSurvey/?referer=iussp>.

Jaccard, M 2005, *Sustainable Fossil Fuels: The Unusual Suspect in the Quest for Clean and Enduring Energy* Cambridge University Press, London.

Jacobs, J 1961, The death and life of great American cities, Vintage/Random House, New York.

Jacobs, K, Atkinson, R, Peisker, VC, Berry, M and Dalton, T 2010, *What future for public housing? A critical analysis*, Final Report No. 151 for the Australian Housing and Urban

Research Centre, Southern Research Centre

Jansen, SJT 2011, 'Lifestyle Method', in SJT Jansen, HCC Coolen and RW Goetgeluk (eds), The Measurement and Analysis of Housing Preference and Choice, Springer Netherlands, pp. 177-202.

Jette DJ, Grover, L and Keck, CP 2003, 'A qualitative study of clinical decision making in recommending discharge placement from the acute care setting', *Physical Therapy*, Vol. 83, Iss.3, pp. 224-236

John, P, Dowding, K and Biggs, S 1995, 'Residential Mobility in London: A Micro-Level Test of the Behavioural Assumptions of the Tiebout Model', *British Journal of Political Science*, vol. 25, no. 3, pp. 379-397.

Johnson, BR, Onweugbuzie, AJ and Turner, LA 2007, 'Toward a definition of mixed methods research', *Journal of Mixed Methods Research*, vol. 1, pp. 112-133.

Johnson, BR and Onwuegbuzie, AJ 2004, 'Mixed Methods Research: A Research Paradigm Whose Time Has Come', *Educational Researcher*, vol. 33, no. 7, pp. 14-26.

Judd, B, Edgar, L, Easthope, H, Davy, L and Bridge, C 2014, *Downsizing amongst older Australians*, Final Report No. 214 for the Australian Housing and Urban Research Centre, The University of New South Wales.

Jun, M-J 2008, 'Are Portland's Smart Growth Policies Related to Reduced Automobile Dependence?', *Journal of Planning Education and Research*, vol. 28, pp. 100-107.

Kahn, M 2000, 'The Environmental Impact of Suburbanisation', *Journal of Policy Analysis and Management*, vol. 19, no. 4, Autumn, pp. 569-586.

Kahneman, D and Lovallo, D 1993, 'Timid Choices and Bold Forecasts: A Cognitive Perspective on Risk Taking', *Management Science*, vol. 39, no. 1, pp. 17-31.

Kahneman, D and Tversky, A 1977, *Intuitive Prediction: Biases and Corrective Procedures, Decision Research, A Branch of Perceptronics*, Defense Advanced Research Projects Agency.

—— 1979, 'Intuitive Prediction: Biases and Corrective Procedures', *Management Science*, vol. 12, pp. 313-327.

Kaplan, R and Austin, ME 2004, 'Out in the country: sprawl and the quest for nature nearby', *Landscape and Urban Planning*, vol. 69, no. 2–3, pp. 235-243.

Katz, B, Altman, A and Wagner, J 2006, 'An Urban Agenda for an Urban Age', paper presented at Urban Age Conference Berlin, Germany, 10 November.

Kay, A and Marsh, A 2007, 'The Methodology of The Public Choice Research Programme: The Case Of 'Voting With Feet', *New Political Economy*, vol. 12, no. 2.

Kellet, J 2011, 'The Australian quarter acre block: the death of a dream?', *Town Planning Review*, 2011, Vol.82(3), pp.263-284

Kenworthy, J 2007, 'Urban Planning and Transport Paradigm Shifts for Cities of the Post-Petroleum Age', *Journal of Urban Technology*, August, pp. 47-70.

Kenworthy, J, Laube, F, Newman, P, Barter, P, Raad, T, Poboon, C and Guia Jr, B 1999, *An International Sourcebook of Automobile Dependence in Cities, 1960-1990*, University Press of Colorado, Boulder.

Kenyon, E and Heath, S 2001, 'Choosing This Life: Narratives of Choice amongst House Sharers', *Housing Studies*, vol. 15, no. 5, pp. 619–635.

Keyfitz, N 1972, 'On future population', *Journal of the American Statistical Association*, vol. 67, no. 338, pp. 347-363.

Keyfitz, N 1982, ‘Can knowledge improve forecasts?’, *Population and Development Review*, vol.7, no.4, pp.579-593.

Khoo, S-E, Hugo, G. and McDonald, 2011, ‘Skilled Migration from Europe to Australia’, Population, Space and Place, vol. 17, pp.550-566

Kim, JH, Pagliara, F and Preston, J 2005, 'The Intention to Move and Residential Location Choice Behaviour', *Urban Studies*, vol. 42, no. 9, pp. 1621–1636.

Knight, FH 1921, *Risk, Uncertainty, and Profit*, Schaffner and Marx; Houghton Mifflin Company, Boston, MA.

Kolb, DA 1984, *Experiential Learning*, Englewood Cliffs: Prentice Hall, NJ.

Kotkin, J 2005, 'The new suburbanism: a realist’s guide to the American future', *The Planning Center*.

Krueger, R A and Casey, M A 2000, *Focus groups: A practical guide for applied research* (3rd ed.), Thousand Oaks, CA: Sage

Krizek, K and Waddell, P 2002, 'Analysis of Lifestyle Choices: Neighborhood Type, Travel Patterns, and Activity Participation', *Transportation Research Record*, vol. 1807, pp. 119-128.

Krugman, P 2010, 'The new economic geography, now middle aged', paper presented at the Association of American Geographers Meetings, Washington, DC, 16 April, 2010.

Krumme, G 1999, 'Location-Theoretical Traditions and Significant Concepts', viewed 9 June 2012, <http://faculty.washington.edu/krumme/450/traditions.html>.

Krupka, DJ 2007, *Location-Specific Human Capital: Location Choice and Amenity Demand*, Discussion Paper No. 2987, The Institute for the Study of Labor (IZA), Bonn.

Kulish, M, Richards, A and Gillitzer, C 2011, *Urban Structure and Housing Prices: Some Evidence from Australian Cities*, Research Discussion Paper 2011-03, Economic Group, Reserve Bank, Australia.

