

University of Southern Queensland
Faculty of Engineering and Surveying

URBAN FRINGE AGRICULTURE AND ITS POTENTIAL CONTRIBUTION TO SUSTAINABLE CITIES: A CASE STUDY OF WESTERN SYDNEY

A dissertation submitted by

Craig Stephen Lonard

in fulfilment of the requirements of

Courses ENG8411 and ENG8412 Research Project

towards the degree of

Bachelor of Spatial Science (Surveying)

Submitted: October, 2012

Abstract

To reach the ultimate goal of sustainable cities in Australia, we need to explore all aspects of how urban landscapes function, what is required to sustain these landscapes into the future, what resources are needed to sustain cities and what wastes are created. The role of urban agriculture can be seen as pivotal to reaching these sustainable goals. This research paper examines how urban fringe agriculture can contribute to a sustainable city, environmentally, economically and socially. The research investigated how other countries are utilising urban planning to include agriculture into their cities. It explored the opportunities and constraints of urban agriculture that exist in urban and regional planning of our capital cities.

The missing link in the literature on urban agriculture is the application in urban and regional planning of tools that assist urban agriculture. The research findings show that for urban agriculture to reach its full sustainable potential it needs to be recognized in urban planning. The research project implemented a regional planning model that involved the creation of small city farms positioned to take advantage of the proximity to employment, consumers and recycled water. The model acknowledges the important role local food can play in building communities, removing discrimination and providing food security for the poor and disadvantaged of Australian cities while providing more food options for urban residents.

As part of the research, the proposed model was applied to Western Sydney's growth centre precinct of Austral to highlight how the proposed model would not adversely affect the critical supply of housing. The success of the model is measured by the calculation of area of agricultural land which is retained for urban agriculture into the future.

This practical implementation of the proposed planning model can be an example of how agriculture can be integrated into any new urban growth area across Australia. The practical creation of urban agriculture on the fringes of our cities can be seen as a large step forward to reaching the sustainable goals set by the city planning guidelines.

University of Southern Queensland
Faculty of Engineering and Surveying

ENG8411 & ENG8412 Research Project

Limitations of Use

The Council of the University of Southern Queensland, its Faculty of Engineering and Surveying, and the staff of the University of Southern Queensland, do not accept any responsibility for the truth, accuracy or completeness of material contained within or associated with this dissertation.

Persons using all or part of this material do so at their own risk, and not at the risk of the Council of the University of Southern Queensland, its Faculty of Engineering and Surveying or the staff of the University of Southern Queensland.

This dissertation reports an educational exercise and has no purpose or validity beyond this exercise. The sole purpose of the course pair entitled “Research Project” is to contribute to the overall education within the student’s chosen degree program. This document, the associated hardware, software, drawings, and other material set out in the associated appendices should not be used for any other purpose: if they are so used, it is entirely at the risk of the user.

Prof Frank Bullen
Dean
Faculty of Engineering and Surveying

Certification

I certify that the ideas, designs and experimental work, results, analysis and conclusions set out in this dissertation are entirely my own effort, except where otherwise indicated and acknowledged.

I further certify that the work is original and has not been previously submitted for assessment in any other course or institution, except where specifically stated.

Craig Stephen Lonard

Student No 0050093245

Signature

Date

Acknowledgements

I would like to thank my wife, Joanne, and daughters, Kaitlyn, Meaghan and Emma, for their support, encouragement and patience during the preparation of this dissertation. I would like to also thank Mick and Marilyn for their advice and help in editing the dissertation. I would like to thank my employer, Vince Morgan Surveyors, for their support during the dissertation and the use of their premises over the long hours of drawing and for supporting me for through my long educational journey over the past 20 years. Finally I would like to thank my supervisor Marita Basson for her advice and support. Without her support and encouragement

Table of Contents

ABSTRACT	I
CERTIFICATION	III
ACKNOWLEDGEMENTS	IV
GLOSSARY OF TERMS	IX
1.0 INTRODUCTION	1
1.1 PROJECT AIM	2
1.2 PROJECT JUSTIFICATION	2
1.3 METHODOLOGY	3
2.0 LITERATURE REVIEW	5
2.1 DEFINITIONS	5
2.1.1 <i>Urban Agriculture</i>	5
2.1.2 <i>Urban Agriculture History and Development</i>	5
2.1.3 <i>Urbanisation</i>	7
2.1.4 <i>Urban Fringe</i>	9
2.2 PRESSURE ON AGRICULTURAL LAND USE	10
2.2.1 <i>Affordable Housing</i>	10
2.2.2 <i>Food Globalisation</i>	11
2.2.3 <i>Rural/Lifestyle Living</i>	12
2.2.4 <i>Economic Pressures</i>	14
2.3 BENEFITS OF URBAN AGRICULTURE	16
2.3.1 <i>Food security</i>	16
2.3.2 <i>Economic Benefits</i>	19
2.3.3 <i>Employment Benefits</i>	20
2.3.4 <i>Social Benefits</i>	21
2.3.5 <i>Environmental Benefits</i>	23
2.4 AUSTRALIAN PLANNING	26
2.4.1 <i>Urban planning past and future</i>	26
2.4.2 <i>Population Trends</i>	28
2.4.3 <i>Current Planning in Australian Cities</i>	29
2.4.3.1 <i>Sydney's Plan</i>	30
2.4.3.2 <i>Melbourne's Plan</i>	31
2.4.3.3 <i>South East Queensland Plan</i>	34
2.4.3.4 <i>Perth's Plan</i>	36
2.5 CONCLUSION	38
3.0 SUSTAINABLE BENEFITS TO CITIES FROM URBAN AGRICULTURE	39
3.0 INTRODUCTION	39
3.1 ECONOMIC BENEFITS	40
3.2 ENVIRONMENTAL BENEFITS	44
3.3 SOCIAL BENEFITS	46
3.3 CONCLUSION	47
4.0 TECHNIQUES SUPPORTING URBAN AGRICULTURE	48
4.1 ALTERNATIVE FOOD NETWORKS	48
4.2 PURCHASE DEVELOPMENT RIGHTS	50
4.3 COMMUNITY ENGAGEMENT	52
4.4 AGRICULTURAL PRECINCTS	54
4.5 AGRO-TOURISM	58
4.6 CONTINUOUS PRODUCTIVE URBAN LANDSCAPE	60
5.0 PROPOSED PLANNING MODEL	68

5.1	INTRODUCTION.....	68
5.2	PLANNING MODEL RATIONALE.....	70
5.2.1	<i>Objective A1: Creation of Opportunities for Local Food Production and Distribution.....</i>	70
5.2.2	<i>Action 1: Community Gardens</i>	70
5.2.3	<i>Action 2: Farmers' Markets.....</i>	71
5.2.4	<i>Objective A2: Creation of Areas of Local Food Production.....</i>	72
5.2.5	<i>Action 3: City Farm Creation as part of Open Space</i>	72
5.2.5	<i>Action 4: Reuse of Waste</i>	73
5.2.6	<i>Action 5: Retention of Existing Farms</i>	73
5.2.7	<i>Action 6: City Farms as a Buffer</i>	73
5.2.8	<i>Objective A3: Economic Sustainability of City Farming</i>	74
5.2.9	<i>Action 7: Purchase of open space for Agriculture</i>	74
5.2.10	<i>Action 8: Reduced rural land rates.....</i>	75
5.3	PROPOSED PLANNING MODEL ASSISTING URBAN AGRICULTURE.....	76
6.0	WESTERN SYDNEY CASE STUDY.....	88
6.1	AUSTRAL PRECINCT	88
6.2	EXISTING PLANNING OF AUSTRAL PRECINCT.....	92
6.3	OBJECTIVE A1.....	97
6.3.1	<i>Community gardens.....</i>	97
6.3.2	<i>Farmers Markets.....</i>	100
6.4	OBJECTIVE A2.....	103
6.4.1	<i>City Farm Sites A & G</i>	107
6.4.2	<i>City Farm Site B</i>	110
6.4.3	<i>City Farm Site C & D</i>	112
6.4.4	<i>City Farm Site E</i>	114
6.4.5	<i>City Farm Site F</i>	116
6.5	OBJECTIVE A3.....	118
6.5	CONCLUSION	121
7.0	FURTHER RESEARCH	123
8.0	CONCLUSION	124
9.0	REFERENCES	127
	APPENDIX A PROJECT SPECIFICATION	I
	APPENDIX B PROJECT APPRECIATION.....	II
	APPENDIX C PLANNING MODEL CHECKLIST	III

Table of Figures

Figure 1.1 Percentage of urban population and agglomerations by size	3
Figure 1.2 Sydney's Growth Centres	4
Figure 2.1 a warehouse rooftop garden Brooklyn, New York	5
Figure 2.2 Urban agriculture Havana Cuba	7
Figure 2.3 Urbanisation in Western Sydney: Oran Park	8
Figure 2.4 Determinants of housing affordability	10
Figure 2.5 Farmland Conversion Cycle	13
Figure 2.6 Western Sydney Land use Survey	14
Figure 2.7 Food Deserts in Cleveland United States	17
Figure 2.8 World War Two victory farming New York	18
Figure 2.9 Farmers markets in the United States	22
Figure 2.10 Images of Community Building through community gardens in Cleveland United States	23
Figure 2.11 County of Cumberland Planning Scheme	27
Figure 2.12 World Population Growth 1950-2050	28
Figure 2.13 Metropolitan Plan for Sydney 2036	31
Figure 2.14 Melbourne's Green Wedges	32
Figure 2.15 Melbourne's Urban growth boundaries and new growth areas	33
Figure 2.16 South East Queensland land use SEQ regional plan	35
Figure 2.17 Directions 2031 and Beyond Perth WA	37
Figure 3.1 Agricultural production value of mainland capital cities 2009/10	41
Figure 3.2 Agricultural production value Mushrooms 2009/10	42
Figure 3.3 Vegetable production value 2009/10	42
Figure 3.4 Egg production value 2009/10	43
Figure 3.5 Cut Flowers & Turf production value 2009/10	43
Figure 3.6 Penrith city council three bin service	45
Figure 3.7 Greygums Oval Cranebrook	45
Figure 4.1 Growth of Farmers Markets in Australia	49
Figure 4.2 Farmers market managers social benefits	49
Figure 4.3 Lancaster County farmland –PDR USA	51
Figure 4.4 The Lim Chu Kang Agro technology Park – Kranji, Singapore	54
Figure 4.5 Agricultural Precinct in the Waroona Shire, WA	55
Figure 4.6 Werribee agricultural precinct, Victoria	56
Figure 4.7 Tractor rides Calmsley Hill Farm	58
Figure 4.8 Xiedao Green Resort Beijing China	59
Figure 4.9 Organoponico in Cienfuegos Cuba	61
Figure 4.10 Phillip Bay Market Garden	62
Figure 4.11 Kyeemagh Market Gardens	63
Figure 4.12 Kyeemagh Market Garden	63
Figure 4.13 Kyeemagh Market Garden	64
Figure 4.14 Bunnerong market gardens	64
Figure 4.15 Bunnerong market garden	65
Figure 4.16 Bunnerong market garden	65
Figure 4.17 Bunnerong Market garden aerial view	66
Figure 4.18 Kingston Green wedge, Melbourne	67
Figure 5.1 Overview of the planning model	70
Figure 5.2. Community Gardens in the Indiana, USA and Sydney NSW	79
Figure 5.3 Penrith farmers' market	80
Figure 5.4 City farm as open space already in existence in Kyeemagh NSW	82
Figure 5.5 Recycled wastewater	83
Figure 5.6 The traditional market gardens in Phillip Bay NSW	84
Figure 5.7 Farming as a buffer in Austral NSW	85
Figure 6.1 South West Growth Centre Sydney 2011	88
Figure 6.2 Aerial imagery Austral Precinct	89
Figure 6.3 Austral Precinct Existing Land use	90

Figure 6.4 Austral Precinct existing Land use graph	91
Figure 6.5 Part of the Sydney Structure plan	92
Figure 6.6 Bonds Creek Austral	93
Figure 6.7 Indicative layout Plan Austral Precinct	94
Figure 6.8 Austral Proposed indicted land use graph	95
Figure 6.9 Calculated areas and projected dwellings for Austral	96
Figure 6.10 Location of proposed community gardens Austral	98
Figure 6.11 Austral and Gurner Ave community garden locations	99
Figure 6.12 Austral Town centre	102
Figure 6.13 Existing agricultural land use of the Austral precinct	105
Figure 6.14 Austral precinct city farm sites	106
Figure 6.15 existing city farm site image A	107
Figure 6.16 Proposed City Farm sites A & G	108
Figure 6.17 existing city farm site image G	109
Figure 6.18 existing city farm site image B	110
Figure 6.19 Proposed City Farm site B	111
Figure 6.20 Existing city farm site image D	112
Figure 6.21 Proposed City Farm site C & D	113
Figure 6.22 Existing city farm site image E	114
Figure 6.23 Proposed City Farm site E	115
Figure 6.24 Existing city farm site image F	116
Figure 6.25 Proposed City Farm site F	117
Figure 6.26 Direct marketing of agricultural production in Austral	118
Figure 6.27 Re-calculated lot and dwelling projections for Austral Precinct	121

Glossary of Terms

The following terms have been used throughout the text.

ABS	Australian Bureau of Statistics
AFN	Alternate food networks
CBD	Central Business District
CSA	Community supported agriculture
CPUL	Continuous productive urban landscape, an urban landscape which is used for production of food and community interaction
Food miles	In basic terms it represents the distance food travels from production to consumption.
Green Belt	A planning tool used to limit urban expansion into rural areas, widely used in the United Kingdom post World War Two.
ILP	Indicative Layout Plan
LFFP	Local Food Flavours Plus, a policy of local food in Toronto Canada
NAAM	National alternative agriculture model, an initiative from the Cuban government to produce food in cities.
PDR	Purchase development rights
Peri-Urban	Another name for the area on the urban fringe of cities.
RLRPA	Regional landscape and rural productive land as classified in the SEQ regional plan.
SEQ	South East Queensland
SWGC	South West Growth Centre, an urban growth area of Western Sydney
UA	Urban Agriculture
UDP	Urban development program from Perth WA.
UPA	Urban and Peri-urban agriculture is agriculture within and on the fringe of a city.

1.0 INTRODUCTION

Urban Agriculture (UA) is the process of growing food in and around cities. It is seen by some as a way to meet the demand for food into the future while increasing the sustainability of our cities (Brown 2002; Houston 2005; Yokohari & Bolthouse 2011). Urban agriculture includes greenbelts, urban fringes, vacant city lots, community gardens, fish farms and greenhouses (Brown 2002). It contributes to sustainability by advancing numerous principles such as food security (Brown 2002; Elliss & Sumberg 1998; Mason & Knowd 2010), economic growth (Viljoen & Bohm 2005), and more environmentally sensitive production with less food miles (Brown 2002; Choy et al. 2008). It helps limit the carbon footprint (Mason & Knowd 2010; Page et al. 2011) of cities which will become more important in the future with the implementation of government policies such as a carbon tax. It contributes to social integration, provides open space and good amenity for living (Viljoen & Bohm 2005).

The pressures on land used for agriculture come from the continued displacement of agricultural land for affordable housing, increased competition from imported food and the globalised food network. Agricultural profitability is impacted by supermarket food dominance which limits returns to the farmer (Adams & Salois 2010). Higher land values driven by the desire for rural living within the commuter sphere of cities are making the cost benefits of subdivision higher than returns from sales from agricultural production (Houston 2005). Socially, the urban population's connection to its food source is being lost (Jeffs 2009) and the demand for produce all year round is forcing changes in how food is produced and supplied. Today we expect to find seasonal fruit and vegetables on supermarket shelves all year round.

A hundred years ago the majority of the world's population grew the food it needed. Today the increasing urbanisation of the world's population to nearly 60 percent (in Australia 85 percent) means that these growing cities rely on commercial agriculture to feed it. Agricultural production has moved to a more global system (Brown 2002; Butt 2011; Jeffs 2009) with large scale agriculture seen as a key to feeding the world in the future. With climate change looming on the horizon the pressure on agriculture to meet this demand is becoming more severe. Additionally, aspirations of the world's poor for a better life mean that we need a new system of food production and distribution to meet these challenges (Viljoen & Bohm 2005).

Agriculture on the urban fringe and in cities of Australia has been ignored until recently as land has always been abundant in Australia. It is not until the land has been degraded that the limitations of this resource becomes apparent. Land on the fringe is considered as idle and as land awaiting urban expansion (Gallent 2006; Mason & Knowd 2010). The rapid urbanisation of the areas surrounding Australian cities post World War Two (Bunker & Holloway 2002) has led to a large urban footprint of lower density than older European settlements which developed over thousands of years from communities based around

agricultural production. This research project evaluated the importance of agriculture to cities in general and used Western Sydney as a case study to argue for the inclusion of agriculture into planning of cities and not limit agricultural uses to a temporary use while awaiting urban or industrial development.

1.1 Project Aim

This project aimed to define the broad potential economic, social and environmental value of agriculture in an urban setting. It endeavoured to define how urban planning can enable agriculture to fit into the urban footprint of cities without causing land use conflicts. The sustainability advantages of agriculture in an urban setting were outlined and utilised to create a regional planning model. This planning model design will allow the inclusion of agriculture in urban design and master planning as an essential piece of infrastructure of a city. Finally, the planning model was applied into the South West Growth Centre (SWGC) Sydney to show how the potential sustainable improvements from urban agriculture could be implemented without detrimental effects to housing affordability.

1.2 Project Justification

The rapid urbanisation of the world's population since the Industrial Revolution has formed the western world as we know it. Half of the world's population today live in urban areas and as much as two thirds will by 2030 (UN 2012). Mankind lives in a highly urbanised society, use resources at an unsustainable rate and produces an ever increasing volume of waste which has to be dealt with (UN 2012). People in the developing world are aspiring to a better standard of living, moving to jobs in the city and relying more and more on food sources from outside of cities (Elliss & Sumberg 1998). It will be important to the developed world to reduce cities' energy and resource use, to allow for an increase of the use of these resources in the developing world. The ultimate goal is to make the global use of resources more sustainable. If the developing world used energy and resources like the developed world we would need a planet three times its current size to sustain life (Giradet 2005). People in the United States of America consume food which takes eight times more energy to produce and supply, than it actually provides during its consumption (Viljoen et al. 2005).

One of the main reasons for the increased use of resources around cities is urbanisation. Urbanisation is moving cities into areas which were actively used for agriculture along the edges of cities (Giradet 2005). Figure 1.1 shows the global urban population and spread of agglomerations. The question should be asked how we are going to supply the food to the growing urban population, while using the land which was once used to grow the food needed for urban living. Urban agriculture could be part of the answer to a number of problems facing the world today, such as food security and environmental degradation (Viljoen et al. 2005). UA could be a way which we can reduce our reliance on oil for the production of food before we reach peak oil (Paxton 2005). This research project applied the knowledge from around the world to an Australian context, showed how planning can help bring agriculture into cities to improve sustainability and combat the traditional sprawl of

Australian cities. The planning model will enable innovation and adaption of different agriculture techniques which may not exist or are just emerging. This will allow the planning model to be adapted into any planning situation across the world. The model will be at a strategic or regional level and will use the existing metropolitan regional plans in Australian capital cities as a template.