Kupke, V., 2000, *The implications of changes in the labour market for the ownership aspirations, housing opportunities, and characteristics of first home buyers*, Final Report No. 18 for the Australian Housing and Urban Research Centre, Western Australia

Lambiri, D, Biagi, B and Royuela, V 2007, 'Quality of Life in the Economic and Urban Economic Literature', *Social Indicators Research*, vol. 83, pp. 1–25.

Landis, J and Zhang, M 1998, 'The second generation of the California urban futures model Part 2: Specification and calibration results of the land-use change submodel', *Environment and Planning B: Planning and Design*, vol. 25, pp. 795 - 824.

Langridge, J, Kelly, G and Melhuish, T 2005, *Modelling Possible Futures and Scenarios: A Description and Guide for the use of the AMR Sustainable Future Model*, Resources Futures Program, CSIRO Sustainable Ecosystems

Lawson, V 1995, 'The politics of difference: Examining the quantitative/qualitative dualism in poststructuralist feminist research', *The Professional Geographer*, vol. 47, no. 449-457.

Lee, BHY, Hall, F and Waddell, P 2010, 'Reexamining the influence of work and nonwork accessibility on residential location choices with a microanalytic framework', *Environment and*

Planning A, vol. 42, pp. 913-930.

Lee, R 2000, 'The Lee-Carter Method for Forecasting Mortality, with Various Extensions and Applications', *North American Actuarial Journal*, vol. 4, no. 1, pp. 80-93.

Levinson, DM 1998, 'Accessibility and the journey to work', *Journal of Transport Geography*, vol. 6, no. 1, pp. 11–21.

Lewis, M 1999, Suburban Backlash: The Battle for Melbourne, the World's Most Liveable City, Melbourne, Blooming Books

Libby, R and Blashfield, RK 1978, 'Performance of a Composite as a Function of the Number of Judges', *Organizational Behaviour and Human Performance*, vol. 21, pp.121-129.

Lindstrom, B 1997, 'A sense of place: housing selection on Chicago's North Shore', *Sociological Quarterly*, vol. 31, no. 1.

Llewelyn, DY 2006, *The Northern Way: Quality of Place - The North's Residential Offer - Phase I Report: Exploring the Literature – Defining the relationship between QoP/RO and REC, 36910*, Llewelyn Davies Yeang Architecture Planning Design, UK.

Losch, A 1954, *The Economics of Location*, Yale University Press, New Haven.

Lovallo, D and Kahneman, D 2003, 'Delusions of success: How optimism undermines executives' decisions', *Harvard Business Review*, pp. 56–63.

Lutz, W 2006, *MicMac Deliverable D16, Report describing application of argument-based forecasting (including interactive questionnaire in Excel), Work Package 3, Expert knowledge in assumption making*, International Institute for Applied Systems Analysis, Laxenburg, Austria.

—— 2009, *Toward a Systematic, Argument-Based Approach to Defining Assumptions for Population Projections, Interim Report IR-09-037*, International Institute for Applied Systems Analysis, Laxenburg, Austria.

Lutz, W and Goldstein, JR 2004, 'Introduction: How to Deal with Uncertainty in Population Forecasting?', *International Statistical Review*, vol. 72, no. 1.

Lutz, W, Goldstein, JR and Prinz, C 1996a, 'Alternative Approaches to Population Projection', in W Lutz (ed.), *The Future Population of the World: What Can We Assume Today?*, Revised Edition, International Institute for Applied Systems Analysis, Laxenburg, Austria.

Lutz, W, Saariluoma, P, Sanderson, WC and Scherbov, S 2000, *Interim Report IR-00-020 New Developments in the Methodology of Expert – and Argument-Based Probability Population Forecasting*, International Institute for Applied Systems Analysis, Laxenburg, Austria.

Lutz, W, Sanderson, W and Scherbov, W 1996b, 'Probabilistic Population Projections Based on Expert Opinion, Revised Edition', in W Lutz (ed.), *The Future Population of the World: What Can We Assume Today?*, International Institute for Applied Systems Analysis, Laxenburg, Austria.

Lyndall, BB and Eves, C 2011, 'The impact of infrastructure charges on new housing costs : an international comparison', in Y Wang, Y Pang and G Shen (eds), *Proceedings of 2011 International Conference on Construction and Real Estate Management,* Guangzhou, China, pp. 894-899.

Madsen, LM and Adriansen, HK 2004, 'Understanding the use of rural space: The need for multimethods', *Journal of Rural Studies*, vol. 20, pp. 485-497.

Makowski, M and Wierzbicki, A 2003, 'Modelling knowledge: Model-based decision support and soft computations', in X Yu and J Kacprzyk (eds), *Applied Decision Support with Soft Computing*, Springer-Verlag, Heidelberg, Germany.

Makridakis, S and Winkler, RL 1983, ‘Averages of forecasts: Some empirical results’, *Management Science*, Vol. 29, pp. 987-996

Malpass, P 2011, ‘Path Dependence and the Measurement of Change in Housing Policy’, *Housing, Theory and Society*, vol.28, no.4, pp.305-319

Marcus, C 1995, *House As a Mirror of Self: Exploring the Deeper Meaning of Home* Conari Press.

Marion, B and Horner, MW 2008, 'Development of Spatial Dissimilarity-Based Index of Jobs-Housing Balance', TRB Annual Meeting CD-ROM (Original paper submittal – not revised by author).

Marshall, A 1920, *Principles of Economics - An introductory Volume*, 8th edn, Macmillan, London.

Marshall, G 1998, “Social area analysis”, A Dictionary of Sociology, *Encyclopedia.com*, viewed 27 Jan. 2015 <www.encyclopedia.com>

Martin, R 1999, 'The new ‘geographical turn’ in economics: some critical reflections', *Cambridge Journal of Economics*, vol. 23, pp. 65–91.

Mason M 2010, *‘*Sample Size and Saturation in PhD Studies Using Qualitative Interviews*’, Forum: Qualitative Social Research* Vol 11 No 3

Maude, A 2012, 'A century of debate about population and the environment: Key issues', in J Pincus and G Hugo (eds), *A Greater Australia: Population, policies and governance*, Committee for Economic Development of Australia, Melbourne, Australia, pp. 26-33.