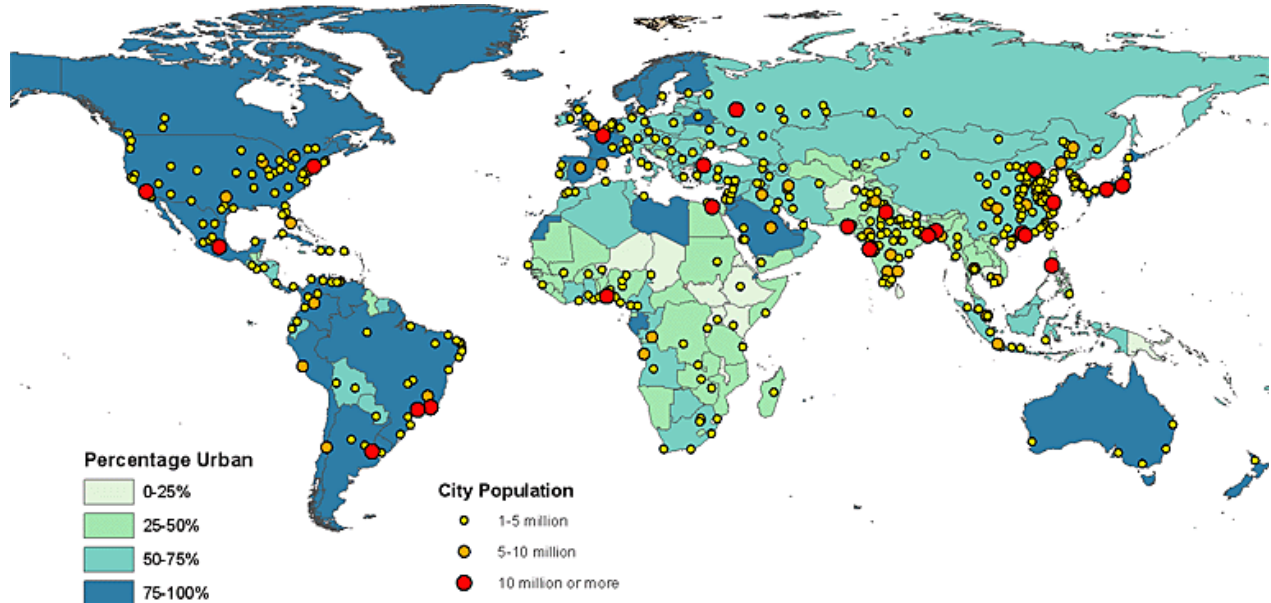


Figure 1.1 Percentage of urban population and agglomerations by size, the world population is increasingly urban, increasing in size and ultimately placing higher pressure on resources (UN 2012)

1.3 Methodology

The project was completed in the following stages.

The first stage was a review of literature from across the world on the economic, social and environmental value of urban agriculture. This included a review of how agriculture is planned for in current regional plans in the mainland Australian capital cities which are facing population growth of five million over the next 20 years.

Stage two was a synthesis and analysis of the knowledge and data from available literature. This stage defined the sustainable benefits of agriculture in cities. This stage involved the compilation of UA applications from across the world. These UA applications were assessed and analysed for adaption into the Australian landscape.

The third stage of the research used the lessons of agricultural applications as a guide to the creation of a planning model for UA. Previous planning has not considered agriculture as an essential piece of infrastructure; the literature review has shown how agriculture is perceived as important to cities' survival and the sustainable benefits of UA for cities. The analysis in the previous stage showed which agricultural applications are suitable and could be applied into urban environments. This fourth stage of the research used the agriculture applications as a guide for the creation of a planning model for agriculture in urban environments. The model

is a verbal model creating a framework, uses objectives, has guidelines and performance criteria. A performance based planning model is not a spatially fixed model with zoning and land use designations.

The final part of the research project was the practical application of the performance model into the planning of a urban land release precinct in Western Sydney. The urban release area of the SWGC is being made available in precincts which are master planned and conform with the (*Metropolitan Plan for Sydney 2036* 2010). The Sydney growth centres currently provide 50 percent of the vegetable production and 60 percent of the agricultural greenhouse production of the Sydney basin (Malcolm & Fahd 2009).

The Austral precinct in the SWGC is currently in the planning phase and is due to be released for housing shortly. The model was applied to the Austral precinct using the guidelines and objectives created in the previous stage of the project. A master plan was produced along with associated images, maps and plans to show how the performance criteria were being met. To calculate the performance of the proposed model, the area of current agricultural production was calculated using aerial imagery and was compared with the proposed area of production under the revised master plan. The area of residential development in the proposed structure plans was also compared to the area under the new planning model to ensure that the appropriate levels of housing were not affected or would not increase housing affordability problems.



Figure 1.2 Sydney's Growth Centres from NSW Planning (NSW 2012)

2.0 LITERATURE REVIEW

This section of the report firstly defines the main components of urban agriculture as it is expressed in current relevant literature. Explores the detailed review on the benefits and constraints of urban and peri-urban agriculture, followed by the review of planning in Australia specifically reviewing the processes and procedures involved in encouraging or discouraging agriculture in and around cities.

2.1 DEFINITIONS

2.1.1 Urban Agriculture

Urban Agriculture (UA) is *“The growing, processing, and distributing of food and other products through intensive plant cultivation and animal husbandry in and around cities”* (Brown 2002, p. 5). UA includes agriculture in greenbelts, the urban fringe, vacant city lots, community gardens, fish farms, raising livestock and green houses. UA is more than just growing food, it is also the distribution of food and other agricultural products to consumers through networks (Pires 2011).



Figure 2.1 Many cities in the United States are encouraging UA, a warehouse rooftop garden of 600 square meters in Brooklyn, New York (21st Century Sustainable and Sustaining Cities 2010).

2.1.2 Urban Agriculture History and Development

UA is a movement which is very different from the bulk food producing farmland. This movement is from the grass roots (Mason & Knowd 2010) and developed from a societal awareness on the value of agriculture and a desire to know where and how their food is being produced.

UA is not new and traditionally food has always been produced close to the market. In the rush to industrialise, urban lands were separated to lessen conflict between land uses, a move later deemed ill-fated (Yokohari & Bolthouse 2011). Tokyo in the nineteenth century was one of the largest cities of the world, yet 40 percent of its land area was under agricultural production. Today in Japan agriculture in cities has changed and the agriculture industry in the whole country is only providing 40 percent of its food requirements. This makes food security a real political issue in Japan (Yokohari & Bolthouse 2011).

During World War Two, the population of Great Britain was enlisted to dig for victory. This famous campaign transformed city areas and rooftops into valuable food producing areas. In 1944, over two million tons of food was produced by one and a half million gardeners (Hunt 2012).

UA today is a growing movement all over the world and makes significant contributions to people in Africa as a source of welfare (Elliss & Sumberg 1998). In developing countries of the world, UA is a source of income to new settlers in cities, as well as a source of nutrition and fibre (Elliss & Sumberg 1998; Howe et al. 2005). In Cuba, UA was developed to deal with the collapse of the Soviet Union, with the disappearance of its only export market for sugar and therefore its ability to purchase food. Figure 2.2 shows a typical example of urban agriculture in Cuba. These farms are called Organoponicos (Viljoen & Howe 2005a). The government changed policy and encouraged all persons to grow food on any open space and as a consequence some 20,000 people now grow food inside Havana (Giradet 2005).

In developed economies of the world, UA is just as important. In Russia, Dachas produce 80 percent of the fresh vegetables used in its cities. It is traditional for many people to go to their Dachas on weekends to tend their crops (Giradet 2005). In St Petersburg alone there are some 560,000 plots of land being cultivated (Giradet 2005). Fourteen percent of Londoners produce vegetables in their own gardens and it is estimated that London could produce 232,000 tonnes of food each year (Elliss & Sumberg 1998). In the United States of America a third of all farms are within metropolitan areas and they produce 35 percent of all crops and livestock sales of the whole country (Houston 2005).

In Sydney, organizations such as Food Fairness Alliance and Hawkesbury Harvest are proactive in public education and changing attitudes towards agriculture in the city. They both promote fresh organic and seasonal food. In Australia there is a 10-30 percent growth forecast in demand for organic food (Chang & Zepeda 2005). This has seen an increase in farmers' markets in Australian cities. In Sydney, Housing NSW promotes community gardens as a place of social interaction and community building while providing access to fresh and healthy food (Community Gardens 2011).



Figure 2.2 Urban agriculture Havana Cuba. As a result of the loss of trade in the late 1990's Havana now provides 50 percent of its food from within the city (Morgan 2011).

2.1.3 Urbanisation

Urbanisation is the moving of people to the city and moving them away from rural living where they could provide some of the food for themselves. In 2007, the majority of the world's population had become urban dwellers (UN 2012). The UN projects that by the year 2050, 70 percent of the world's population will be urbanised. Most of the world's population growth is forecast to be in urban areas (Alig et al. 2004). Currently, the global population is 6.3 billion which is expected to rise to 9 billion by 2050, Giradet (2005) projects that half of the world's population are living in cities which. This proportion will grow to two thirds by 2030.

In China, the expansion of urban areas has been fast, consuming 960 square kilometres of land a year. China is home to three megacities of over ten million inhabitants, Beijing, Shanghai and Tianjin. In 1980, the urban population was only nine percent of the whole population of China. By 1997, it had grown to 30 percent, and is forecast to rise to 90 percent by the year 2060. In China, urban areas are spreading into the peri-urban regions which were once used primarily for agriculture (Yang, Cai et al. 2010).

In the United States of America, since the nineteen seventies urban land has doubled in size. Urban growth is brought on by household formation, economic prosperity, new transportation and communication systems (Heimlich & Anderson 2001). The urbanisation has resulted in a loss of forest and cropland from the fringes of the metropolitan areas. By 2025, there will be an estimated 70 million acres of urban land, an increase from 39 million acres in 1997. The creation of this sprawl has seen the government create over 1000 planning rules to help control the urbanisation rate (Alig et al. 2004).

Australia has always been one of the most urbanised countries in the world, with 92 percent of the population living in urban areas (UN 2012). The urban areas of Australia are confined to the eastern fringe of the continent with the majority of urban growth projected to be in this area (Houston 2005). Sydney will grow by an extra one million people by 2031 (Jeffs 2009). Sydney's growth is confined to urban growth centres. These centres cover 27,000 hectares of new urban land and will accommodate 180,000 new households (*Sydney's Growth Centres* 2012). Melbourne's urban fringe, along with South East Queensland, are some of the fastest growing areas of Australia, Melbourne's population is expected to reach five million by 2030. For every person who is moving to inner Melbourne five people are moving to the urban fringe, expanding the city (Carey, Rachel et al. 2011). The continued urbanisation in Australian cities is resulting in displacement of agriculture, through land speculation and fragmentation of lots (Butt 2011; Carey, Rachel et al. 2011).



Figure 2.3 Urbanisation in Western Sydney: Oran Park development in the south west growth centre which is in the middle of a productive farm in Western Sydney (Sydney's Growth Centres 2012).

2.1.4 Urban Fringe

The urban fringe (also known as peri-urban area) is an area which is not urban but is also not rural, where the land use is blurred (Choy et al. 2008). This fringe is an area which is converting to urban through the urbanisation process (Jarosz 2008). It has traditionally been seen as just an area awaiting urban development and this area has seen rapid population growth (Merson et al. 2010). The fringe area could be considered as the area which is within the sphere of influence of a city (Houston 2005). This sphere has increased with the invention of rapid transport systems which has made commuting to the urban fringe easier with the ultimate consequence of increased land values.

The urban fringe is the area where agriculture tends to intensify (Butt 2011) and is able to take advantage of the close proximity to markets, reliable water supply and labour. It is the area where conflict arises among different land uses. Agriculture is fighting higher land values, land speculation by developers and conflict between new residential owners and farm practices such as weed spray and noise.

In the United Kingdom, the Green Belt has been a response by planners to containing urban sprawl since the 1950's. Urban fringes account for 20 percent of the total land of the United Kingdom, which is equal to the area that cities occupy. The use of this land is fiercely debated. Gallent (2006) argues that if the fringe is sanitised or changed it will appear elsewhere. He also suggests that agriculture in the fringe is degraded and less useful (Gallent 2006). Others believe in protecting the urban fringe for agriculture and amenity (Houston 2005; Mason & Knowd 2010).

One of the items of conflict in the peri-urban areas in Australia is agriculture, the conflict is between new residents of urban areas which have encroached into areas used traditionally for agriculture (Houston 2005). The urban fringe in Australia is the area where the majority of new housing developments will be created in coming years to house the growing population of Australian cities (Butt 2011). In Sydney by the nineteen ninteys rural living had become the major land use of the urban fringe. The main reason was that land use is derived from market forces only (Mason & Knowd 2010). Similarly Melbourne's urban fringe has seen an increase of rural lifestyle living and a decrease in farming (Butt 2011).

2.2 Pressure on agricultural land use

Land is a valuable and scarce resource. Land use in cities and on urban fringes is highly contested and debated (Gallent 2006). To maintain viability agriculture needs to overcome the demand for alternate land uses (Sinclair 2001). The alternate land uses are derived from pressure for certain types of land development in and around cities of which agriculture is only one option. The following section will outline where the pressure on land use change is coming from.

2.2.1 Affordable Housing

Affordable housing is intended for low to middle income earners, which include private owners, renters and public housing tenants (Arman et al. 2009). It is considered a basic right to have access to affordable housing which does not cost so much as to effect the liveability of the household (Disney 2007). The need for affordable housing has seen cities grow and expand to meet the demand. The response from governments to affordability has been to accelerate and streamline access to land for development into housing, usually on the fringe of cities resulting in the conversion of existing agricultural lands into urban uses (Yates & Milligan 2007). Yates and Milligan (2007) argue that affordability is a complex issue, not just based on access to land but with many different and opposing forces as illustrated in Figure 2.4.

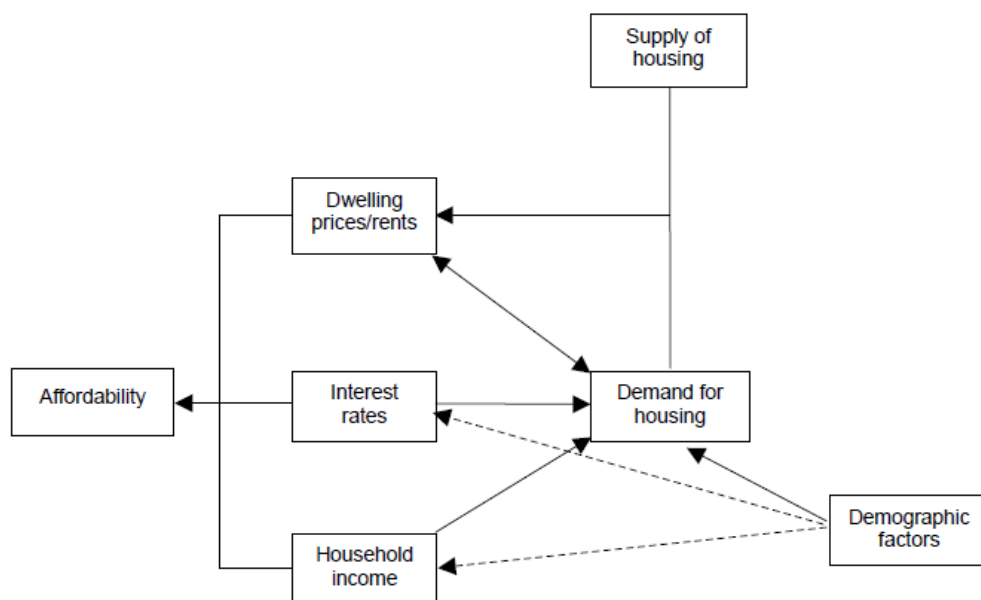


Figure 2.4 Determinants of housing affordability. The consequences of decreasing affordability(Yates & Milligan 2007)

The supply of affordable housing is critical to the economic prosperity and welfare of communities. Insufficient supply of affordable housing can lead to higher wages and inflation

(Disney 2007; Yates & Milligan 2007). The government's management of the economy is made more difficult with the increasing number of households at risk of affordability problems, due to the sensitivity of these households to change of circumstances (Yates & Milligan 2007). A prime example of this is the introduction of the carbon tax. The government has been forced to spend extra money to compensate the households most at risk. Housing affordability can also have social consequences such as loss of family cohesion (Disney 2007) and a reduction of household security with the constant need to move (Yates & Milligan 2007).

The measure of affordability is generally accepted as households in the lowest forty percent of income levels and spending no more than thirty percent of their income on housing (Gurran et al. 2008; Wulff et al. 2011; Yates & Milligan 2007). In Australia, 93 percent of Sydney's low income earners, totalling 44,000 households, are facing housing affordability issues (Wulff et al. 2011). Overall, the gap between demand and supply has seen the shortfall of affordable housing supply in Australia grow to 186,000 households nationally (National Housing Supply Council 2011).

The housing affordability crisis in Australia is predicted to increase in the coming years with the demographics of households changing (Yates & Milligan 2007). Households are becoming smaller due to an ageing population along with an increase in single person households. Australia has focused recently on improved planning efficiency to get a better supply of housing, but has not focused on improving the range of housing or the supply or specific housing for low and middle income earners (Gurran et al. 2008). In Australia it has been argued that affordability has been decreased by the containment strategies of the urban footprint in metropolitan planning (Gurran et al. 2008; Yates & Milligan 2007).

Affordable housing is crucial to a nation and its people. Without it, people are impoverished, families and communities eroded, jobs lost, the economy weakened, and the environment damaged. The shortage of affordable housing has become a deep and significant problem throughout Australia and needs to be addressed. Any perceived change to planning and supply of new housing needs to make sure that any change does not inflate the affordability problem.

2.2.2 Food Globalisation

In a developing trend, the world is globalising the production of food. The demand for any particular food at any time, the location and ease of transport systems and the wide open spaces of developing countries with cheap labour have driven this trend (Giradet 2005; Mason & Knowd 2010; Paxton 2005; Viljoen et al. 2005). Consumers in industrialised nations are accustomed to being able to choose whatever they would like to eat at any time of the year. This food is produced from the global food basket (Paxton 2005). To meet the consumer demand there has been a doubling of air freight of fresh foods over the past twenty years (Paxton 2005). Heathrow airport in London was once the major source of food for the

city. It is once again that source thanks to the air transport of food from around the globe (Giradet 2005). The distance food is transported is commonly known as food miles and will be discussed in addressed in section 2.3 the benefits of UA.

Supermarkets are dominating the supply and distribution of food and are looking to increase profits with cheap imports from overseas (Merson et al. 2010). In the United Kingdom, 10 percent of the retail food business account for 80 percent of the food distributed (Viljoen et al. 2005). The emergence of this supermarket system has removed a connection between consumers of food and the farmers that produce it (Mason & Knowd 2010). The industrial scale food production is driven by what type of food can be produced the cheapest and be stored the longest period of time (Paxton 2005). Today, produce is chosen by retailers not on taste and nutrition but on transport and storage potential. The result is a loss in variety and resistance from disease. Carrots are a perfect example, in 1903 there were 287 varieties under cultivation compared to the 21 varieties being grown today (Paxton 2005). In some countries changes to the supermarket distribution systems have resulted in some foods being imported and exported from the same region. For example, in 1997 England imported 126 million litres of milk while at the same time exporting 270 million litres (Paxton 2005). As a direct result of globalisation the smaller farmer cannot compete with or supply the quantities demanded by supermarkets and are forced out of production (Jeffs 2009).

Some of the globalisation of food production originated as a priority policy of the International Monetary Fund and the World Bank, as they encouraged the bulk production of food in developing countries (Paxton 2005). The global bulk production of food is seen as a way for these Third World economies to gain economic wealth (Viljoen et al. 2005) and contribute to paying off their foreign debt (Paxton 2005). In Russia, as the result of globalisation of food production the cost of food has risen substantially (Brown 2002). Some developing countries now face food security issues due to the conversion of its farming to bulk production for export markets which is opposite to the plans envisaged by the World Bank (Paxton 2005).

To compete in the global market farms have been restructured in Australia to create larger farms that are more reliant on irrigation, long distance transport and central processing (Butt 2011). There has been a significant decline in agriculture in the Sydney basin from not only urban expansion but also economic factors such as imports of cheaper food from overseas and the growth of larger farms west of the divide to supply the supermarket chains (Merson et al. 2010).

2.2.3 Rural/Lifestyle Living

Ever since the Industrial Revolution city dwellers have desired open space and rural living. The advent of mass transportation and increased mobilisation (Van Dam et al. 2002) has allowed the modern worker to work in the city while enjoying living in the countryside. The desire for the amenity of rural living, with all the comforts of city living is idealistic: the rural

lifestyle resident is in search of peace and quiet, open space and greenness (Van Dam et al. 2002). The result is a low density sprawl of rural lifestyle living (Choy et al. 2008). It would be highly unlikely once land is turned into urban use that it will ever revert to rural land uses again (Choy et al. 2008). The change of land use to a short term, high value urban use will not be changed back to low value agricultural land use. A decline in agriculture is seen as the catalyst for urbanization. Land speculation contributes to this decline with lifestyle living further diluting the landscape (Choy et al. 2008).

The cycle of conversion of farmland to rural living as shown in figure 2.5 is typical in both the United States of America and Australia (Sinclair et al. 2004). The desire to live in a rural area makes the market respond with increased housing (James et al. 2010). The new residents dilute the value of agriculture, increase the value of land (Butt 2011), resulting in more land use conflicts and a reduction of farm viability (Sinclair 2001). In a consumer survey in the United States of America 70 percent of respondents preferred living in a rural setting within 30 miles of a city (Heimlich & Anderson 2001).

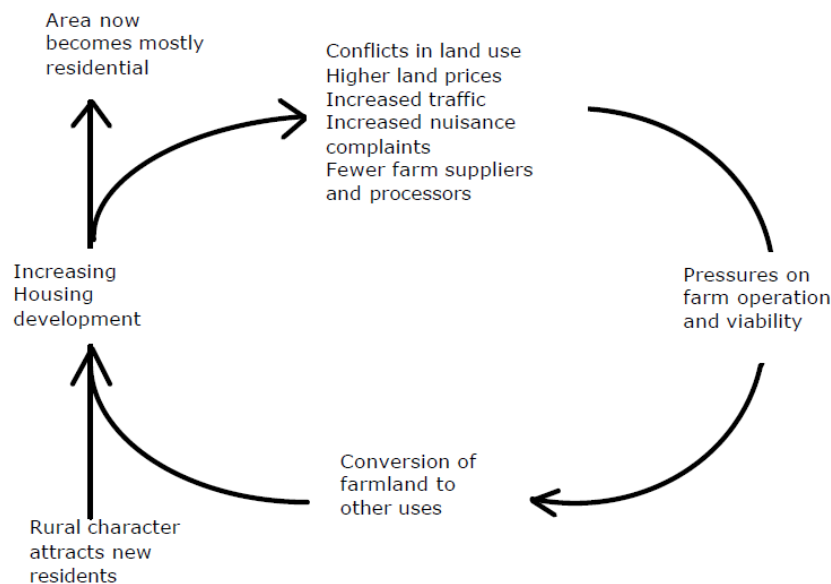


Figure 2.5 Farmland Conversion Cycle (Sinclair 2001)

The resulting low-density development is dispersed and requires a lot of land. This type of development has geographic separation of essential places such as work, schools, and shopping. There is almost complete dependence on automobiles for travel (Heimlich & Anderson 2001). This low density development is more expensive to service and support with \$1.24 per hectare needed from each tax dollar raised while farmland only requires 38c per hectare in each dollar raised (Heimlich & Anderson 2001). Rural residential development also has an impact on the biodiversity of regions with clearing of trees and scrub for protection from bushfires (Sinclair et al. 2004).

Melbourne's peri-urban region has seen an increase in rural lifestyle living and a decrease in farms which is causing the dilution of the areas used for agriculture so agriculture becomes less important overall in the community (Butt 2011). In Sydney, by the nineteen nineties, rural living had become the major land use in the urban fringe. The main reason was that the land use had been derived from market forces only (Mason & Knowd 2010). The residential land use in the rural area of Western Sydney is 78 percent equating to 25,276 allotments with an average size of two hectares. Figure 2.6 shows the land use in Western Sydney in 2004 once the rural villages were excluded (James et al. 2010; Sinclair et al. 2004). The demand and desire for rural living in Western Sydney is producing conflicts in land use and is contributing to a loss of viability of farms (Sinclair et al. 2004). Western Sydney's fringe is a diverse and prosperous community with agriculture providing economic activity and adding a unique character to the area (Sinclair et al. 2004), which makes it a desirable place to reside, so the cycle continues.

Land Use	Number of Uses	Percentage of Total
Rural Residential	25,676	78.3
Intensive Plants	2,226	6.8
Vacant	1,620	4.9
Public Uses	1,195	3.6
Extensive Agriculture	944	2.9
Commercial	575	1.8
Extractive Industry	295	0.9
Intensive Animals	276	0.8
TOTAL	32,907	100.0

Figure 2.6 Western Sydney Land use Survey showing the number of lots and the percentage of the overall land use of the region (Sinclair et al. 2004)

2.2.4 Economic Pressures

The value of land is highest when there is high demand and competition between uses of the land. The urban fringe is the most contested area and as a consequence the value of land in some cases is too high to make agriculture economically viable. The cost of land on the fringe is being inflated by the urbanisation process forcing farm sizes to shrink (Mason & Knowd 2010). The result is land values surpassing production values (Carey, Rachel et al. 2011; Jeffs 2009). Speculation by developers has increased land values which is restricting any further investment in agriculture or allowing new farmers into the market (Jeffs 2009). Some farmers are using the land as a retirement fund and cashing in the land for high economic returns (Jeffs 2009).

In Western Sydney, the value of land is forcing farmers to intensify the farming practices on smaller parcels of land (Sinclair et al. 2004). The land value in Sydney is prohibitive creating new farmers (Jeffs 2009). In some cases, the value of a two hectare lot has increased from \$500,000 to over \$1.5 million in as little as 10 years (Sinclair et al. 2004). Melbourne's fringe land prices are rising and farmers cannot purchase more land for farm expansion or they are selling and moving further away from the city (Carey, Rachel et al. 2011).

Small farmers in cities face other economic problems, such as an inability to access bank loans like large industrial scale agriculture (Brown 2002). The security of tenure is also a concern for urban and peri-urban farming, due to its part time and transient nature. This makes the access to economic funding difficult to establish. It is difficult to invest hundreds of thousands of dollars into a business if it could be forced to move in the near future when the government decides to shift the urban boundary of a city further into the fringe (Sinclair et al. 2004).

Due to the size restrictions on farming in urban and peri-urban areas, some co-op farmers cannot earn enough money from farming only, but they use the small plots to supplement their income from secondary jobs (Jarosz 2008). In other situations, some farmers are forced to get second jobs to cope with the increased financial pressure (Cheng 2012). Cheap imports from overseas, driven by the large supermarket chains, are driving prices down (Merson et al. 2010). In 2010, farmers were selling produce for minimal value at unsustainable levels, such as the profit of only five cents per leek after six months of growing and tending to a crop. The competitive nature of the vegetable industry has seen the wholesale price of pumpkins fall to eight cents per kilogram from one dollar per kilogram, in 12 months (Cheng 2012).

2.3 Benefits of Urban Agriculture

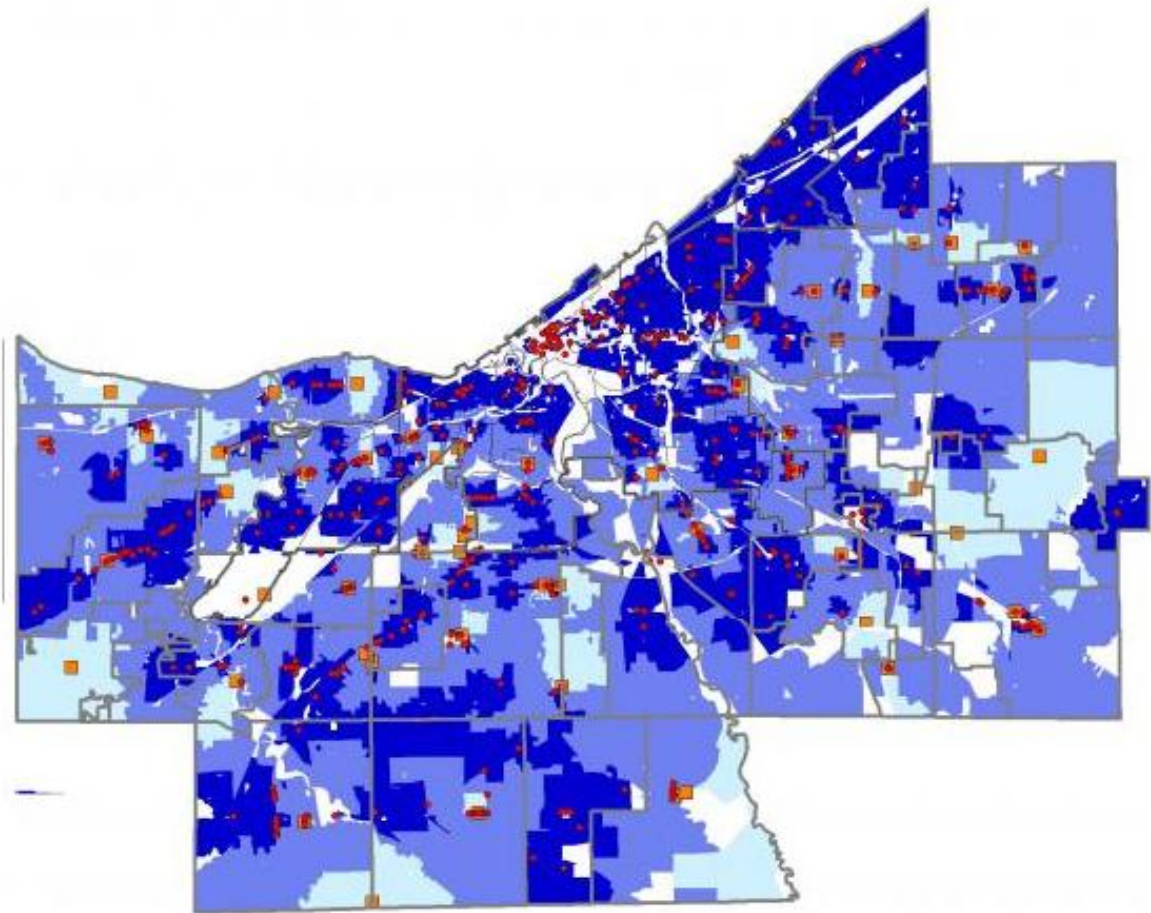
There has been a significant amount of literature written recently on the virtues of urban agriculture. The following sections outline the main benefits derived from agriculture from within and around cities. This type of agriculture is known as urban and peri-urban agriculture (UPA).

2.3.1 Food security

Food security includes having access to a fresh and reliable source of food. In Africa where food security is an everyday issue, poor migrants to a city can use their agricultural skills to secure income and a food source (Elliss & Sumberg 1998). But in modern Western countries we also have a need for a secure source of food. Recently, issues such as mad cow disease, bird flu and genetically modified food (Chang & Zepeda 2005; Ingo 2011; Mason & Knowd 2010) have highlighted the need for countries to be self-sufficient in producing food. China has recognized the importance of food security in planning. In Beijing's expansion, the government has set aside 500 hectares of land specifically for providing a supply of some fresh food for the city (Giradet 2005).

Food security issues are not normally associated with wealthy countries like the United States of America, but in fact it is a reality to the poor of that country. In 1999, a senate report concluded that 31 million residents were food insecure in the United States of America (Brown 2002). Many community organisations are helping the poor to access food, to cure anxiety about food and the lack of fresh, nutritional food (Brown 2002). Programs like Reimagining Cleveland are reconnecting some of the poor with food and reconnecting local communities (Reimagining Cleveland 2012).

Other projects such as the homeless garden project in Santa Cruz California, are producing food and profits which are donated to charities such as soup kitchens to feed the homeless (Brown 2002). Another significant issue affecting food security is the location and access to grocery shopping. This can affect the food security of a specific spatial area due to the lack of transport for the poor. This spatial pattern is known as a food desert. A food desert is more likely to be found in poorer neighbourhoods than in affluent suburbs. Food deserts are found in both European (Viljoen et al. 2005) and American cities. Figure 2.7 shows the relationship of major shopping, fast food outlets and the resulting food deserts in Cleveland, Ohio, United States of America. As a response, Reimagining Cleveland is taking vacant lots and turning them into urban farms. The ultimate goal is to have all residents of this city live within 400 meters of an urban farm (Reimagining Cleveland 2012).



Orange squares are grocery stores greater than 25,000 square feet. Red dots are fast food restaurants. Dark blue areas are where residents have fast food closer (half-mile away) and grocery stores further (one mile). Data and maps produced by the Cuyahoga County Planning Commission in 2008.

Figure 2.7 Food Deserts in Cleveland United States (Reimagining Cleveland 2012)

Biosecurity improvement is an important benefit of locally produced fresh food. A continued supply of food at times of global or national disasters, or in times of regional conflict is a benefit of producing food locally with small distribution networks (Carey, Rachel et al. 2011). This idea is not new: during World War Two, the Allied countries responded to the global crisis with Dig for Victory in the United Kingdom, United States of America and the creation of a land army in Australia. Food was produced in parks, on ovals, rooftops and even street verges. The result was the production of 70 percent of food locally in the United Kingdom and a huge contribution to the war effort (Hunt 2012). Figure 2.8 shows victory farming areas in New York during the World War. Countries such as Russia after the collapse of the communist regime, African countries in civil conflict or Cuba after the loss of access to funds have all responded with an increase of agriculture in the cities in order to feed their populations (Petts 2005; Viljoen et al. 2005).



Figure 2.8 World War Two victory farming New York (Howard 2012)

With the onset of climate change, drought, fire and flood in Australia, food security has become an increasing concern. Jeffs (2009) and Merson et al. (2010) suggest that agriculture should be an essential service which needs to be provided to cities to ensure their survival. During the height of the drought in 2009, the only location that fresh lettuce was available from in NSW was the Richmond/ Windsor area of Western Sydney. In 2010, the main source of fresh vegetable seedlings in Queensland was destroyed by poison, causing a rise in prices and shortages of some fresh food across Australia (Glennie 2010). Food security of university students in Melbourne's Monash University is being protected by the creation of a community garden to give students access to fresh food (Preiss 2012).

One of the main issues facing cities of today is food security, whether they be growing or decaying cities. While planning allows for agriculture it is not planned for implicitly and therefore the food systems for our cities are vulnerable and are not being protected (Butt 2011; Carey, Rachel et al. 2011).

2.3.2 Economic Benefits

The economic benefits of urban and peri-urban agriculture range from providing a supplement to income for a few farmers, to providing up to 25 percent of the economic activity from a city. Europe and North America is faced with an ageing population, a diminishing tax base and slow stagnant economic growth, and the restoration of peri-urban agriculture and woodland management is considered a pathway to economic growth (Yokohari & Bolthouse 2011).

The poor in developing African countries already use agriculture as a way to generate income from small urban farms. They supplement their incomes and provide an avenue for wealth creation (Elliss & Sumberg 1998; Petts 2005). It is not only in developing countries that this is experienced: in peri-urban regions close to cities of developed countries where the markets are close, there is an increase in part time farming to supplement income (Butt 2011). Some of these co-op farmers cannot earn enough money from farming, but use these small plots in cities to supplement their income from secondary jobs (Jarosz 2008). These part time urban farmers who contribute some income from other pursuits, could be classified as persons with a passion or hobby farmers (Heimlich & Anderson 2001).

The ability for the urban and peri-urban farmer to readily have access to the market allows the use of direct marketing, which enables the farmers to keep more of the profit (Jarosz 2008). In the Northern hemisphere there is a huge trend towards direct marketing of food from local growers (Mason & Knowd 2010). The urban farmer close to consumers can use the niche market of organic food, which has higher economic return, to their advantage (Heimlich & Anderson 2001).

When calculating the economic cost or benefit of agriculture in an urban environment transportation costs associated with agriculture, either during production or distribution, are not taken into account. These transportation costs are reduced dramatically when food is produced in or close to cities and these savings need to be taken into account when calculating the economic benefits of UPA (Viljoen & Bohm 2005).

The current trend for shopping in the supermarket dominant world sees an outward flow of the majority of the cash from the local economy. By use of the multiplier effect Paxton (2005) believes that every 10 United Kingdom pounds spent on local food is worth twenty five pounds to the local economy (Paxton 2005).

In addition to the benefits previously mentioned the economic benefits to society of lowering health expenditure (Brown 2002) and increasing the employment opportunities (Carey, Rachel et al. 2011; Jeffs 2009) are both important considerations when assessing the economic benefits.

Economically, the value of production in the regions inside and adjacent to cities has long been underestimated (Houston 2005; Viljoen et al. 2005). A review of American cities in the

early nineteen nineties revealed that agriculture was carried out on five percent of land in the United States of America, but accounted for 17 percent of agricultural sales (Houston 2005). In Australia, the economic value of farming is generally recognised by planners who are trying to limit urban expansion and fragmentation of land on the edges of our cities (Butt 2011; Choy et al. 2008). Houston found that the gross value of agricultural production was up to 25 percent of the state from the peri-urban lands around Australian cities (Houston 2005).

In New South Wales (NSW), there is some confusion and differences between the economic value and output of farming in the Sydney basin (James et al. 2010) but the Sydney Basin has always played an important part in food production for the city. The following quote from a nineteen fifties' book on the Cumberland Plain in Sydney shows how agriculture has played an important economic role in Sydney for a long period.

"The County is a small area and not particularly rich from the growing point of view, yet in 1947 it produced three-quarters of the State's lettuces, half the spinach, a third of the cabbages and a quarter of the beans; 70 percent of the State's poultry farms were in the County and more than 18 percent of Sydney's milk came from the County;..... Rural production in the county has always played an important part in supplying food for Sydney" (Winston 1957, p. 49)

Based on the reports of the Australian Bureau of Statistics (ABS), which is considered the most reliable data for pure economic value of output from the farming within the Sydney basin (James et al. 2010), the economic value of Sydney's agriculture was \$671 million in 2007/8. The NSW Department of Primary Industries, however, estimated a value of one billion Australian dollars based on findings from a report in 1995 which indicates rapid decline since (James et al. 2010). If all economic activity of the agricultural sector is taken into account, it provides according Gillespe and Mason (2003) up to \$4.5 billion dollars of economic activity (14 percent) of the NSW economy from the Sydney basin annually. Victoria's fruit and vegetable production was worth \$1.4 billion in 2009 (Carey, Rachel et al. 2011) with the Melbourne region providing sixteen percent of the overall output of Victoria (Butt 2011). The value of peri-urban agriculture in Queensland is estimated at \$6.2 billion in 2006 by Stokwell (Choy et al. 2008). The most interesting fact from all studies on the economic value of agriculture, Australian peri-urban and urban zones consistently contribute nearly a quarter of all agriculture output (Houston 2005) even considering the debate about the exact value it is a considerable value and it has long been underestimated and valued.