Maurin, V and Vidal, J-P 2012, *Monetary Policy Deliberations: Committee Size and Voting Rules*, Working Paper Series, No.1434, European Central Bank, Eurosystem

Mayer, M 2006, ‘Manuel Castells the City and the Grassroots’, *International Journal of Urban and Regional Research*, vol. 30, no.1, p.202-206

McDonald, P 2012, 'Forecasts and projections of Australia's population', in J Pincus and GJ Hugo (eds), *A Greater Australia: Population, policies and governance*, Committee for Economic Development of Australia, Melbourne, pp. 50-59.

McDonald, P 2013, ‘Migration to Australia - impact of changing government policies’, *Australian Population Association seminar series (10 September)*, Flinders University, Adelaide, Australia

McDougall and Vines, 2006, *City of Adelaide: A Thematic History*, viewed 18 January 2013, <www.adelaidecitycouncil.com/>.

McMaster, R and Watkins, C 2006, 'Economics and underdetermination: a case study of urban land and housing economics', *Cambridge Journal of Economics*, vol. 30, pp. 901–922.

Mee, K 1994, Dressing up the suburbs: representations of Western Sydney, in K. Gibson and S. Watson (eds.) *Metropolis Now: Planning and the Urban Contemporary Australia*, Sydney: Pluto Press, pp.60-77

Mees 2003, 'Practice Review: Paterson’s Curse: the Attempt to Revive Metropolitan Planning in Melbourne', *Urban Policy and Research*, vol. 21, no. 3, pp. 287–299.

Melhuish, T, King, A and Taylor, E 2004, ‘The regional impact of Commonwealth Rent Assistance’, *Australian Housing and Urban Research Institute*, Final Report No. 71, RMIT-NATSEM Research Centre

Melhuish, T, Murchison Council (WA), Mid West Development Commission, CSIRO Sustainable Ecosystems 2005, *The Path-Maker Project: Strategic Investments for the Future of the Murchison: a Systems Approach for the Future*, CSIRO Sustainable Ecosystems, Canberra

Mertens, DM 2010, 'Transformative Mixed Methods Research', *Qualitative Inquiry*, vol. 16, pp. 469-474.

Mindali, O, Raveh, A and Salomon, I 2004, 'Urban density and energy consumption: a new look at old statistics', *Transportation Research Part A: Policy and Practice*, vol. 38, no. 2, February, pp. 143–162.

Mok, D 2007, 'Do two-earner households base their choice of residential location on both incomes?', *Urban Studies*, vol. 44, no. 4, pp. 723-750.

Mol, A 2002, 'Cutting Surgeons, Walking Patients: Some Complexities Involved in Comparing', in J Law and A Mol (eds), *Complexities: Social studies of knowledge practices* Duke University Press, Durham, NY, pp.218-257.

Mol, A and Law, J 2002, 'Complexities: An introduction', in J Law and A Mol (eds), *Complexities: Social studies of knowledge practices* Duke University Press, Durham, NY, pp.1-22.

Montgomery, M and Curtis, C 2006, *Working Paper No 2: Housing Mobility and Location Choice*, Urbanet, Department of Urban and Regional Planning, Curtin University.

Moodie, R, Whitney, D, Wright, M and McAfee, A 2008, *Melbourne 2030 Audit Expert Group Report*, Commissioned by the Department of Planning and Community Development.

Morgan, D L 2014,'Probability Sampling' in Given, L M, (ed.) *The SAGE Encyclopedia of Qualitative Research Methods*, SAGE Knowledge, p.682, viewed 1 July 2014 <http://knowledge.sagepub.com>

Moro, M, Brereton, F, Ferreira, S and Clinch, JP 2008, 'Ranking quality of life using subjective well-being data', *Ecological Economics*, vol. 65, no. 3, 15 April 2008, pp. 448–460.

Morrow-Jones, H, Irwin, E and Roe, B 2004, 'Consumer Preference for Neotraditional Neighborhood Characteristics', *Housing Policy Debate*, vol. 15, no. 1, pp. 171-202.

Morse JM, 1995, 'The significance of saturation', *Qualitative Health Research*, Vol 5, Iss.3, pp.147-149

Munley, VG 1982, 'An alternate test of the Tiebout hypothesis', *Public Choice*, vol. 38, pp. 211-217.

Murray, D, Hall, R., Leask, B., Marginson, S. and Ziguras 2011, 'State of Current Research in International Education', *background paper prepared for AEI supported International Education Research-Policy Symposium*, 8 April, Canberra, Australia

Myers, D and Gearin, E 2001, 'Current Preferences and Future Demand for Denser Residential Environments', Housing Policy Debate, vol. 12, no. 4, pp. 633-659.

Napier, Sir CJ, *1835*, *Colonization, Particularly in Southern Australia: With Some Remarks on Small Farms and Over Population,* Marchant Printer, London

National Housing Supply Council, 2011, *State of Supply Report*, Australian Government, Canberra

National Housing Supply Council, 2013, *Housing Supply and Affordability Issues, 2012-13*, Australian Government, Canberra

Neary, J 2001, 'Of hype and hyperbolas: Introducing the new economic geography', *Journal of*

Economic Literature, vol. 39, pp. 536–561.

Neimark, P and Rhoades Mott, P 1999, *The Environmental Debate: A Documentary History*, Greenwood Press, Westport, CT.

Nelson, R 2012, 'Unconventional gas and produced water', *Australia's Unconventional Energy Options*, Committee for Economic Development of Australia, Melbourne, pp. 27-40.

Newman, P 2005, 'Pipe dreams and ideologies: values and planning', *People and Place*, vol. 13, pp. 41-53.

Newman, P 2006, 'Transport greenhouse gas and Australian suburbs. What planners can do?', *Australian Planner*, vol. 43, no. 2, pp. 6-7.

—— 2007, 'Beyond Peak Oil: Will Our Cities Collapse?, *Journal of Urban Technology*, vol. 14, no. 2, pp. 13–28.

Newman, P and Kenworthy, J 1989, *Cities and Automobile Dependence: An International Sourcebook*, Avebury Technical, Great Britain.