2.3.3 Employment Benefits

Employment in the agricultural sector is relatively undervalued for agriculture in and around cities (Jeffs 2009), the estimation of farming employment is difficult due to the part time hobby farmers, the linguistic barriers of some farmers and self-employed farmers often do not consider it as a job (Petts 2005). In Africa new city migrants have the skills that they

developed in the rural areas which is being utilised as an advantage by farms located close to this source of labour (Elliss & Sumberg 1998).

In Australia there are employment opportunities for urban dwellers in agriculture (Carey, Rachel et al. 2011), these jobs could be either part time to supplement income or full time depending on the circumstances. Agriculture in the Sydney basin currently supports eleven percent of the state's workforce (Jeffs 2009).

2.3.4 Social Benefits

One of the main social benefits from urban agriculture is health related, the United States of America government spent fifteen percent of their budget on health (Chantrill 2012) while in Australia 61 percent of persons over the age of twenty are overweight (World Health Organization 2008). Today we over process foods, foods are high in starch, fats and sugars some potentially contain large amounts of pesticides which all can have a detrimental effect on health (Paxton 2005). Urban agriculture can assist in health improvements by encouraging activity in open space, as well as increased access and consumption of fresh nutritious food (Brown 2002; Howe et al. 2005; Viljoen et al. 2005).

The consumption of fresh fruit and vegetables is essential to protect against dietary disease (Carey, Rachel et al. 2011). Only a small percentage of the Australian community consume the suggested amount of fruit and vegetables. In fact only ten percent of Victorians consume the suggested daily intake (Carey et al. 2011), urban farming can help address this unhealthy pattern of consumption of food. It is recognised by many projects that the consumption of fresh food to be one of the main benefits of urban food production. The goal of the Toronto food policy is to improve the health of residents, it provides local fresh food as a tool to help reach these goals (Mason 2006b). Projects such as the Penrith food project, established in 1990 to create a healthier food supply are specifically enabling people to access fresh local food for health benefits through community gardens (Mason 2006b).

Local food production and distribution is generally through alternate food networks (AFN). The food is sold and distributed through farming co-ops and community farmers markets. Figure 2.9 shows the distribution of farmers markets in the United States of America. AFN drive social change by co-operation between the consumer and grower, creating a better understanding between the consumer and grower (Jarosz 2008). The AFN consist of community markets which foster and grow the community through interaction (Viljoen & Bohm 2005) providing personal connections in the community (Brown 2002). Today there are more than twenty farmers markets in Sydney (Mason & Knowd 2010) as well as a new movement from peri-urban farmers called 'Hawkesbury Harvest' which enables social interaction between farmer and consumer.

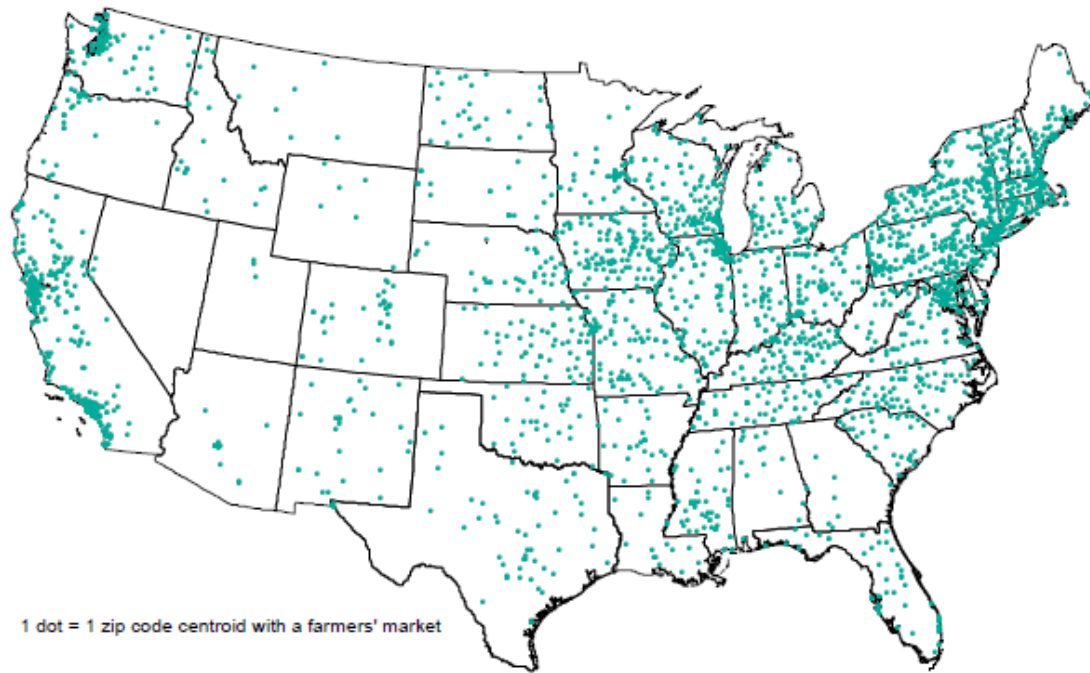


Figure 2.9 Farmers markets in the United States (Heimlich & Anderson 2001)

In cities across the world there has been an increase of the community or allotment garden. Community or shared gardening helps build a sense of community through combined decision making, sharing of resources, negotiation and problem solving (Community Gardening - The benefits 2007). In the re-development of Cleveland 160 community gardens have been built, these gardens are re-building neighbourhoods and making it a safer place to live (Brown et al. 2008). A prime example is Detroit which was the fastest growing city in the world, but now is in urban decline and planners are turning to urban farming to revitalise the city and reconnect communities (Harris 2012). Community gardens can be an effective social tool to reduce discrimination, groups who are discriminated against can be involved in producing the food they need, while expressing their ethnic identity (Howe et al. 2005). The reduction of crime is seen as an achievement of community gardens, by building stronger communities with a pride of ownership and belonging (Howe et al. 2005).

Before the rapid urbanisation of cities across the world, food was grown close to cities where rural culture, traditions and history were built. Urban agriculture can help maintain and reconnect with the traditions of farming near the cities through tourism which in turn will protect the heritage and history of cities for future generations (Carey, Rachel et al. 2011). Urban Agriculture draws from the traditional base of local areas which produce food such as in Florence with its many orange and olive groves, vineyards and wheat fields (Giradet 2005). Urban agriculture will lead to the development and recognition of rural culture by urban populations (Yang et al. 2010) which will help with social understanding and traditions of food production.

Working green spaces are a way to combine both leisure and productive places (Yokohari & Bolthouse 2011) the introduction of different and the changing of the landscape with the changing seasons will make living in the city a more stimulating and enjoyable place (Viljoen et al. 2005).



Figure 2.10 Images of Community Building through community gardens in Cleveland United States (Brown et al. 2008)

2.3.5 Environmental Benefits

“While agricultural production can create environmental problems of its own, properly managed farmlands provide non-market benefits by improving water and air quality, protecting natural biodiversity and preserving wetlands relative to development” (Heimlich & Anderson 2001, p. 4)

In an era when climate change and carbon emissions are being debated, both politically and socially, the benefits of urban agriculture are important. Food production closer to the urban population is seen as better use of resources in a carbon restrained economy (Merson et al. 2010), due to the reduction of the quantity of fossil fuels being used in the production, processing, packaging and distributing of food (Jarosz 2008; Paxton 2005). Urban agriculture can be seen as one way to deal with climate change and the carbon footprint of our cities (Mason & Knowd 2010). Urban Agriculture can help by reducing carbon dioxide emissions, improved biodiversity, air quality and the provision of heat island sinks (Viljoen et al. 2005). The amount of oil used to produce, process, package and transport food in current systems is extremely high when compared to the production and distribution of local organic food (Viljoen et al. 2005). More energy is used in the production and distribution of food than the

energy that is supplied to the consumer, which in itself, is unsustainable (Viljoen et al. 2005). In addition climate change could bring increased opportunities for agriculture within cities due to the location of more certain water resources (Choy et al. 2008).

One of the main measures on carbon or energy expenditure, is on the distance food travels to the consumer from the producer in modern distribution systems. This is known as food miles. Urban agriculture results in a reduction of the food miles as the food is produced from within or adjacent to the city (Brown 2002; Carey, Rachel et al. 2011). Most perishable foods can be produced in UPA with little refrigeration and storage, making even higher savings on energy use (Viljoen et al. 2005). Today's long distance transport and central processing of food (Butt 2011) is the main route of distributing produce to consumers in the city. In London and other European cities a large percentage of food comes via air transport, which uses substantially more energy than that is grown locally (Giradet 2005). Air freight can contribute up to 37 percent more in carbon emissions than traditional ground transport (Paxton 2005). The transport of food and drink has increased by 50 percent in the last fifteen years in United Kingdom, while the volume of food transported has only increased by sixteen percent, resulting in food transport being responsible for a third of the growth in the transport sector (Paxton 2005). To add to the distance food travels, some countries often import and export the same type of food depending on the contract with a supermarket. In 1997 the United Kingdom imported 126 million litres of milk while exporting 270 million litres (Paxton 2005). Shopper miles are an important part of food miles, it is preferable to have locally produced food but if consumers need to drive a distance to access it, the energy expended in transport is still significant. One shopping trip by car can use more fuel than the transport to the point of sale (Paxton 2005).

Nutrients in the food chain are just as important as the amount of energy used or emitted during the production of food. The current nutrient cycle sees nutrients flowing from the rural areas to urban areas and not returning, when sewerage waste is dumped into the sea. This waste contains nitrogen, potash and phosphate which could be used to grow crops (Giradet 2005). There is a huge potential to develop recycling networks in cities to capture and reuse nutrients (Yokohari & Bolthouse 2011). The use of organic waste for compost can also reduce the volume of material heading for land fill (Viljoen et al. 2005). Recycling compost in community gardens leaves much waste on site to be reused with little nutrients lost from the local area and a reduction of fertilisers that are required to grow food. In a urban farm setting, compost could be created on a farm scale entirely from the surrounding residences (Lennartsson 2005). Urban agriculture can reuse some of the wastewater that would otherwise be sent out to the oceans, it can also reuse solid waste in the form of compost (Brown 2002). This enables cities to move towards environmentally sustainable food systems by reusing urban waste and water assisting cities to self-sufficiency (Elliss & Sumberg 1998; Giradet 2005).

By the very nature of urban agriculture being within or adjacent cities it is able to access a more certain water supply in the face of climate change (Sinclair et al. 2004), which is enhanced by the access to more recycled water. Community gardens located within 400m of

any resident is the goal of programs in Detroit and Cleveland (Brown et al. 2008), it will reduce food miles and carbon related emissions. The reuse of green waste and composting will limit the unsustainable nutrient flow from rural areas into the sea.

2.4 Australian Planning

2.4.1 Urban planning past and future

Modern urban planning evolved from the rapid urbanisation of cities during the industrial revolution, the need to improve living conditions and stop the spread of disease (SVY4203 Urban and Regional Planning 2012; Kaiser & Godschalk 1995; Watson 2009). Urban planning was a new revolution with utopian ideas where plans like Howards garden city were developed, which separated land uses and provided open space and brought the country into the city (Watson 2009). Urban planning evolved to grand beautiful city designs as envisaged by Le Corbusier. Cities were highly controlled and regulated, containing efficient wide streets, transport links with connected open space and separation of land uses. The idea of wide boulevards and monuments in many European cities come from Le Corbusier (Watson 2009). Contrary to this, to accommodate growth after the world wars architects like Frank Lloyd Wright in America envisaged spread out cities of less density, wide open space with rapid transport links like the freeway. The next leap forward in planning was the inclusion of the community in creating plans and policies. Planning has given local communities a forum to give their point of view on what was needed and what was wanted in their area (Watson 2009), with the idea that the outcomes would be much better for communities.

Planning laws were based primarily on the zoning system, which originated in Germany and spread across the western world and particularly in Europe (Birch & Silver 2009; Watson 2009). Master plans were used by planners to stipulate the spatial extent of land use, figure 2.11 shows a master plan for Sydney, the Cumberland Plan prepared in 1948. This zoning system is what has regulated land use for nearly 50 years (Kaiser & Godschalk 1995) and is still the basis for most planning. Recently there has been interest in creating new systems to enable planning to adapt to the changing world and meet the requirements of the community into the future (Kaiser & Godschalk 1995; Watson 2009).

Planning needs to adapt to the rapidly urbanising world with a view to reduce the drain on resources and enable the world to adapt to climate change. The need for development control is to ensure public interest, sustainable development (Tang & Tang 1999). Some of this adaption has come in the form of urban containment in cities such as Beijing and Sydney (Long et al. 2011), with the accepted practice of denser more compact cities with walkable neighbourhoods. Another planning innovation is the use of incentives or penalties (Watson 2009), such as in Hong Kong which uses a bonus system is used to reward developers if they meet a minimum lot size. The incentive then allows the developer to create more housing or commercial space if the developer provides a larger re-development, with services such as communal space and off street parking (Tang & Tang 1999).

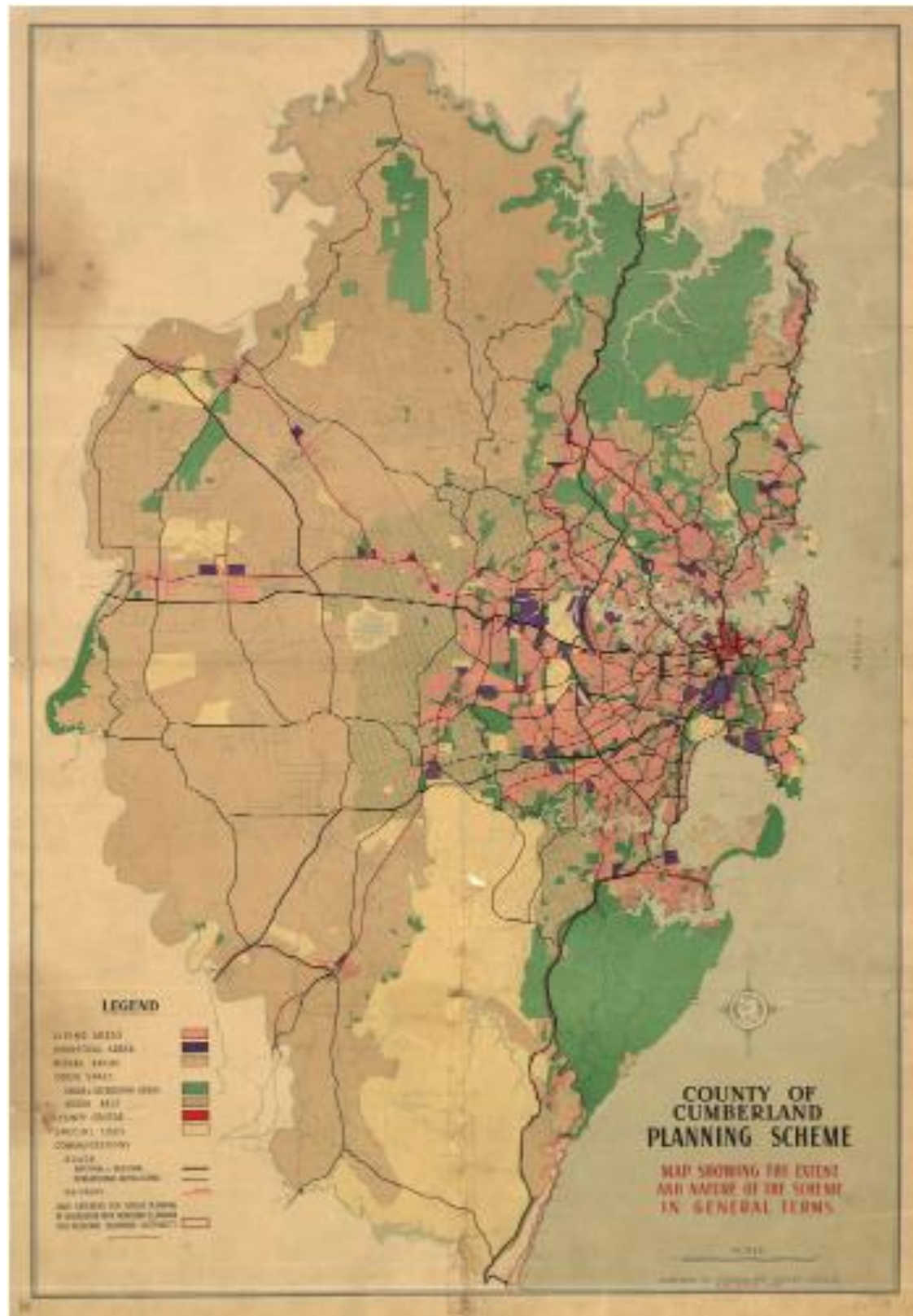


Figure 2.11 County of Cumberland Planning Scheme (County of Cumberland Planning Scheme 1948)

Today planning is changing from more ridged zoning systems to be more flexible and enable innovation to proceed (Watson 2009), some of these plans are verbal (Kaiser & Godschalk 1995). Verbal plans do not have specific zoning, but create a more flexible framework, they contains goals, facts and guidelines suggest how to reach the goals (Kaiser & Godschalk 1995). Planning of areas today increasingly use performance planning. This form of planning regulates the impacts of a particular development, such as noise or pollution, it states the desired levels of noise and pollution that would be acceptable in the development not what type of development is permissible, resulting in innovation and adaption of development to meet community goals (Watson 2009).

The future of planning and planning models is to form a policy framework, which both integrates all levels of planning and enables innovation in developing urban spaces, to deal with the growing challenges and complexity of urban environments. Sydney, for example has seen four regional plans in just twenty years with an increasing concentration on concepts rather than a specific urban footprint and layout (Bunker & Holloway 2002).

2.4.2 Population Trends

The population of the world is expected to grow by 2.3 billion to be 9.3 billion by the year 2050 (UN 2012). This population growth will be mainly in urban areas with urban population expected to rise to 6.3 billion by the year 2050 (UN 2012). Most of the population growth will be in Asian cities (UN 2012). Figure 2.12 shows the growth and decline of urban and rural population. By 2050 67 percent of the world's population will be living in cities (UN 2012).

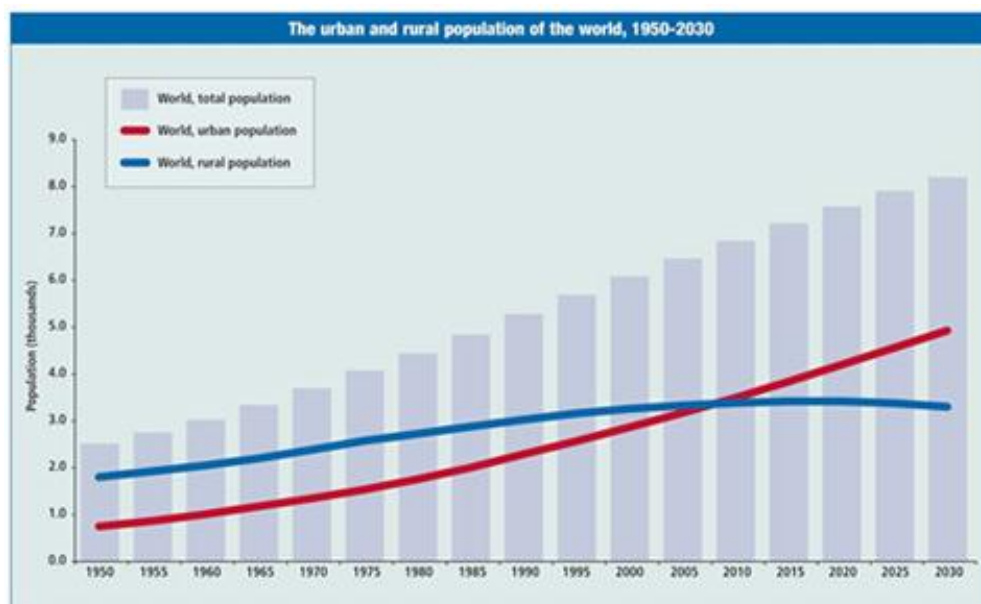


Figure 2.12 World Population Growth 1950-2050 (UN 2012)

Australia is not immune to this population growth and will see its population grow from 22 million in 2011 to between 30 and 40 million in 2056 (ABS 2008). With Queensland's and Western Australia's population expected to double (ABS 2008). In Australia we are going to see an increase in the percentage of the population living in the capital cities from 67 percent to 69 percent of the population in 2056 (ABS 2008). With the total population of capital cities is expected to rise by over 5 million persons by 2056.

The population growth in the year 2011 across Australia was 1.4 percent with most of the increase coming in capital cities and along the east coast (ABS 2012). The capital cities continue to lead in population growth with 224,000 new residents. Population growth in the outer suburbs of Australian cities contributed to two thirds of population growth for the year 2011. Six out of the ten fastest growing regions of Australia were located in the outer suburbs of Melbourne and Perth (ABS 2012). Melbourne's population increased on average 1300 people per week, while Sydney increased by 1100 people per week. The outer suburbs of Sydney contained 35 percent of Sydney's growth in the last twelve months (ABS 2012), while the Whyndam district in Melbourne experienced 8 percent growth over the same period to be the highest in Australia. It is projected that most of the growth in population in Australia over the coming years will be in Perth, Brisbane, Sydney and Melbourne with Perth having the highest growth of 116 percent (ABS 2008).

In 2011 Sydney population reached 4.3 million with a 1.3 percent growth rate over the previous twelve months (ABS 2012). Sydney's metropolitan area is now 63 percent of total state population. Western Sydney accounted for twenty five percent of the population growth in NSW in 2011 (ABS 2012), some of the fastest growing Local Government Areas in Sydney are located in Western Sydney, they are Parramatta, Blacktown, Liverpool and Camden. The projected population of Sydney is expected to reach at least 5.4 million in 2026 (ABS 2008) an increase of 1.1 million persons in fourteen years, equivalent to 80,000 persons per year or about 30,000 homes per year. But households are expected to grow more than the population growth. New South Wales will increase households by 41 percent or 1.08 million households by 2036 (New South Wales Household and Dwelling Projections 2006-2036 2008). Some of the increases in households in NSW are due to the reduction in household sizes, which is projected to be 2.49 in 2036 (New South Wales Household and Dwelling Projections 2006-2036 2008).

2.4.3 Current Planning in Australian Cities

The previous section highlighted the growth that is expected and is occurring in the capital cities of Australia. This section will briefly describe the city wide metropolitan plans which have been created, to facilitate and support the population and housing growth, with special consideration of how it effects or helps agriculture in and around cities.

2.4.3.1 Sydney's Plan

The metropolitan plan for Sydney 2036 is the current regional plan for Sydney. This plan is building on the city of cities concept started in the last regional plan, a second CBD in Parramatta and regional centres located around the city. Sydney 2036 has a goal to build a connected city both internally and with the rest of the world. It promotes the idea of a compact city with increasing densities near existing centres, it restricts new growth to designated growth centres and has a policy of 70 percent urban infill and only 30 percent greenfield development. The metropolitan plan has major goals talking climate change, growing the economy, increasing transport links between centres, and housing the growing population.

The plans vision is highlighted by:

- *“Plan land use, service provision and infrastructure capacity for 770,000 additional homes and 760,000 more jobs by 2036”*
- *“Locate more than 50 per cent of planned employment capacity in Western Sydney “*
- *“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” (Metropolitan Plan for Sydney 2036 2010, p. 14)*

The plan aims to benefit agriculture by limiting the urban footprint, which will help protect agricultural lands adjacent to the city. In a letter to the Sydney Morning Herald it was explained that agriculture lands are important to the city and are being protected by limiting growth to areas where only five percent of land is used for agriculture (Reynolds 2010). In 2011 the NSW government changed hands, as planning is very political so did the vision of limiting new housing to the growth centres. A new policy of owner nominated land rezoning has enabled large portions of land to become potential greenfield housing sites (Review of Potential Housing Sites 2012) additionally the premier of NSW said prior to his election that he favoured 50/50 proportion of infill to greenfield development (Nicholls & Moore 2011). So agriculture on the fringe or in the city is not provided for in the metropolitan plan, the current plan says that agricultural lands should be set apart and due to noise and dust and be treated like industrial land.

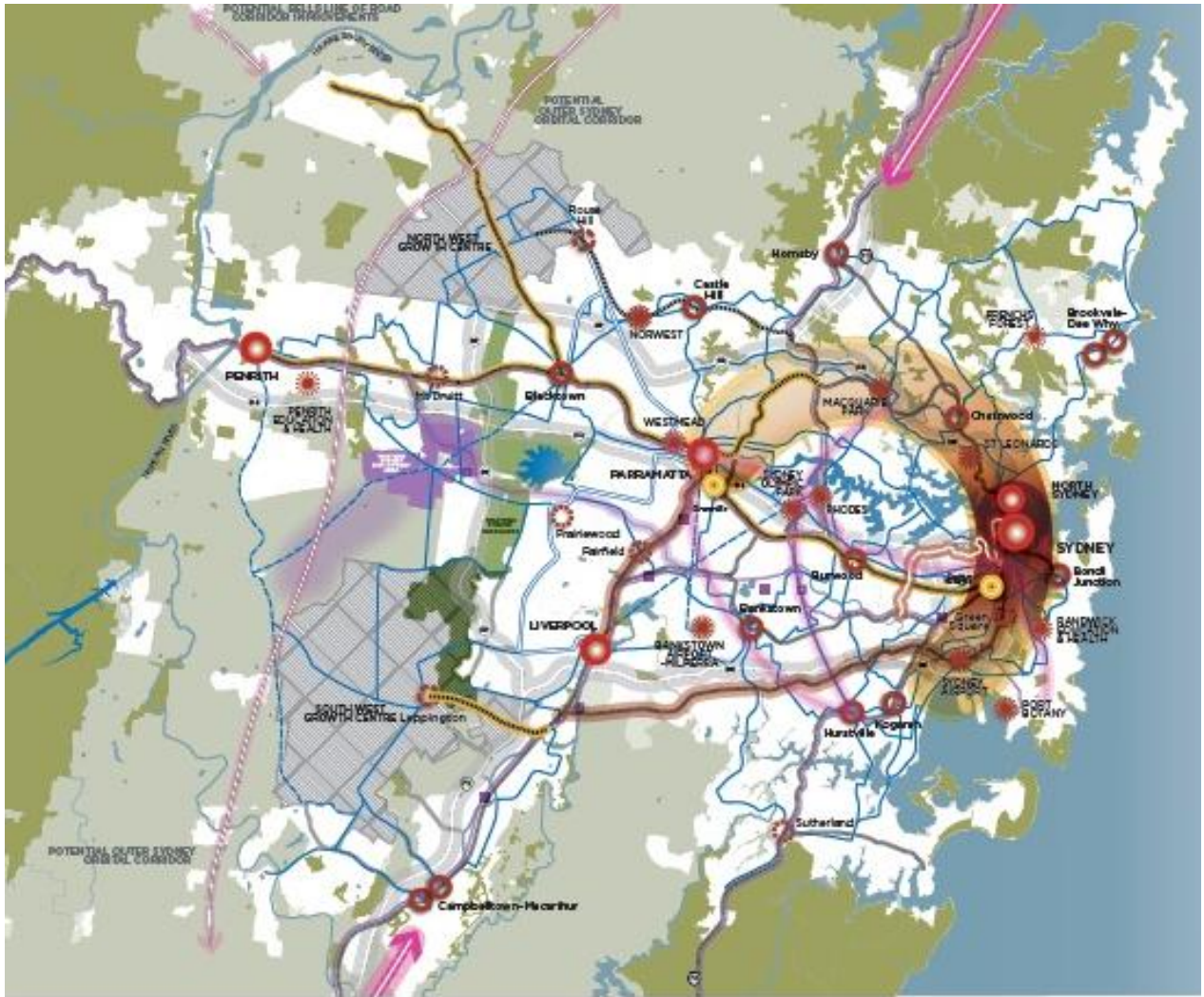


Figure 2.13 Metropolitan Plan for Sydney 2036 (Metropolitan Plan for Sydney 2036 2010)

2.4.3.2 Melbourne's Plan

Melbourne is currently developing a new strategic plan and vision for the development of the city. The strategic plan Melbourne 2030 was released in 2002 and has been updated since by two plans, Melbourne @ 5 million and Delivering Melbourne's Newest Sustainable Communities, both of these plans continue to build on the foundation of Melbourne 2030 and were released in 2009.

Melbourne 2030 plan is similar to Sydney with visions of:

Creating a compact city by setting a limit on growth and establishing an urban growth boundary. This will make Melbourne network of centres and links with regional centres throughout the state. It has the goal of multi centred city with growth across 25 activity centres, building and improving on transport links within the city. Melbourne has a unique

plan to establish a policy for protection of its green wedges to protect amenity, bushland, resource land and the rural character of these areas (Melbourne 2030 2002).

There are twelve green wedges around Melbourne that have developed over time as a consequence of the ribbon development along transport corridors. These wedges are important to Melbourne with land designated to protect agriculture, mining, recreation, cultural heritage, open space, biodiversity and city supporting infrastructure such as airports and sewerage treatment. The green wedges are planned so that, each wedge has policies and planning documents uniquely prepared for each wedge (Green Wedges 2011). What is important is that they provide agricultural opportunities, protected and separated from residential uses (Melbourne 2030: a planning update Melbourne @ 5 million 2009). The South East wedge comes to within 10km of Melbourne's CBD at Kingston, it contains land fragmented by transport and mining activities but agriculture could be developed and fostered more considering its historic past in agriculture, good soils and proximity to market (Green Wedges 2011).

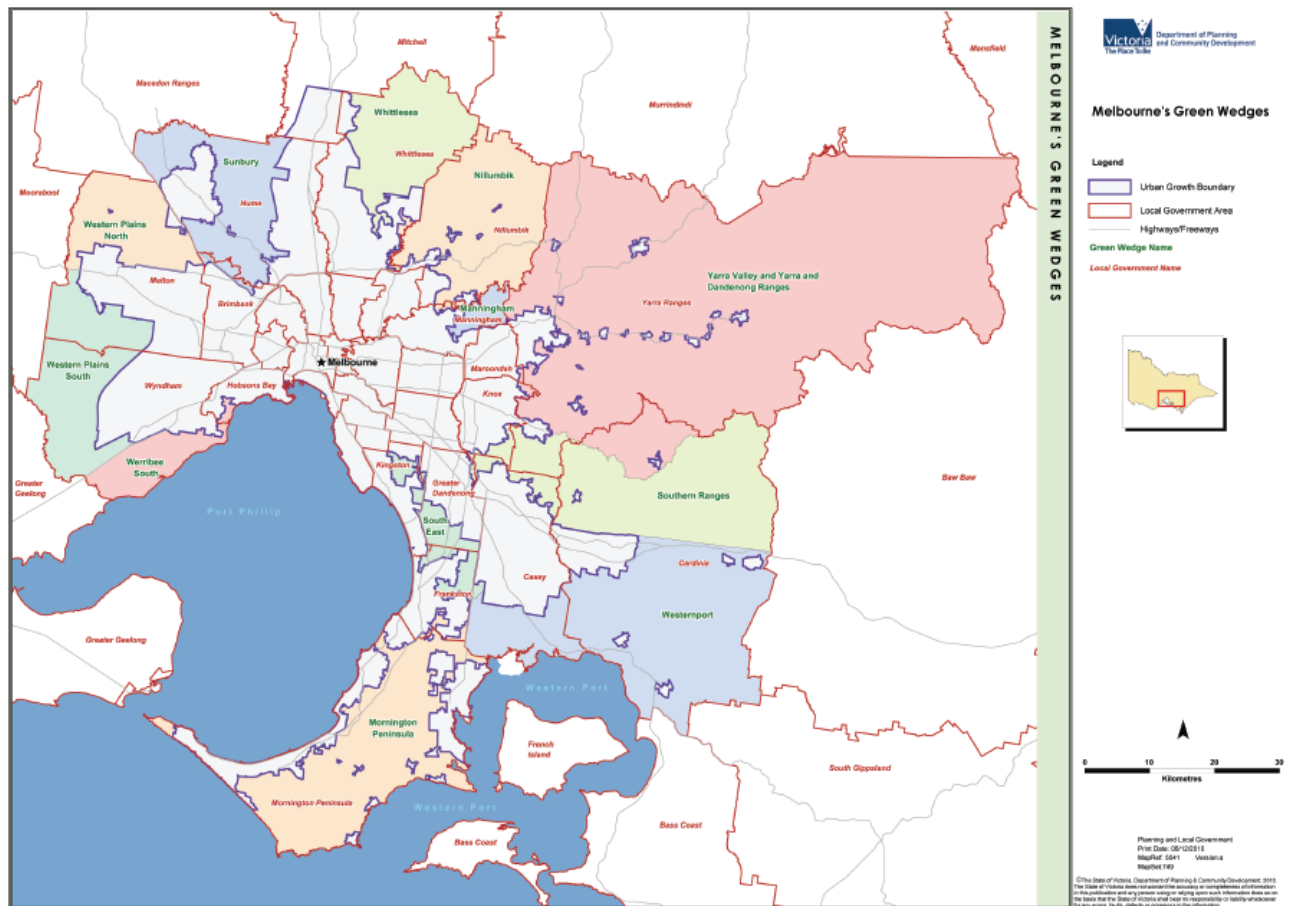


Figure 2.14 Melbourne's Green Wedges (Green Wedges 2011)

The Melbourne 2030 plan was updated by *Melbourne @ 5 million* in 2009 as a consequence of new population projections. Its main aim is to ensure that the city can cope with the expected population growth, by setting into motion the review of the urban growth boundary. This plan refines some of the initial visions of Melbourne 2030. It refines the polycentric city

policy with the creation of six CBD like centres which are connected with efficient public transport, they will create more employment and there will be more compact redevelopment around these centres. Between the centres the transport corridors will feature opportunities to create employment.

One of the major changes in this plan is the movement of the urban growth boundary with 47 percent of new dwellings designated to be within new growth areas on the fringes of the city. Some of these movements are into the green wedge areas and are contrary to the policy in Melbourne 2030 but are deemed necessary to help cope with the projected population increases.

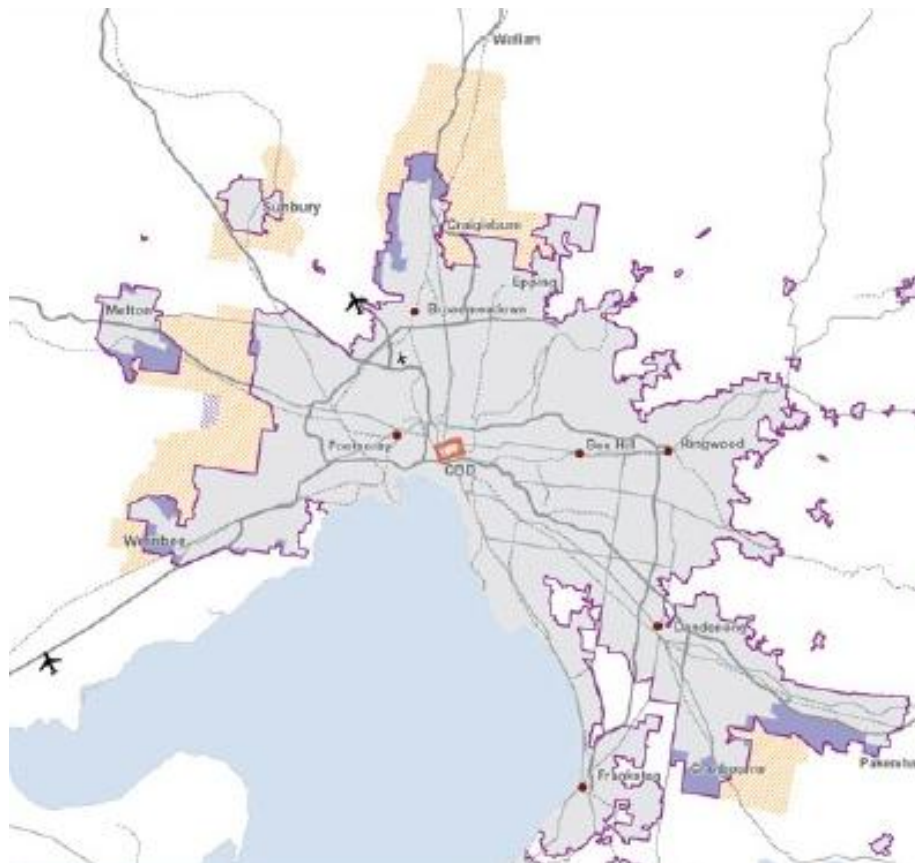


Figure 2.15 Melbourne's Urban growth boundaries and new growth areas (Delivering Melbournes newest sustainable communities 2009).

The latest update of the strategic plan for Melbourne is *Delivering Melbourne's Newest Sustainable Communities*. This plan coincides with *Melbourne @ 5 million* and changes the urban growth boundary, reserves land for a ring road and sets aside some grassland reserves in the west of the city. It highlights the requirement for planners to find an area to accommodate 600,000 new dwellings but wants to do it in a sustainable way by creating sustainable communities, maintaining affordability and ensuring the co-ordinated delivery of infrastructure to new communities. It sets goals to have employment and transport links to the

newest communities to ensure they are connected and in accord with the goal of compact walkable neighbourhoods in new communities. This policy also protects and enhances the green wedges policy and ensures that they are not impacted by the new growth areas (Delivering Melbourne's newest sustainable communities 2009).

2.4.3.3 South East Queensland Plan

In Queensland as a result of the current population projections, one million extra people will be living in the region by 2031. The region needed to have an overall policy to streamline the development process and coordinate between different local governments. The South East Queensland (SEQ) regional plan was created in 2009 with a vision of how the region will adapt and change in the coming twenty years. The plan is a move towards sustainable development with a vision of a region with a diverse range of living options with interconnected communities by efficient public transport and open spaces between the urban living areas.