Newman, P and Kenworthy, J 1999, *Sustainability and Cities: Overcoming Automobile Dependence*, Island Press, Washington, DC.

Newman, P, Kenworthy, J and Vintila, P 1992, *Housing, Transport and Urban Form, The National Housing Strategy Background Papers No 15*, Australian Government Publishing Service, Canberra.

Newton, P 2004, 'Reshaping the future of cities', *Ecos*, no. 118, Jan-Mar 2004.

Neyman, J 1934, 'On the Two Different Aspects of the Representative Method: The Method of Stratified Sampling and the Method of Purposive Selection', *Journal of the Royal Statistical Society*, Vol.97, No.4, pp. 558-625

New South Wales Government 2010, *Metropolitan Plan for Sydney 2036* Published by the Department of Planning and Infrastructure, Sydney, Australia.

—— 2012a, *Sydney over the next 20 years*, Department of Planning and Infrastructure, viewed 7 June 2012, <www.planning.nsw.gov.au/sydney-over-the-next-20-years>.

—— 2012b, *NSW Long Term Transport Master Plan*, New South Wales

Nielsen, BG, 2010, "Is Breaking Up Still Hard to Do? – Policy Retrenchment and Housing Policy Change in Path Dependent Context", *Housing, Theory and Society*, vol. 27, no. 3, pp.241-257

Nielsen, J and Landauer, TK 1993, 'A Mathematical Model of the Finding of Usability Problems', *Proceedings of INTERCHI*, vol.93, pp.206-13.

Nowotny, K 2010, 'Workplace Location Attractiveness and Local Public Goods'.

O'Neill, P 2011, 'Bringing Scholarship and Judgement into the Australian Population Debate', *Geographical Research, Special Issue: Australian Population Debate*, vol. 49, no. 3, pp. 237–241.

O'Sullivan, A 2003, *Urban economics*, McGraw-Hill/Irwin, Boston, Mass.

Office for National Statistics (ONS) UK 2009, *2008-based National Population Projections*, viewed 30 June 2010, <www.statistics.gov.uk/downloads/theme_population/NPP2008/NatPopProj2008.pdf>.

—— 2010, *2010-based national population projections - principal projection and key variants*, viewed 20 December 2011, <http://www.ons.gov.uk/ons/rel/npp/national-population-projections/2010-based-projections/stb-2010-based-npp-principal-and-key-variants.html#tab-Variant-population-projections>.

—— 2011, *National Population Projections, 2010-based projections, Background and Methodology, 2010-Based National Population Projections*, viewed 25 January 2013, <www.ons.gov.uk/>.

Office of the Environment and Heritage 2012, 'Who Cares about the Environment in 2012? – A survey of NSW people's environmental knowledge, attitudes and behaviours', *Social Research Series*, NSW Government, Australia

Olaru, D, Nariida, S and Ton, T 2005, Activity Spaces and Travel Time in Sydney, Association for European Transport and contributors.

Ostrom, E 2000, 'Collective Action and the Evolution of Social Norms', *Journal of Economic Perspectives*, vol.14, no.3, pp.137-158.

Parker, D, Lockwood, T and Marano, W 2012, "Developments in valuation and assessment: an Australian case study", *Property Management*, vol.30, no. 1, pp.52-64

Parliament of Australia, 2014, 'Inquiry into foreign investment in residential real estate', House of Representatives Committees, viewed 30 July 2014, <www.aph.gov.au/economics

Partridge, MD 2010, 'The duelling models: NEG vs amenity migration in explaining US engines of growth', Papers in Regional Science, vol. 89, no. 3, pp. 513-536.

Paul, V and Haslam McKenzie, F 2011, 'Agricultural Areas Under Metropolitan Threats: Lessons for Perth and Barcelona' in Luck, G. W., Race, D, Black, R. (eds) *Demographic Change in Australia's Rural Landscapes: Implications for Society and the Environment*, Springer, Australia

Perkins, A, Hamnett, S Pullen, S, Zito, R and Trebilcock, D 2009, 'Transport, Housing and Urban Form: The Life Cycle Energy Consumption and Emissions of City Centre Apartments Compared with Suburban Dwellings', Urban Policy and Research, vol.27, no.4, pp.377-396, December.

Pinnegar, S, van den Nouwelant, R, Judd, B and Randolph, B 2012, 'Understanding housing and location choices of retiring Australians in the 'baby boom' generation', *City Futures Research Centre*, University of NSW, Australia

Pittenger, DB 1976, *Projecting state and local populations* Ballinger Pub. Co, Cambridge, Mass.

Planning Research Centre 2005, 'Meeting the Sea Change Challenge: Sea Change Communities in Coastal Australia', University of Sydney, *Report for the National Sea Change Taskforce*, Australia

Plaut, PO 2006, 'The intra-household choices regarding commuting and housing', *Transportation Research Part A: Policy and Practice*, vol. 40, no. 7, August, pp. 561-571.

Pope, JC 2008, 'Buyer information and the hedonic: The impact of a seller disclosure on the implicit price for airport noise', *Journal of Urban Economics*, vol. 63, no. 2, pp. 498-516.

Powell, LN 2012, *The accidental city: improvising New Orleans*, Harvard University Press, Cambridge, Mass.

Power, TM 1996, *Lost Landscapes and Failed Economies: The Search for a Value of Place*, Island Press, USA.

Prest, W, Round, K and Fort, C, (eds) 2002, *The Wakefield Companion to South Australian*

History, Wakefield Press, Kent Town, SA.

Productivity Commission, 2004, First Home Ownership, Report, No.28, 31 March 2004, Australian Government, Melbourne

Productivity Commission 2011, Performance Benchmarking of Australian Business Regulation: Planning, Zoning and Development Assessments, Australian Government, Melbourne

Prommer, I and Wilson, C 2006, *MicMac Deliverable D14, An analytical summary of the current practices of definition of assumption making in population projections, Work Package 3, Uncertainty, expert knowledge*, International Institute for Applied Systems Analysis, Laxenburg, Austria.

Queensland Government 2009, *The South East Queensland Regional Plan 2009–2031*, Queensland Department of Infrastructure and Planning, Brisbane.