The land is divided into rural living, urban land, regional landscape and rural production as shown in figure 2.16. The region will become more sustainable by containing the urban footprint, reducing car dependency, using a more compact form in the urban design of new areas. The plan will increase density and provide opportunities for mixed use development. The plan has similar ideas of multiple centres connected with good public transport network. It provides areas in the west and south west corridors for urban expansion and it consolidates growth into these areas to enable efficient infrastructure delivery. The plan intends to protect the inter-urban breaks with the intention that this land will cater for multiple uses including agriculture, recreation and heritage retention.

The inter-urban breaks are part of the regional landscape and rural productive land (RLRPA) which covers eighty five percent of the land in the plan. These lands are identified as non-urban lands with attributes that need protecting such as biodiversity, koala habitat, good quality agricultural land, water catchments and storages. It is intended to be able to maintain the existing land uses and rights and limit rural lifestyle living and development to the immediate edge of existing villages and towns.

The plan has a policy of: *“Plan, design and manage development, infrastructure and activities to protect, manage and enhance regional landscape values”* (South East Queensland Regional Plan 2009-2031 2009, p. 56).

The RLRPA land is also considered as having the potential to act as an ecological offset for development in areas with remnant vegetation of high fragmentation.

Rural industries are recognized in the SEQ regional plan, they are important to both the economy and sustainability of the region. The plan sees that the most effective way to retain agriculture is to stop further land fragmentation which would make rural holdings less viable into the future. The plan attempts to restrict development to existing towns and villages. The

plan looks to improve infrastructure for farming in the rural areas and protect farmland from conflict with rural lifestyle properties. A process to identify agricultural precincts is part of the way that Local Government is protecting and enhancing this type of land use (South East Queensland Regional Plan 2009-2031 2009).

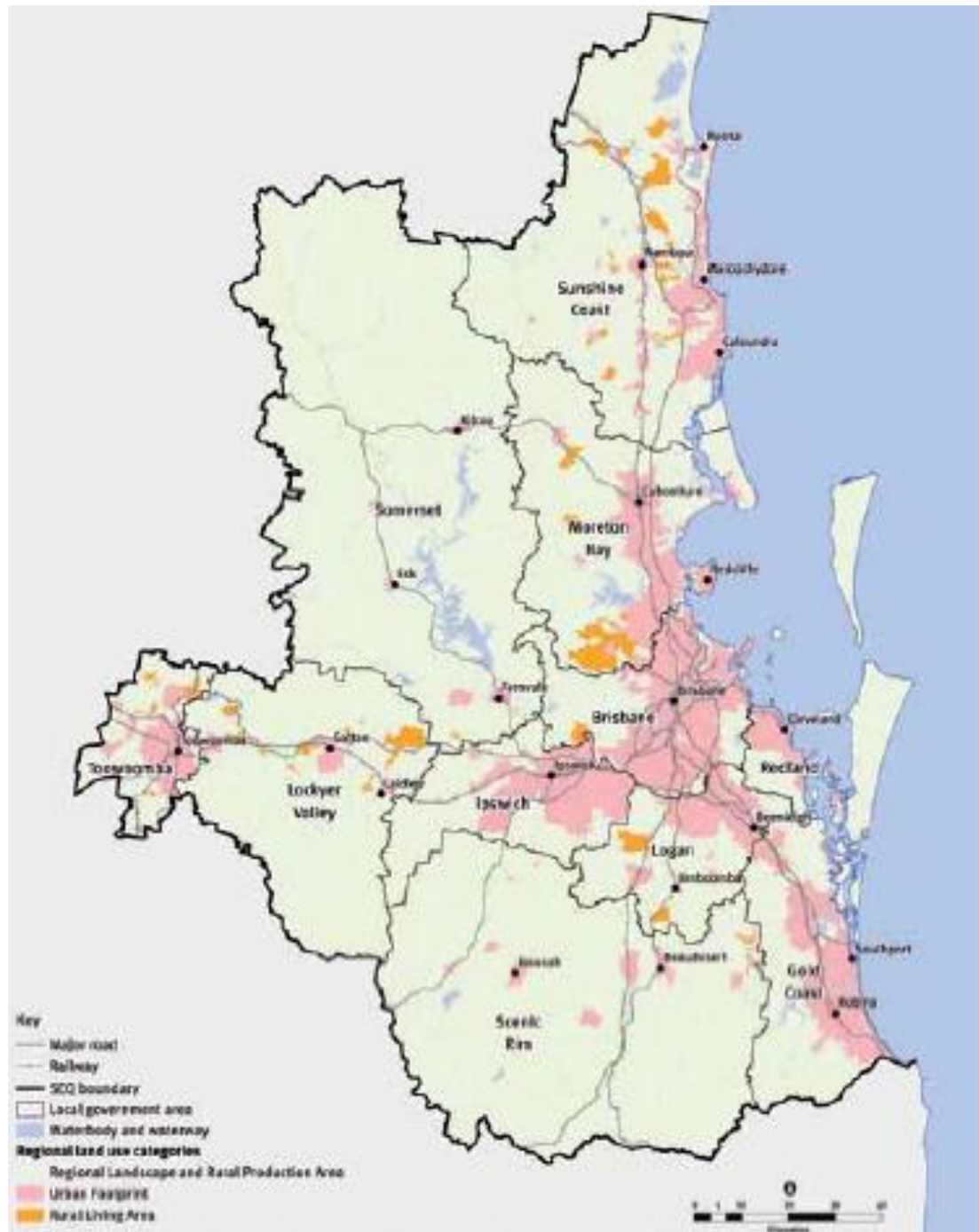


Figure 2.16 South East Queensland land use as depicted in the SEQ regional plan (South East Queensland Regional Plan 2009-2031 2009)

2.4.3.4 Perth's Plan

Perth's metropolitan area is one of the fastest growing cities in Australia (ABS 2012) the population is expected to rise to 2.4 million by 2030 (ABS 2008). To help deal with the expected increase in population in an orderly and sustainable way, the Western Australian Government has developed a metropolitan plan, Directions 2031 and beyond.

This plan vision is by 2031:

“Perth and Peel people will have created a world class liveable city; green, vibrant, more compact and accessible with a unique sense of place” (Directions 2031 and beyond 2010, p. 21).

The regional plan is achieving this through design of a compact connected city of activity centres, which will be based on transit oriented development. The plan uses a framework which is intended to guide the preparation of structure plans and zoning by local government. Directions 2031 and beyond has been used to set up the framework and guidelines for beyond 2031 by setting into motion the use of scenarios to monitor the progress and further enhancement of planning for Perth.

The activity centres will be connected by public transport corridors which will encourage the integration of land use and transport facilities; figure 2.17 shows the overall structure of activity centres in the plan. Transit oriented development will have higher residential densities within a walkable radius of transit stops, increased employment and amenity of the activity centres at these transit nodes. The redevelopment and enhancement of the activity centres is planned to increase the amount of people living in the inner regions of Perth and relieve some of the development pressure on the outer fringes of Perth.

The plan will create two sub regional plans to help develop Perth. Split into inner and middle Perth, which will concentrate on infill development and strengthening the existing centres to encourage more activity. The outer Perth sub regional plan will be concentrating on the orderly release and rezoning of land for urban development.

Directions 2031 allows for 47 percent of the new housing to be in growth areas on the fringe of the city. The projections of population show that there will be a need for at least 400,000 new households by 2031, which equates to about 11,000 new households per year in the urban fringe of Perth. These new greenfield areas will be developed in a compact urban form consisting of walkable neighbourhoods to reduce the trips and length of motor vehicle trips. Directions 2031 and beyond created an urban expansion management program, the Urban Development Program (UDP) which will ensure that there is an appropriate level of land available for development, to ensure housing affordability. The program will enable land to be rezoned for urban development in stages with land in the pipeline for up to 10 years. This is intended to give agricultural business some certainty and allow for investment in the agricultural sector.

The plan does not specifically protect or recognize the importance of agriculture in and around Perth. But the plan does allow for the protection of some areas of traditional heritage, such as the Swan valley with its long history of agriculture. One potential positive for urban agriculture is that the plan builds on the network of open space that exists in Perth. It is designed to protect biodiversity and the natural resources of the region, this may enable agriculture to be implemented into these regions similar to the Green Wedges policy of Melbourne (Directions 2031 and beyond 2010).

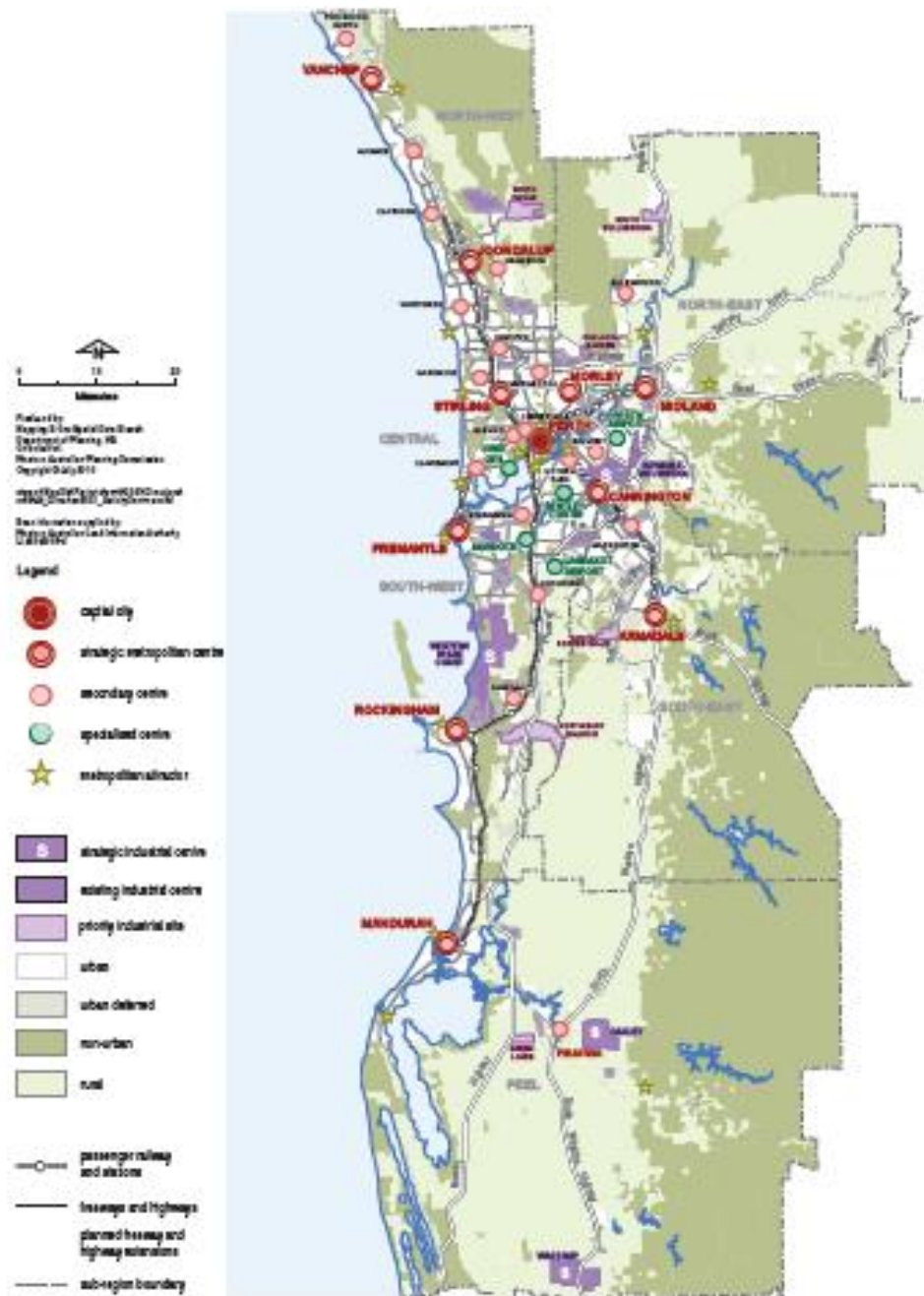


Figure 2.17 Directions 2031 and Beyond The centre of the planning of Perth is the transport networks and corridors (Directions 2031 and beyond 2010)

2.5 Conclusion

The literature review has provided evidence that the global population is rising and is becoming increasingly urban. The review outlined the further challenges of climate change, adaption to a carbon constrained economy and a drive for more sustainable living. This will lead to the benefits of agriculture and food security from urban and urban fringe farming to come more to the fore of public awareness and policy. The benefits of agriculture in and around cities have been discussed in detail in the literature and there is evidence that it could be a way for the world to meet some of the challenges ahead. Planning can be an integral part of that process by developing ideas and policies to allow for the integration of agriculture into urban landscapes.

In Australia, a highly urbanised and wealthy country we have had only limited success with preparing our cities for UPA. The planning for the major capital cities, the fastest growing urban centres in Australia, with 5 million new residents over the next twenty years have not allowed for agriculture to be an integral part of the landscape, relying on containing the urban footprint to enable agriculture to exist on the fringe. But there is potential for agriculture in Australian cities, beyond just the fringe. Most city regional plans have allowed for open space to be part of the urban landscape with the green wedges of Melbourne, the inter urban spaces of Brisbane and the network of open space in both Sydney and Perth. These regions have a huge potential for urban agriculture while not impacting on the amenity of the urban landscapes or potentially affecting housing supply and affordability.

The regional planning of all major Australian capital cities are pointing towards more compact and denser urban development with a network of connected places and limiting of growth to certain areas. The question of how will Australian cities move to be more sustainable while expanding ever further into the peri-urban area still remains. The literature points towards utilising agriculture to improve the sustainability of cities. The next chapter will define the sustainable advantages to cities for implementing or retaining agriculture on the fringes and within cities.

3.0 SUSTAINABLE BENEFITS TO CITIES FROM URBAN AGRICULTURE

3.0 Introduction

This section will analyse the benefits of UA, before it can be discussed the reader should be reminded of what UA represents. The definition of UA from the review of literature: *“agriculture in and around cities including the distribution of food in local networks”*. To further define UA the following considerations should be made. The local nature of UA is the cornerstone of the sustainable benefits of this form of food production and therefore UA is considered local, in both production and consumption of food. UA in new urban settings should be more organic in nature and rely on fewer inputs from external areas. UA in an urban setting is further defined by the compatibility of farming and living in one spatial location. For UA to be more compatible within an urban setting the intensive animal keeping and broad acre farming which is based on industrial style production, is not and should not be considered in a urban setting and should be excluded from this definition of UA.

UA is not a replacement for industrial scale food production and there will always be a need for large scale food production. The projected growth of the world’s population and its continued urbanisation means that food will need to be produced in an ever increasing volume to feed city dwellers. UA should however be seen as an important step towards a more sustainable system of food production.

The sustainable advantages to cities of UA are threefold, economic, environmental and social. The following sections will discuss these advantages in detail and in addition to the analysis of the literature it will draw on examples from across the globe where UA is practiced.

3.1 Economic benefits

The first sustainable benefits to be discussed are the economic advantages from urban agricultural activity in cities. The economic advantage of agriculture has traditionally been seen as the creation of wealth. This advantage has witnessed a large change in the dynamics and techniques for agriculture. Today agriculture is based on a globalised system of food production where competition is fierce. This competition has evolved agriculture into a highly industrialised and specialised system, driven by the open market and dominated by supermarkets and large agro-food business. On pure economics alone UA cannot compete against large industrial scale food systems. Therefore the economic advantage of UA is not in the creation of wealth on a global scale but must be considered over the longer term for the whole of society.

Employment in UA is one of the sustainable benefits to cities, local food production requires a more intensive form of production and distribution, it requires more farmers. The farms are smaller and more intensive than the industrial scale farms typical of today. Due to the small size and the spatial location close to and inside city areas, there is a readily available workforce in close proximity to urban farming. Some of this workforce, in the increasingly urbanised society have come from an agricultural background and have the technical skills required in UA. Traditionally, in Australia the new migrant workers have provided the workforce for market garden and fresh food production on the fringes of our cities. Originally it was the Chinese in the 19th century who used their skills on the fringes of cities, then Italian then Lebanese, Vietnamese. Today they are coming from countries like Iraq and Afghanistan. Jeffs (2009) found in a study that eleven percent of the agricultural workforce of NSW was employed in the Sydney urban and peri-urban areas which can be equated to 33,000 jobs nationally in 2011.

For UA to be sustainable the income of a city farmer needs to be high enough to sustain an acceptable lifestyle. The city farmers' income from the organic style of farming returns a higher level of income to the farmer by retaining a higher share of profit. Generally the prices in the community are lower due to the reduction of transportation and refrigeration costs. The local food distribution and direct marketing opportunities allow the farmer to interact and develop relationships with the consumer. This relationship after some time allows for an increase in understanding of what the consumer will be prepared to pay, for good quality fresh food. This in turn increases the economic return to the city farmer.

One sustainable economic benefit that can be directly attributed to local food production, and distribution, is the increase of wealth distributed throughout the local community. The multiplier effect of any money spent in the local community is fourfold as it filters through the entire community. This is in contrast to the current system of globalised food production where money spent in local communities may be exported, in some circumstances not only outside the local economy but sometimes out of Australia.

In contrast to sustainable economic benefits, UA could be seen as a catalyst to the reduction of the global food basket and industrial sized agricultural production as is typical today. With the world population expected to rise to nine billion by 2050 the introduction of UA will augment this global production enabling mankind to reach the goal of feeding the world.

The following tables are indicative of the economic value of UPA production of the mainland capital cities of Australia. The total value of agricultural production as estimated by the ABS is in excess of three billion dollars for the 2009/10 financial year. The figures could well be understated as it is limited to the statistical divisions of the capital cities which in some cases are much smaller than the peri-urban areas defined by Huston (2005).

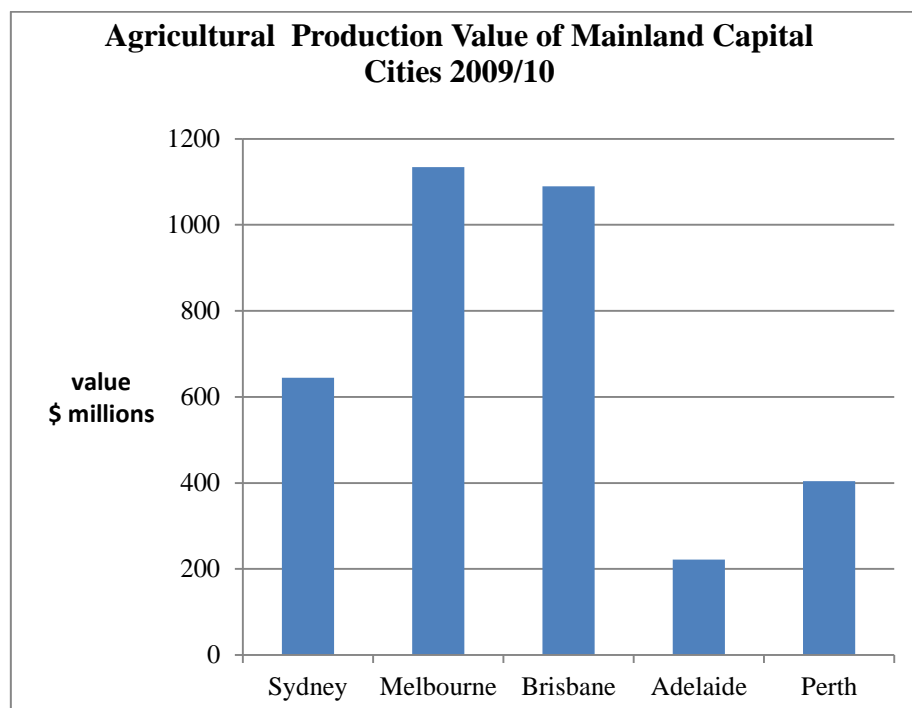


Figure 3.1 Agricultural production value of mainland capital cities compiled from ABS data for 2009/10 financial year.