Quigley, JM 2008, *Urban Economics* in SN Durlauf and LE Blume (eds), *The New Palgrave Dictionary of Economics*, Second edn, viewed 11 June 2012 <http://www.dictionaryofeconomics.com>.

Quine, WO 1951, 'Two dogmas of empiricism', *The Philosophical Review*, vol. 60, pp. 20-43.

Rai, RK, Balmer, M, Rieser, M, Vase, VS, Schonfelder, S and Axhausen, KW 2007, 'Capturing human activity spaces: New geometries', TRB Annual Meeting CD-ROM (Paper revised from original submittal).

Randolph, B 2004, 'The Changing Australian City: New Patterns, New Policies and New Research Needs', *Urban Policy and Research, Practice Review*, vol. 22, no. 4, pp. 481-493.

—— 2006, ‘Delivering the Compact City in Australia: Current trends and future implications’, *Urban Policy and Research*, vol. 24, no. 4, pp.473-490

Randolph, B and Holloway, D 2007, ‘Rent Assistance and the Spatial Concentration of Low Income Households in Metropolitan Australia’, *AHURI Final Report No. 101*

Randolph, B and Judd, B 2000, ‘Community renewal and large public housing estates’, *Urban Policy and Research*, vol.22, pp.481-493

Rappaport, J 2009, 'The Increasing Importance of Quality of Life', *Journal of Economic Geography*, vol. 9, no. 779–804.

Ratcliffe, J and Krawczck, E 2011, 'Imagineering city futures: The use of prospective through scenarios in urban planning', *Futures*, vol. 43, pp. 642-653.

Reschovsky, A 1979, 'Residential Choice and the Local Public Sector: An Alternative Test of the “Tiebout Hypothesis”', *Journal of Urban Economics*, vol. 6, pp. 501-520.

Reserve Bank of Australia, 2003, *Productivity Commission Inquiry on First Home Ownership, Submission by Reserve Bank of Australia*, viewed 10 October 2013, www.rba.gov.au/publications/submissions/prod-comm-frst-home.pdf

Reserve Bank of Australia, 2014, *Submission to the Inquiry into Foreign Investment in Residential Real Estate, House of Representatives Standing Committee on Economics*, viewed 30 July 2014, www.rba.gov.au/publications/submissions/Inquiry-into-Foreign-Investment-in-Residential-Real-Estate.pdf

Revenues SA 2012, *Information Circular No: 48, Stamp Duties Act 1923, Stamp Duty on Off-the-Plan Apartments*, viewed 25 December 2012, <www.revenuesa.sa.gov.au/info_circulars/IC_048.pdf>.

Richardson, HW 1977, 'A Generalisation of Residential Location Theory', *Regional Science and Urban Economics*, vol. 7, pp. 251-266.

Richmond, B 2000, ‘The “Thinking” in Systems Thinking: Seven Essential Skills’, Pegasus Communications

Rickwood, P and Glazebrook, G 2009, 'Urban Structure and Commuting in Australian Cities', *Urban Policy and Research*, vol. 27, no. 2, pp. 171-188.

Rickwood, P, Glazebrook, G and Searle, G 2008, 'Urban Structure and Energy—A Review', *Urban Policy and Research*, vol. 26, no. 1, pp. 57-81.

Rittel, HW and Webber, MM 1973, 'Dilemmas in a General Theory of Planning', *Policy Sciences*, vol. 4, pp. 155-169.

Roback, J 1982, 'Wages, rents and the quality of life', *Journal of Political Economy*, vol. 90, no. 6, pp. 1257–1278.

Roberts, BH 2007, *Changes in Urban Density: Its Implications on the Sustainable Development of Australian Cities*, CSIRO, Sustainable Ecosystems Division, Canberra.

Rocheleau, D 1995, 'Maps, numbers, text, and context: Mixing methods in feminist political ecology', *The Professional Geographer*, vol. 47, pp. 458-466.

Rogers, A, Raquillet, R and Castro, LJ 1978, 'Model migration schedules and their applications', *Environment and Planning A*, vol. 10, no. 5, pp. 475-502.

Roots, J, Millar, J and Thwaites, R 2013, ‘Farming in Rural Amenity Landscapes: Maintaining Food Productivity in a Changing Environment’ in Farmar-Bowers, Q., Higgins, V. and Millar, J., (eds) *Food Security in Australia: Challenges and Prospects for the Future*, Springer, New York

Rosen, S 1974, 'Hedonic prices and implicit markets: product differentiation in pure competition ', *Journal of Political Economy*, vol. 82, pp. 34–55.

Rouwendal, J and Meijer, E 2001, 'Preferences for housing, jobs, and commuting: a mixed logit analysis', *Journal of Regional Science*, vol. 41, no. 3, pp. 475-505

Rowan, S and Wright, E 2010, 'Developing stochastic population forecasts for the United Kingdom: Progress report and plans for future work', paper presented at the United Nations Statistical Commission and Economic Commission for Europe Conference of European Statisticians, Lisbon, Portugal, 28-30 April 2010.

Rowe, G and Wright, G 2001, 'Expert Opinions in Forecasting: The Role of the Delphi Technique', in J Armstrong (ed.), *Principles of Forecasting*, Kluwer Academic, Boston, pp. 125-144.

Rowland, DT 2003, *Demographic Methods and Concepts*, Oxford University Press, UK.

Rubino, A 2002, Italian in Australia: past and new trends, Proceedings of Innovations in Italian teaching workshop, Griffith University, Queensland, viewed 21 October 2013, <http://www.griffith.edu.au/__data/assets/pdf_file/0004/340834/1_rubino.pdf>

Ruming, K, Randolph, B, Pinnegar, S and Judd, B 2010a, 'Urban renewal and regeneration in Sydney, Australia: Council reflections on the planning and development process', *Journal of Urban Regeneration and Renewal*, vol. 3, pp. 357-369.

Ruming, K, Tice, A and Freestone, R 2010b, ''Commonwealth Urban Policy in Australia: the case of inner urban regeneration in Sydney, 1973-75', *Australian Geographer*, vol. 41, no. 4, pp. 447-467.

Rumsfeld, D 2011, *Known and Unknown – A Memoir, Author's Note*, Penguin, NY.