Figure 3.2 shows that the urban production of mushrooms contributes a high percentage of the state's total production of mushrooms in the mainland capital cities. The peri-urban production of tomatoes is also high, with Sydney 35 percent, Adelaide 65 percent and Perth 72 percent. The overall production of vegetables as shown in figure 3.3 shows that between 24 to 37 percent of the state's total production is grown in, or adjacent to, the mainland capital cities of Australia. This high percentage of the state production of fresh vegetables is evidence that even without any planning intervention production of food is a viable economic concern on the urban fringe of cities. The displacement of such agricultural pursuits by continued pressures, as discussed in Chapter Two, should be considered when planning any urban growth into these fringe areas of the cities.

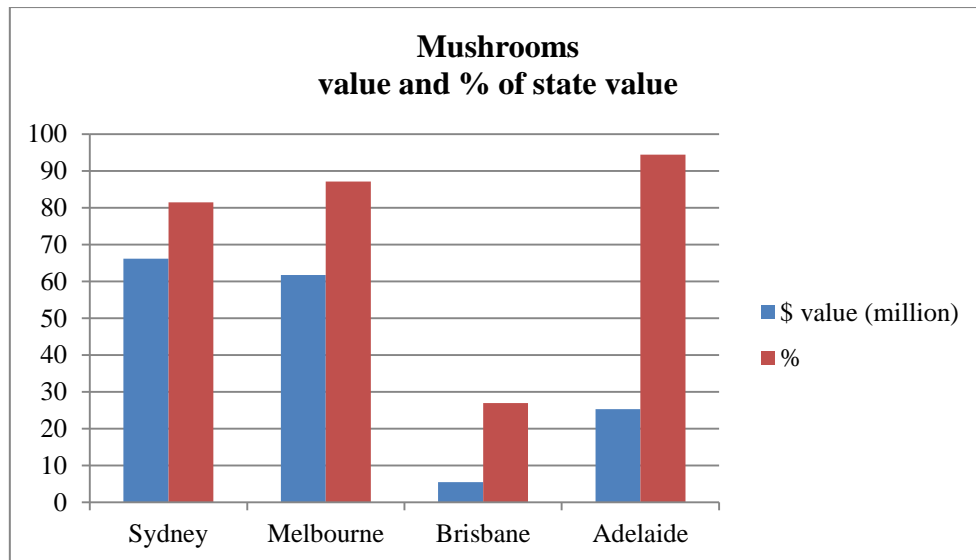


Figure 3.2 Agricultural production value and percentage of state production of Mushrooms 2009/10

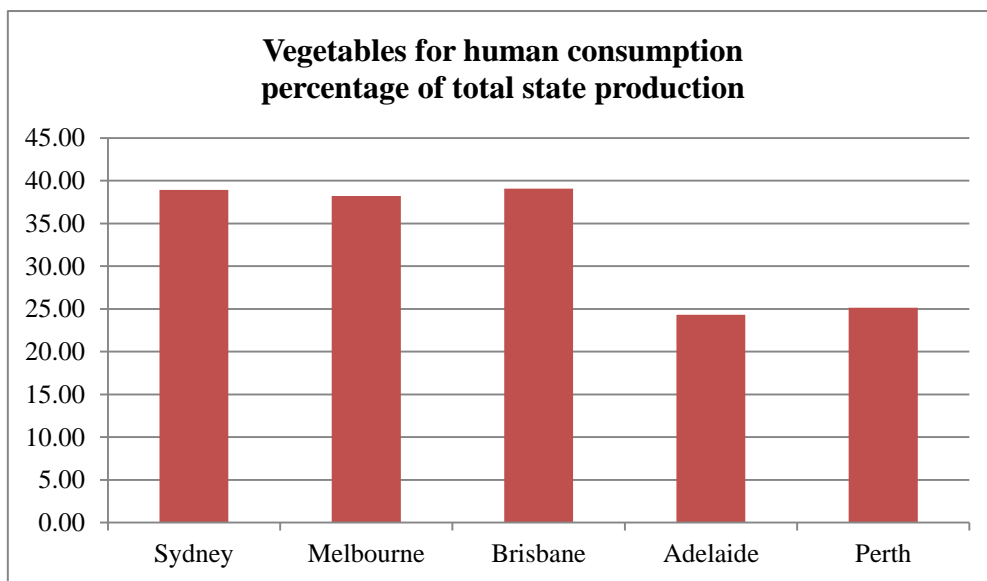


Figure 3.3 Vegetable production value as a percentage of state production 2009/10

In addition to vegetables, the peri-urban areas of Australia are used extensively for other agricultural pursuits such as production of eggs as shown in figure 3.4 where some cities contribute up to 35 percent of the production of the whole state. Meat poultry is also produced widely in these regions with it contributing about \$800 million dollars, with Melbourne producing up of 64 percent of the overall state production. The cut flower and turf industry is another significant agricultural pursuit in peri-urban regions and figure 3.5 illustrates that this important industry is dominated by the urban fringe around Australian capital cities.

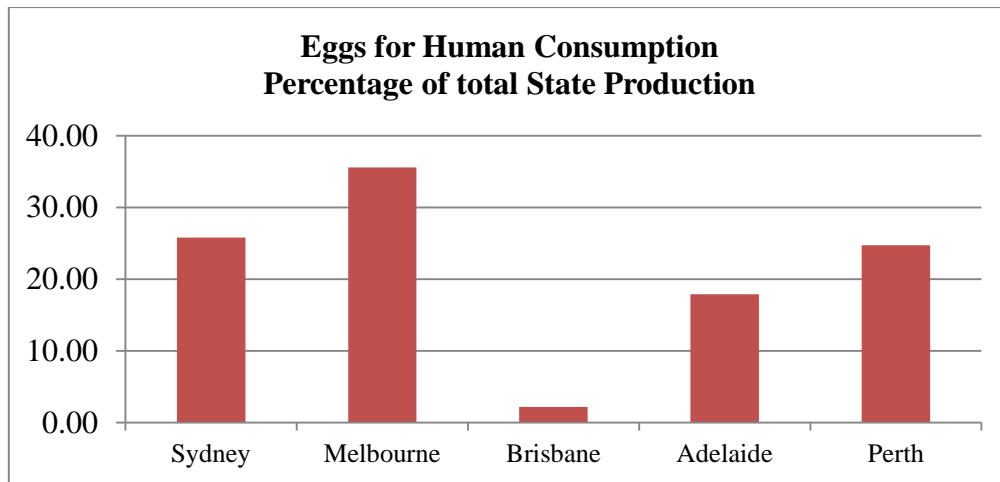


Figure 3.4 Egg production value as a percentage of state production 2009/10

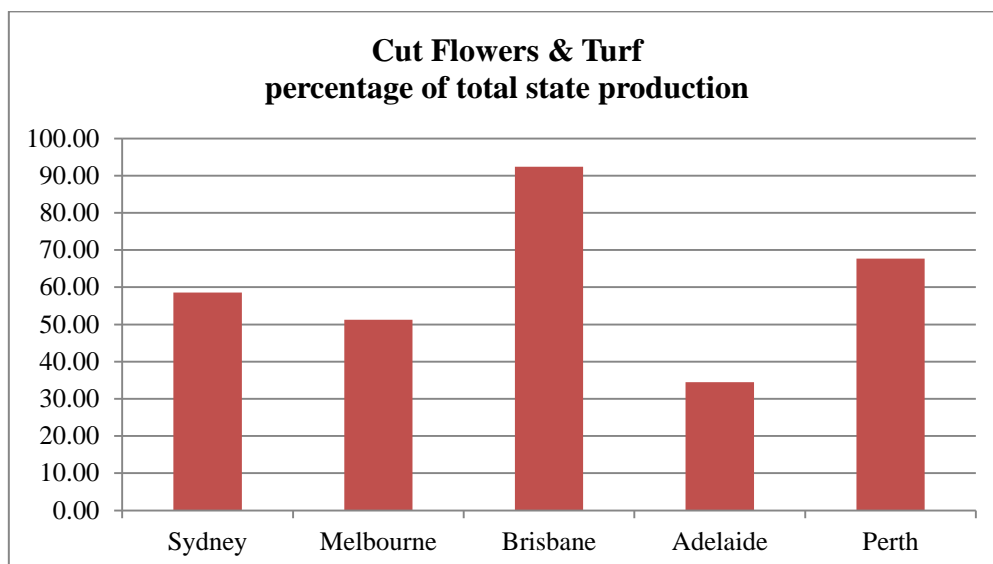


Figure 3.5 Cut Flowers & Turf production value as a percentage of state production 2009/10

3.2 Environmental benefits

As the environmental benefits are difficult to quantify and may not be directly attributed to UA, this section will discuss the benefits which can be attributed to cities in reaching the goal of sustainability. The first and most obvious benefit from local food production and distribution is the reduction of carbon emissions and limitation of the use of oil in producing food. A current example that shows how this goal is reasonable is the efforts by the Cuban government (Viljoen & Howe 2005a), and in particular the capital city of Havana. After the fall of the communist block Cuba lost most of its economic markets for its exports such as sugar. A total of 75 percent of all export and import markets were lost. As a direct result, the government could not import food, oil and fertilizers to feed, or grow the food required for the country. Part of the governments' solution was to introduce an alternative agriculture policy. In this policy, large farms were restructured into smaller farms, and the general population was encouraged to grow food on any spare land or open space within the city. The goal was to develop more labour intensive and less mechanical farms. The result was a food production system with low external inputs in and around Cuban cities resulting in more sustainable outcomes. Less oil, fertilizers and transport is used in the production and distribution of food in Cuba. As a result the food produced is small scale organic production with higher yields and greater nutrition than what was produced prior to the crisis (Simovic & Taboulchanas 2000; Viljoen & Howe 2005a).

Food miles represent the distance food travels from production to consumption (Paxton 2005). Any reduction of the food miles will have dramatic environmental benefits (Paxton 2005; Viljoen et al. 2005). There has been some investigation of the current system of food distribution which utilises the global food basket. This practice has been highlighted as a major contributor to food miles. The expectation of the community that they can purchase any food type at any time or season has led to the complex system of global production and a major increase of food miles. Supermarkets have long and large distribution networks, designed to reduce costs for the supermarket. In the process, food is packaged, stored and distributed for ever increasing periods of time (Giradet 2005). The environmental impact is the increase of carbon emissions during these processes and increased landfill from excess packaging. Additionally, the carbon emissions from the shopper travelling, usually by motorcar, to central supermarkets add to the food miles (Paxton 2005). The introduction of locally produced and distributed food decreases the distance food travels, reduces storage times and the packaging required to maintain freshness. The importance of the local geographical context of UA is the major contributor to the environmental benefit through the reduction of emissions coupled with the promotion of organic sustainable practices.

The modern urban environment has little regard for the waste that is produced. It is an increasing problem that urban living produces large amounts of waste that needs to be disposed of in landfill (Giradet 2005). Additionally, the human waste created in urban environments is increasing along with the growing urban population. The author believes that a further environmental benefit of UA is the ability it has to reuse some of these wastes and reduce the amount of packaging waste that needs to be disposed of through landfill. There are

some examples today where water recycling networks are used to provide reliable and cheap recycled water for industry and households. Technology is available for modern recycling plants to be reduced in size and to supply small specific areas with recycled water (*The Water factory* 2011). UA also has the capacity to reuse the organic waste from households (Brown 2002; Viljoen et al. 2005). This waste is collected and transformed to organic fertilizer, reducing the need for importing fertilizers and reducing landfill. Examples of this system are currently being used to provide organic topsoil for council use on playing fields in Western Sydney (Council 2012).



Figure 3.6 Penrith city council three bin service and organic compost created from the organics bin and reused on sporting fields (Council 2012)



Figure 3.7 Greygums Oval Cranebrook, after and during organic compost application (Nearmap 2012)

The nutrient cycle of traditional industrial scale agriculture consists of importation of fertilizer, and pesticides. The organic process draws these nutrients in the fertilizer into the food. This food is then transported to the city and the nutrients are consumed and used by the residents of cities. Waste nutrients are then transported to the sea through the sewer (Giradet 2005). UA in contrast has the ability to retain a percentage of nutrients in a cycle, reduces the

import and export of nutrients to the city. The sustainability of a potentially closed loop system to cities is then available to cities which can encourage UA and local food production.

3.3 Social Benefits

The third section on the benefits of UA is the social benefits. These benefits may not seem important, but the author believes that if cities are to move to be more sustainable into the future, the sustainability of the social systems within these cities is just as important as the economics or environmental considerations.

Urban Agriculture could be considered to have originated in the Third World from the concern for food security for the general population (Brown 2002). Food and access to food is a basic necessity for life. The security of food on an international, national or local scale is an important social consideration. Many migrants, low income workers and socially isolated members of the community face real food security issues every day (Mason & Knowd 2010) . The implementation of UA into cities enables these groups, in particular, to have access to fresh, nutritious food every day. The use of community gardens and ‘backyard’ growing of food gives the socially disadvantaged access to a reliable food source (*Reimagining Cleveland* 2012; Brown et al. 2008). One of the best example of a reaction to food insecurity still is the food grown in cities during World War Two. The United Kingdom saw the increase of allotment gardens triple in four years during this time. It guaranteed residents a certain supply of food and reduced the need to import food during German U-Boat blockades of the country (Howard 2012).

A second social benefit from UA could be considered as both a social and economic advantage. Many health benefits are providing by secure access to fresh food, as opposed to the highly processed food, typical of the modern supermarket chains. The benefits from eating a healthy diet of fresh foods, high in nutrients is essential for continued good health and wellbeing. Various studies of food consumption in Victoria have shown that only 10 percent of the population consume the recommended dietary intake of fresh fruit and vegetables. The introduction of UA into urban environments will increase the visibility of fresh food production. It also allows access to these fresh foods through local food distribution, decreasing reliance on fast and highly processed food. It could be suggested that the added social benefit of UA would be the reduction to society of health costs.

The social cohesion of urban communities can be increased by the introduction of UA into cities, especially when it coincides with community gardening. Community gardens have been shown to provide places for interaction of residents and enable understanding and cooperation between diverse community members (Brown et al. 2008). Examples exist in modern urban environments, of community building, such as in Detroit (Harris 2012) and Cleveland (*Reimagining Cleveland* 2012) where UA is being used to rebuild the community in declining urban spaces. It has been found that community gardens build a sense of place, ownership and pride, and has been shown to decrease and prevent crime (Brown et al. 2008). All this builds a more sustainable community from the simple introduction of UA.

3.3 Conclusion

The triple advantage to sustainability of cities with UA outlined in the previous sections have been discussed and developed and generally agreed upon in the current available literature. Planning for Australian cities is adapting to include sustainability as a major goal. The combination of the sustainable benefits of UA and cities striving to reach sustainability goals should not be ignored. In the review of literature, specific planning for UA has generally not been addressed in Australia and has been marginally addressed overseas. But there are initiatives by governments both overseas and in Australia which need to be explored.

The next step in this project and indeed planning for sustainable cities is to encourage UA in many different forms into and around cities. The question for the following parts of the research is how to plan for the projected growth of Australian cities and maintain the ultimate sustainable goals. The answer may be in providing UA into cities of the future. The next chapter will discuss the various options that have been attempted. It will discuss the applications of continuous productive landscapes, precincts of agriculture, community engagement, agro-tourism and other policies from the literature review to see what options will suit Australian cities of the future.

4.0 Techniques Supporting Urban Agriculture

The previous chapter described the sustainable value of urban agriculture which has been extensively discussed in overseas literature and implemented into cities. This section will explore and discuss different tools and applications which support urban agriculture in cities. It will also discuss if these techniques and tools can be applied or can be actively utilised in the Australian capital cities which will be facing the largest population increase in the coming years.

4.1 Alternative Food networks

Alternative food networks (AFN) are described as a network of food production and distribution, that is not the current conventional form of farming on an industrial and global scale (Jarosz 2008). AFN can consist, but is not limited to, community farms, farmers markets and community supported agriculture (CSA). AFN have shorter supply lines and are generally considered organic and environmentally sustainable (Tregear 2011). These networks have risen from gentrification of the urban fringe (Jarosz 2008), the increase of wealth of residents (Tregear 2011) and recent food quality scares (Higgins et al. 2008). AFN are built on the basis of quality, local food, the natural environment and are part of the sustainable farming movement in North America and Europe (Higgins et al. 2008).

The localisation of the food supply is widely acknowledged as a sustainable goal for cities across the world (Jarosz 2008). It has sustainable benefits with a strong connection between social justice and environmental sustainability. These local food systems also enable the maintenance of rural livelihoods in places like Europe (DuPuis & Goodman 2005). Local food protects cultural heritage, helps combat food globalisation and restrict food miles (Higgins et al. 2008; Tregear 2011). With the re-localising of food, the focus is on developing relationships between farmers and consumers (Higgins et al. 2008). In the recent literature on AFN it has been argued that local food can be seen to be used by some to gain economic advantage and entrench social disadvantage by restricting development (DuPuis & Goodman 2005).

These AFN are described as ‘face to face’ where products are purchased directly from the farmer in stalls, farmers markets, food co-ops, pick your own (Higgins et al. 2008). The community garden networks are considered as part of the alternate networks of food production. Food is produced organically, travels less and marketed directly, allowing the farmers to keep more of the proceeds of sales. AFN also use less fossil fuels and expend less money to distributors (Jarosz 2008). The growth of demand for organic and fresh food can be seen from the growth in growers or farmers markets across the world and in Australia.

In Australia, there has been an increase of farmers markets (see fig 3.1), their frequency and the number of stall holders (Australian food statistics 2010-11 2012). Today seven percent of fresh food in Australia is being produced and distributed through alternative methods, including farmers markets and food co-ops (Australian food statistics 2010-11 2012). In

Victoria alone there are 70 farmers markets held regularly across urban and rural areas (Carey, Rachel et al. 2011). In Sydney, there are 11 markets currently held across the metropolitan area (Australian farmers market association 2012).

State			Vic	NSW	WA	Qld	SA	Tas	ACT	NT	Total
Number of farmers markets	Year	2004	22	28	5	8	4	3	0	N/A	70
	Year	2011	68	43	13	12	9	5	2	N/A	152

Figure 4.1 Growth of Farmers Markets in Australia (Australian food statistics 2010-11 2012)

In a study of beef producers in the Gippsland region of Victoria, it was found that farmers were embracing AFN through environmental management strategies which enabled better control over what they produced, what was paid and who purchased the product. This control enabled the farmers to respond to different consumer demands more easily. Interaction with the buyers enabled them to ask for higher prices. They are also able to avoid the environmental, social and economic costs associated with conventional systems of distribution (Higgins et al. 2008).

Urban agriculture is uniquely situated to take advantage of AFN developing in Australian cities. These urban and peri-urban farmers can be economically better off by retaining a higher profit share. Urban consumers benefit from fresher and healthier food with wider community benefits such as employment and increased income. The Australian environment will benefit from reduced food miles, less emissions and more sustainable farming practices. Social benefits for residents of Australian cities will be a better understanding between farmer and consumer and more community harmony and involvement. Figure 3.2 shows the results of survey of farmers market managers in 2011 highlighting the benefits of farmers markets which are considered important to the users of these markets.