Saumure, K and Given, L M, 'Nonprobability Sampling', in Given, L M, (ed.) *The SAGE Encyclopedia of Qualitative Research Methods*, SAGE Knowledge, pp.563 - 564, viewed 1 July 2014 <http://knowledge.sagepub.com>

Sandelowski, M, Voils, CI and Knafl, G 2009, 'On Quantitizing', *Journal of Mixed Methods Research*, vol. 3, July 2009, pp. 208-222.

Sarkissian, W 2013, 'Not in my backyard: Community responses to higher density living – is it all in the mind?' *Paper presented on 29 May 2013 at the Bob Hawke Prime Ministerial Center*, University of South Australia

Saunders, P 1981, 'Social Theory and the Urban Question', Unwin Hyman Ltd, UK

Sawyer, KR, Beed, C and Sankey, H 1997, 'Underdetermination in Economics: The Duhem-Quine Thesis', *Economics and Philosophy*, vol. 13, pp. 1-23.

Scheiner, J and Kasper, B 2003, *Lifestyles, choice of housing location and daily mobility: the lifestyle approach in the context of spatial mobility and planning, UNESCO*, Blackwell Publishing Ltd.

Schively, C 2007, 'Understanding the NIMBY and LULU Phenomena: Reassessing Our Knowledge Base and Informing Future Research', *Journal of Planning Literature*, No. 21, pp.255 – 266

Scott, AJ 2010, 'Jobs or amenities? Destination choices of migrant engineers in the USA', *Papers in Regional Science*, vol. 89, no. 1, pp. 43–63.

Searle, G 2006, 'Is the City of Cities Metropolitan Strategy the Answer for Sydney?', *Urban Policy and Research, Practice Reviews*, vol. 24, no. 4, pp. 553–566.

—— 2007, 'Sydney's urban consolidation experience: Power, politics and community', *Urban Research Program*, Research Paper 12, March, Griffith University, Queensland.

Shapiro, JM 2006, 'Smart Cities: Quality of Life, Productivity, and the Growth Effects of Human Capital', *The Review of Economics and Statistics*, vol. 88, no. 2, May, pp. 324-335.

Shaw, C 2008, 'The National Population Projections Expert Advisory Group: results from a questionnaire about future trends in fertility, mortality and migration', *Population Trends, Winter*, pp. 42-53.

Shryock, HS, Siegel J S. and Associates 1976, *The Methods and Material of Demography Condensed Edition*, ed. EG Stockwell, Academic Press, NY.

Sieg, H, V., Kerry Smith, H, Banzhaf, S and Walsh, R 2004, 'Estimating the General Equilibrium Benefits of Large Changes in Spatially Delineated Public Goods', *International Economic Review*, vol. 45, no. 4, pp. 1047–1077.

Sipe, N and Gleeson, B 2004, 'Making a Difference with Metropolitan Strategy: Overseas Evidence', *Urban Policy Program, Research Monograph 2*, Griffith University, Queensland

Sirgy, M, Grzeskowiak, S and Su, C 2005, 'Explaining housing preference and choice: The role of self-congruity and functional congruity ', *Journal of Housing and the Built Environment*, vol. 20, pp. 329–347.

Sivam, A, Karuppannan, S and Davis, M 2012, 'Stakeholders' perception of residential density: a case study of Adelaide, Australia', *Journal of Housing and the Built Environment*, vol. 27, pp. 473–494.

Slaughter, R 2002, *Developing and Applying Strategic Foresight*, viewed 30 July 2010, <foresightinternational.com.au/resources/DevandApply_Strategic_Foresight.pdf>.

Small, K and Song, S 1992, 'Wasteful commuting: A resolution', *Journal of Political Economy*, vol. 100, no. 4, pp. 888–898.

Smith, SK, Tayman, J and Swanson, DA 2001, *State and Local Population Projections: Methodology and Analysis*, Springer, NY.

Soltani, A and Bosman, C 2009, 'Evaluating Sustainable Urban Form: Comparing Two Neighbourhood Development Patterns in Adelaide', *Infrastructure*, vol. 14, no. 1.

Song, Y 2005, 'Smart Growth and Urban Development Pattern: A Comparative Study', *International Regional Science Review*, vol. 28, no. 2, April, pp. 239–265.

Spearritt, P 2008, 'The water crisis in Southeast Queensland: How desalination turned the region into carbon emission heaven', in P Troy (ed.), *Troubled Waters: Confronting the Water Crisis in Australia's Cities*, ANU Press, Canberra, pp. 19-36.

Sporton, D 1999, 'Mixing Methods in Fertility Research', *Professional Geographer*, vol. 51, no. 1, pp. 68-74.

State Government of Victoria 2002, *Melbourne 2030 in summary*, Department of Infrastructure, <www.dpcd.vic.gov.au>.

—— 2008, *Melbourne 2030: a planning update – Melbourne @ 5 million*, Department of Sustainability and Development, viewed 6 June 2012, <www.dpcd.vic.gov.au>.

—— 2012, *A New Melbourne Metropolitan Planning Strategy*, Department of Planning and Community Development, Victoria, viewed 6 June 2012, <www.dpcd.vic.gov.au>.

—— 2013a, *Growth Areas Authority, Annual Report 2012-2013*, Victoria, Australia

—— 2013b, *Plan Melbourne Metropolitan Planning Strategy*, Victoria, Australia

State of the Environment 2011 Committee (SOE) 2011, *Australia state of the environment 2011*, Independent report to the Australian Government Minister for Sustainability, Environment, Water, Population and Communities, DSEWPaC: Canberra.

Statistics New Zealand 2009, *Hot Off the Press, National Population Projections: 2009 (base)–2061*, New Zealand Government, Wellington NZ.

Steelman, T and Hess, G 2009, 'Effective Protection of Open Space: Does Planning Matter?', *Environmental Management*, vol. 44, pp. 93–104.

Stimson, R and Adrian, C 1987, ‘Australian Capital City Property Development, Foreign Investment and Investor Attitudes’, Australian Geographical Studies, Vol.25, Issue 1, pp.41-60.

Storper, M and Manville, M 2006, 'Behaviour, Preferences and Cities: Urban Theory and Urban Resurgence', *Urban Studies*, vol. 43, no. 8, July, pp. 1247-1274.

Storper, M and Scott, AJ 2009, 'Rethinking human capital, creativity and urban growth', *Journal of Economic Geography*, vol. 9, no. 2, pp. 147-167.

Strauss, A L and Corbin J 1998, *Basics if qualitative research: Techniques and procedures for developing grounded theory* (2nd ed.), Thousand Oaks, CA,: Sage

Stringer, M, Cornish, I and Finlay, C 1991, 'Strength of Group Identity and Locational Preference in Northern Ireland', *Journal of Social Psychology*, vol. 131, no. 5, pp. 743-745.

Sumerling, P and McDougall, K 2006, *The City of Adelaide: A Thematic History*, viewed 12 December 2012, <www.adelaidecitycouncil.com/>.

Syme, G 2008, 'Sustainability in urban water futures', in P Troy (ed.), *Troubled Waters: Confronting the Water Crisis in Australia's Cities*, ANU Press, Canberra, pp. 99-114.

Taleb, NN 2007, *The Black Swan, The Impact of the Highly Improbable*, Random House, NY.

Tashakkori, A and Teddlie, C 2003, 'Preface', in ATC Teddlie (ed.), *Handbook of mixed methods in social and behavioral research*, Thousand Oaks: Sage, CA, pp. ix-xv.

Thompson, S and Maginn, P 2012, *Planning Australia: An Overview of Urban and Regional Planning*, 2nd edition,

Thorsnes, P and Reifel, JW 2007, 'Tiebout Dynamics: Neighborhood Response to a Central-City/Suburban House-Price Differential', *Journal of Regional Science*, vol. 47, no. 4, pp. 693-719.

Tiebout, CM 1956, 'A Pure Theory of Local Expenditures', *Journal of Political Economy*, vol. 64, no. 5, Oct., 1956, pp. 416-424.

Timmermans, H, Borgers, A, Dijk, J and Oppewal, H 1992, 'Residential choice behaviour of dual earner households: a decompositional joint choice model', *Environment and Planning A*, vol. 24, pp. 517-533

Timmermans, MK 2009, 'Influence of the residential and work environment on car use in dual-earner households', *Transport Research Part A: Policy and Practice*, vol. 43, no. 7, pp. 654-664.

Torrens, PM 2006, 'Simulating Sprawl', *Annals of the Association of American Geographers*, vol. 96, no. 2, pp. 248-275.

Toussaint-Comeau, M and Rhine, SLW 2004, 'The Relationship between Hispanic Residential Location and Homeownership', *Federal Reserve Bank of Chicago Economic Perspectives*, vol. 28, no. 3, 3rd Quarter, pp. 2-12.

Troy, P 1996, *The Perils of Urban Consolidation by Patrick Troy: A Discussion of Australian Housing and Urban Development Policies* Federation Press, NSW.

—— 2004, 'The Structure and Form of the Australian City: Prospects for improved urban planning', *Griffith University: Urban Policy Program, Issues Paper 1, May 2004*.

Troy, P 2008, *Troubled Waters: Confronting the Water Crisis in Australia's Cities*, ANU Press, Canberra.

Troy, P, Holloway, D and Randolph, B 2005, *Water use and the built environment: patterns of water consumption in Sydney*, City Futures Research Report No. 1, City Futures Research Centre, University of New South Wales and Centre for Resource and Environmental Studies, Australian National University

Tversky, A and Fox, CR 1995, 'Weighing Risk and Uncertainty', *Psychological Review*, vol. 102, no. 2, pp. 269-283.

UK Higher Education Commission 2012, ‘Postgraduate Education – An Independent Inquiry by the Higher Education Commission’, viewed 29 July 2013 <www.policyconnect.org.uk/hec/sites/pol1-006/files/he_commission_postgraduate_education_2012.pdf

U.S. Environmental Protection Agency 2011, ‘Expert Elicitation Task Force White Paper’, *prepared for the Science and Technology Policy Council*, U.S. Environmental Protection Agency, Washington DC.

United Nations 2012, *Sustainable development: implementation of Agenda 21, the Programme for the Further Implementation of Agenda 21 and the outcomes of the World Summit on Sustainable Development and of the United Nations Conference on Sustainable Development*, A/67/437/Add.1, United Nations General Assembly.

United Nations Department of Economic and Social Affairs 2009, *Agenda 21* Division for Sustainable Development, United Nations, viewed 25 December 2012, <www.un.org/esa/dsd/agenda21/res_agenda21_00.shtml>.

Uprichard, E 2013, 'Sampling: bridging probability and non-probability designs', *International Journal of Social Research Methodology*, Vo. 16, No. 1, pp.1-11

Urbis JHD 2006, 'National Housing Infrastructure Costs Study', report prepared for the Residential Development Council, a division of the Property Council of Australia, November.

Urbis 2011, 'National Housing Cost Study', report prepared for the National Housing Supply Council, May.

Usher, W and Strachan, N 2013, 'An expert elicitation of climate, energy and economic uncertainties', *Energy policy*, Vol. 61, pp.811-821

van Diepen, A and Musterd, S 2009, 'Lifestyles and the city: connecting daily life to urbanity', *Journal of Housing and the Built Environment*, vol. 24, no. 3, pp. 331-345.

van Dijk, T and van der Wulp, N 2010, 'Not in my open space: Anatomy of neighbourhood activism in defence of land use conversion', *Landscape and Urban Planning*, vol. 96, no. 19-28.

Victorian Department of Infrastructure 1998, *Doughnut City to Café Society*, Government of Victoria, Australia

Vigdor, JL 2002, 'Does Gentrification Harm the Poor?', *Brookings-Wharton Papers on Urban Affairs*, pp. 133–173

Vogt, CA and Marans, RW 2004, 'Natural resources and open space in the residential decision process: a study of recent movers to fringe counties in southeast Michigan', *Landscape and Urban Planning*, vol. 69, pp. 255–269

Waddell, P 1996, 'Accessibility and Residential Location: The Interaction of Workplace, Residential Mobility, Tenure, and Location Choices', *Taxation, Resources and Economic Development Conference,* Lincoln, USA.

—— 2000, 'A behavioral simulation model for metropolitan policy analysis and planning: residential location and housing market components of UrbanSim', *Environment and Planning B: Planning and Design*, vol. 27, pp. 247-263.

Walker, J and Li, J 2007, 'Latent lifestyle preferences and household location decisions', *Journal of Geographical Systems*, vol. 9, no. 1, pp. 77-101.

Wall, HJ 2001, 'Voting with your feet in the United Kingdom: Using cross-migration rates to estimate relative living standards Journal of Regional Science', *Journal of Regional Science*, vol. 80, pp. 1-23.

Walsh, K 2001, *The Changing Face of Australia: a Century of Immigration 1901-2000*, Allen and Unwin, NSW.

Weaver, W 1948, 'Science and complexity', *American Scientist*, vol. 36, pp. 536–541.

Westcott, GC 1991, 'Australia's Distinctive National Parks System', *Environmental Conservation*, Vol. 18, Issue 04, pp.331-340

Western Australian Planning Commission 2006, *Metropolitan Development Program 2005/2006 to 2009/2010*, State of Western Australia

—— 2010, *directions 2031 and beyond: metropolitan planning beyond the horizon*, Department of Planning, Government of Western Australia

Whelpton, PK 1936, 'An empirical method of calculating future population', *Journal of the American Statistical Association*, vol. 31, pp. 457-473.

Wilkinson, C 2011, ‘Strategic navigation: in search of an adaptable mode of strategic spatial planning practice’, *Town Planning Review*, vol. 82, pp.595-613

Willekens, FJ 1990, 'Demographic Forecasting; State-of-the-Art and Research Needs', in CA Hazeu and GAB Frinking (eds), *Emerging Issues in Demographic Research*, Elsevier Science Publishers, BV, pp. 9-66.

Wilson, T 2010, 'Model migration schedules incorporating student migration peaks'', *Demographic Research*, vol. 23, no. 8, pp. 191-222.

—— 2011, 'Modelling with NEWDSS: Producing State, Regional and Local Area Population Projections for New South Wales', in J Stillwell and M Clarke (eds), *Population Dynamics and Projection Methods Understanding Population Trends and Processes*, vol. 4, Springer, London.

—— 2012, 'A Review of Sub-Regional Population Projection Methods', paper presented at a workshop at The University of Queensland on Sub-state Demographic Projections: Methods and Data Access, 4-5 June 2012.

—— 2013, ‘The sequential propensity household projection model’, *Demographic Research*, vol. 28, issue 24, pp.681-712

Wilmoth, D 2005, ‘Urban infrastructure and metropolitan planning: Connection and disconnection’ in *Proceedings of the 2nd State of Australian Cities Conference, City Structure Section*.

Wilson, T and Bell, M 2011, 'Editorial: Advances in local and small-area demographic modelling', *Journal of Population Research*, vol. 28, no. 2-3, September, pp. 103-107.

Wilson, T and Cooper, J 2013, ‘Overview of the new Queensland demographic projection systems', Queensland Centre for Population Research, The University of Queensland, Australia.

Wilson, T and Rees, P 2005, 'Recent Developments in Population Projection Methodology: A Review', *Population, Space and Place*, vol. 11, 337-360.

Winchester, HM 1999, 'Interviews and questionnaires as mixed methods in population geography: The case of lone fathers in Newcastle, Australia', *Professional Geographer*, vol. 51, no. 1, pp. 60-73.

Winstanley, A, Thorns, DC and Perkins, HC 2002, 'Moving House, Creating Home: Exploring Residential Mobility', *Housing Studies*, vol. 17, no. 6, pp. 813-832.

Wirth, L 1938, 'Urbanism as a Way of Life', *American Journal of Sociology*, vol. 44, no. 1, pp. 1-24.

World Commission on Environment and Development 1989, *Our Common Future*, Oxford University Press, Oxford.

Wright, K 2006, ‘The relationship between residential density and non-transport energy use’, Australian Planner, vol.43, no.4, pp.12-13.

Wu, F 2004, 'Intraurban residential relocation in Shanghai: modes and stratification', *Environment and Planning A*, vol. 36, pp. 7-25.

Wullf, M, Healy, E and Reynolds, M 2004, ‘Why Don’t Small Households Live in Small Dwellings? – Disentangling a Planning Dilemma’, People and Place, vol.12, p.68

Wulff, M, Reynolds, M, Dharmalingam, A, Hulse, K and Yates, J 2011, ‘Australia’s private rental market: the supply of, and demand for, affordable dwellings’, *Australian Housing and Urban Research Institute*, Final Report No. 168, Swinburne-Monash Research Centre

Yates, F 1946, ‘A review of recent statistical developments in sampling and sampling surveys’, *Journal of the Royal Statistical Society*, Vol. 109, pp. 12-43

Yates, J 1997, ‘Changing directions in Australian housing policies: the end of muddling through?’, *Housing Studies*, vol.12, pp.265-277.

—— 2001, 'The rhetoric and reality of housing choice: The role of urban consolidation', *Urban Policy and Research*, vol. 19, no. 4, pp. 491-527.

Yates, J 2007, ‘Affordability and access to home ownership: past, present and future?’, National Research Venture 3: Housing affordability for lower income Australians, *Australian Housing and Urban Research Institute*, Research Report No. 10, Sydney Research Centre

Yates, J and Milligan, V 2007, *Housing Affordability: A 21st Century Problem*, Final Report no. 105, Australian Housing and Urban Research Institute, Melbourne

Yates, J, Randolph, B and Holloway, D 2006, ‘Housing affordability, occupation and location in Australian cities and regions’, *Australian Housing and Urban Research Institute*, Final Report No. 91, Sydney Research Centre and UNSW/UWS Research Centre

Yeung, HW 2003, 'Practicing new economic geographies: A methodological examination', *Annals of the Association of American Geographers*, vol. 93, pp. 442-462.

Zhang, M 2006, 'Travel Choice with No Alternative Can Land Use Reduce Automobile Dependence?', *Journal of Planning Education and Research*, vol. 25, pp. 311-326.

Zizek, S 2006, 'Philosophy, the “unknown knowns,” and the public use of reason', *TOPOI*, vol. 25, no. 1-2, pp. 137-142.