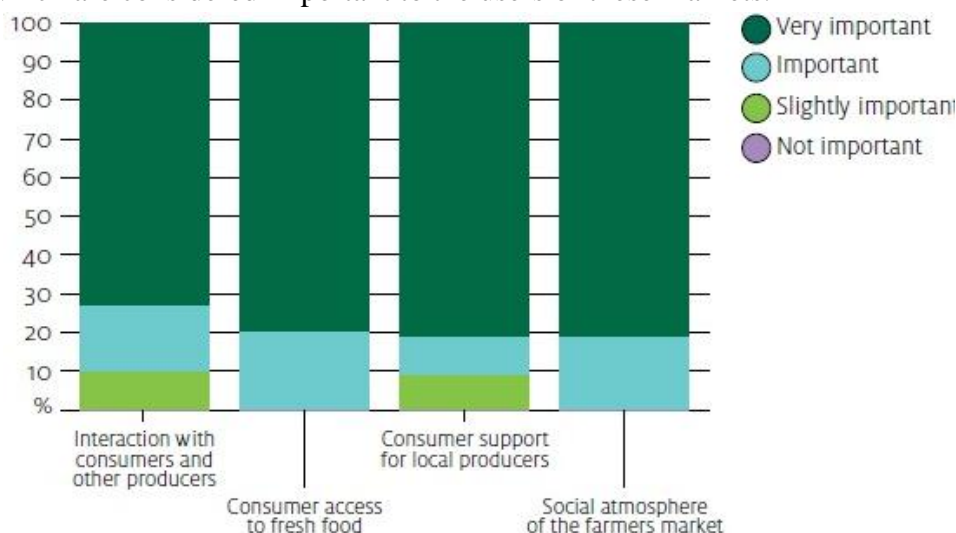


Figure 4.2 Farmers market managers social benefits (Australian food statistics 2010-11 2012)

4.2 Purchase Development Rights

Each parcel of land has many rights associated to it, such as mineral rights, rights for air and water and the right to develop the land to its best possible use. It has become popular in the United States of America and other countries around the world to sell part of the rights of the landowner for economic reward. In Australia, the mineral rights owned by the Crown are sold to various mining and exploration companies for a fee and royalties upon extraction of the mineral wealth.

A purchase of development rights (PDR) is similar, in that the right to further develop the land by an owner is sold to a third party, usually a government body or fund. In return for the purchasing of these rights, a covenant or restriction is placed on the title of the land to restrict any development on the land for either perpetuity or the time limited in the agreement (Crompton 2009; Daniels 1991; Daubenmire & Blaine ; Sinclair et al. 2004). The restriction enables land to remain as agricultural land or be converted into open space into the future but will not allow subdivision for urban housing. The program is voluntary and the land owner has a right to negotiate a better price or refuse to sell the development rights.

The advantages are that they are voluntary and the landowner does not lose any value of the land derived from the market (Daubenmire & Blaine). It is better than zoning as it cannot be changed into the future, which removes any protection that zoning may have had on the land (Crompton 2009; Daniels 1991). The main disadvantage in preserving agricultural land in this manner is the cost of such schemes. The funds come from farmland conversion taxes and open space contributions (Crompton 2009) causing criticism, controversy and calls of too much subsidy for farmers, paid by everyday workers taxes (Daubenmire & Blaine) (Daniels 1991).

One of the options used to calculate the value of the development right paid to owners is the before and after method. The difference between the profits from agricultural production per hectare is divided by the interest rate to calculate the capitalisation rate. The land is then appraised to what a developer would pay for the land. The difference between the two is used as the value of the development rights and paid to the landowner to create the conservation easement. For example if a farm produces value at \$5000 per hectare divide by five percent gives the value of \$100,000 per hectare. A developer may be willing to pay up to \$500,000 per hectare and the develop rights could be purchased for say \$400,000. A farmer can use the funds received to pay debts and reinvest into the farm. As the value of the land is lower due to the limit of development, there is less land tax associated with the farm providing an ongoing advantage (Crompton 2009).

PDR has evolved from when it was first implemented in the United States of America in the nineteen eighties, with 20 states now using PDR and another seven states have enacted PDR legislation but have not implemented it due to lack of funds (Crompton 2009). It first became popular mainly in urban fringe areas in the north east of the United States of America (Daniels 1991) in response to community concerns from urban sprawl and loss of agricultural

land, under the rationale that it was for the public good (Crompton 2009). Since PDR inception, 1.85 million acres of land on 11,000 different parcels have been protected in the United States of America up to 2005 at a cost of \$2.3 billion dollars (Crompton 2009). Lancaster County in Pennsylvania has a PDR which has protected land since the nineteen nineties. This land now provides income from produce and is the basis for tourism in the region.



Figure 4.3 Lancaster County farmland has been preserved by PDR since the nineteen eighties and has resulted in a growth in tourism based on the Amish heritage

In Australia, there is no scheme or legislation that allows for the purchase of development rights. Sinclair (2004) suggests that it would be just as successful in Australia as it is in the United States of America, as we face the same pressures on land use, as do American cities along with a dwindling supply of good arable land. There have also been requests from the farming community as suggested by Jeffs (2009) in a forum on the future of agriculture in the Sydney basin. The largest drawback of a PDR scheme is that they require significant amounts of money (Daniels 1991) to enable land to be protected and as in other parts of the world it is for this reason that governments like Australia may not have not followed this path.

Another option in Australia would be the transfer of development rights. This would function in a way similar to the purchase of development rights in that viable agricultural land is protected, but instead of government providing funds developers would pay for the rights as an offset for increased densities or other development changes to other land which is better equipped for urban development than the land which is preserved (Hanley-Forde et al. nd; Sinclair 2011). This exists in Australia in the form of bio-banking, used specifically for the conservation and protection of high quality ecologically significant areas in return for developing less significant areas. It could be quite easily utilised in protecting agricultural land in Australia where at the moment no PDR is available (Sinclair 2011). This option would lead to developers of urban land paying for the protection of agricultural land and offsetting the costs which are debated and argued in the United States of America.

3.3 Community Engagement

The engagement of the community in the advantages of urban and peri-urban agriculture is seen as critical to its success. The community can be engaged and networked through different associations and organisations. Modern UA has evolved from the green movement and many worldwide organizations have evolved with UA at the centre of their objectives.

The slow food movement was started in 1989 in Italy after concerns on the effect of global food production and the fast food mentality. It has now spread to over 150 countries across the globe, established 2000 local food communities and supports about 10,000 local producers (Slow Food 2012). The slow food movement encourages the protection of local food production, and increasing the pleasure and benefits of eating fresh food produced by sustainable farming practices. One of its goals is to educate the community on the importance of local food production and its benefits. The following words are from the Slow Food Manifesto 1989: *"Our defence should start at the table with Slow Food. Let us rediscover the flavours and savours of regional cooking and banish the degrading effects of Fast Food."* Local food as a vital ingredient in the movement (Slow Food 2012; Mason 2006b).

The use of festivals, open gardens and farm-gate tours are some of the community engagement policies that have been used to inform the public of local, healthy organic food. In the United Kingdom, such initiatives are used to revive struggling local business and renew the local economy. Ludlow has a festival every September which attracts 20,000 visitors, reviving the local agricultural industry and community (Mason 2006b).

These festivals and events are organized through groups such as Local Food Flavours Plus (LFFP) in Toronto Canada. This organization's goal is to look after and nurture local sustainable food producers. It aims to make the industry financially viable, socially responsible for all participants and connects growers and consumers. It is involved in certification of organic farming, education on sustainable farming practices and is involved in public policy debates (Mason 2006b). LFFP has over 100,000 people across Canada eating fresh local food daily, which reduces carbon emissions equivalent to the emissions from 1,000 cars per day and creates employment (Local Food Plus 2012). LFFP has enabled farmers to gain a premium price for their produce due to the certification guaranteeing the quality of the food.

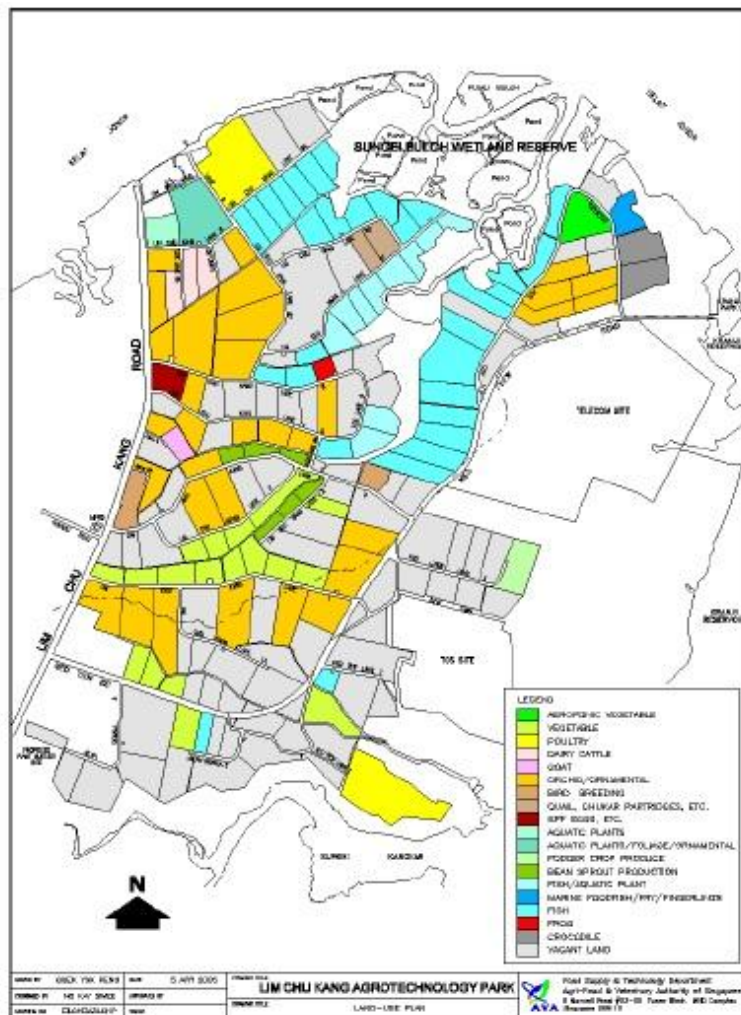
Across the world governments are involved in community engagement through the creation of food policies. These policies are being developed due to the growing dietary problems associated with our current food systems. The Mayor of London introduced the Healthy and Sustainable Food for London project, with goals of education on the benefit of local food and food security. It intends to help value local producers, help to reduce food waste and developing regional food links (Healthy sustainable food for London 2006). In Australia, the National Government has developed the National Food Plan (2011), with goals of food security, food affordability and alleviating problems related to diet.

In Australia, there has been an emergence of a social movement of food for health coming from various programs. In New South Wales, initiatives such as the Penrith Food Project in 1991 led to organizations such as Hawkesbury Harvest. The goal of Hawkesbury Harvest and similar associations is to make society more aware of the benefits of secure healthy fresh food (Mason & Knowd 2010). Hawkesbury Harvest uses a farm-gate trail, where the public can access food directly from the farmer and experience the farmer-consumer interaction. The farm-gate trail is further enhanced by the use of regular media exposure. Wider organizations such as Sydney Food Fairness Alliance are active in engaging the community on the food production and education. This alliance is also lobbying government, providing education and discussion forums in local communities (Sydney Food Fairness Alliance 2012).

This wide range of organizations are important to the ongoing success of UA and can help deliver sustainable benefits to society through education of consumers and producers, networking growers and consumers and promotion of healthy diets and lifestyles. In Australia, these networks are growing in support. It is vital to the continued growth of urban agriculture that these networks are supported by government and public policy.

4.4 Agricultural Precincts

The grouping of agricultural precincts allows the development of a cluster to give more efficient market access. These precincts can create a reputation of quality, distinct food. In the United States of America, agriculture in some cases has developed around the idea of a cluster of agri-businesses to develop market power, all working together to the benefit of all members (Mason & Knowd 2010). Merson et al. (2010) suggests that there can be benefits from clustering in joint marketing and direct access to markets which will increase profits and make the peri-urban farms more economically sustainable. In Australia, agricultural precincts such as the Hunter and Barossa Valleys are known for their wine. The benefit is that the consumer knows about the link to food and is willing to pay a higher price for commodities from these regions.



In Singapore, the government has set up areas specifically for agriculture on the edge of the urban area. The government has set up six agro technology parks, covering 1,500 hectares of land. In 2005, these parks provided 17,000 tons of fresh produce, 6000 tons of fresh fish and 344 million hens' eggs (Mason 2006b). The government body, the Agri-food & Veterinary Authority holds all land ownership in parcels from two to 40 hectares and leases this land long term to farmers. These parks were set up as a policy reply by government to protect the security of food production and to combat the 90 percent reduction of agricultural land since 1960. Even with this policy, 90 percent of food consumed in Singapore is imported (Mason 2006b).

Figure 4.4 The Lim Chu Kang Agro technology Park – Kranji, Singapore (Mason 2006b)

In Western Australia, the Waroona Shire is protecting good quality agricultural land by creating agricultural precincts in areas with excellent soils, access to irrigation water and

close the growing urban areas. This will ensure the land is used to produce food effectively into the future. The local planning documents stipulate a priority agricultural zone which ensures no residential subdivision and no fragmentation of lot sizes, resulting in the area continuing to be competitive in agricultural production (Waroona Local Planning Strategy 2009).



Figure 4.5 Agricultural Precinct in the Waroona Shire, located 108km south of Perth this peri-urban area is under pressure from residential development. Local plans have recognized the value of the agricultural land and have created a precinct for preservation of agricultural land (Waroona Local Planning Strategy 2009).

In Melbourne, the Werribee South Green Wedge has an agricultural precinct designed for agricultural production. This area is specifically used for intensive horticulture. The planning vision is that the precinct be allowed to continue and provide a space for agricultural innovation to suit the changing environment, reduce land use conflicts and continue to be economically viable. The land use policy will make agriculture the priority land use and prohibit and residential development. This area is approximately 3000 hectares, contributes \$100 million dollars to the local economy annually and provides 565 full time jobs. This area is an irrigated area close to the South East Water Treatment Works, where it can be provided with access to water, up to 60 mega litres per day (Werribee South Green Wedge Policy 2010).

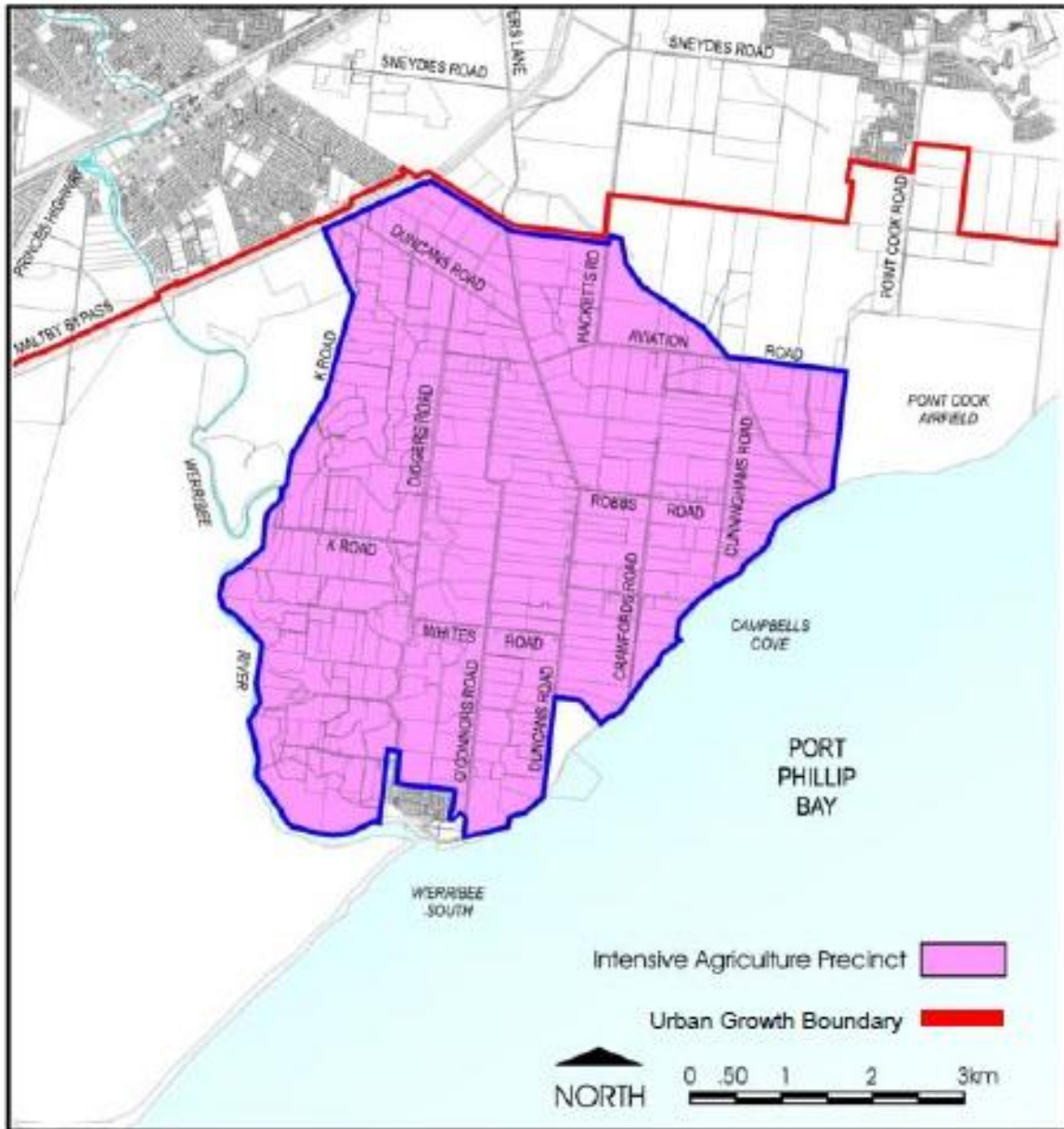


Figure 4.6 Werribee agricultural precinct (Werribee South Green Wedge Policy 2010)

A small precinct for farming is proposed for Adelaide, with a redevelopment of 50 hectares of the Western Parklands adjacent to Adelaide Central Business District (CBD). It is proposed to create a city farm containing a fruit orchard, lettuce farms, opportunities for education and recreation. The designer, Tim Horton, suggests that people need to be connected to food production and bringing food into the city will allow for better food decisions by the community (Monfries 2012).

In NSW, the old green belt created by the 1948 Cumberland Plan, still retains a substantial quantity of land. The land is held by the government in a body called Western Sydney Parklands Trust. One of the strategic goals in the management plan of this body is to promote agriculture in the parklands. With the objective of creating sustainable farming, educating the

community on the benefits of urban farming and enabling farming on undeveloped areas of the parklands as an interim land use. The parklands have a future farming project aimed at developing a small agricultural precinct in Horsley Park. The plans goal is for the Western Sydney Parkland to have up to 10 percent or 520 hectares of the parklands as farmland (*Western Sydney Parkland Plan of Management 2020* 2010).

These examples of existing precincts and proposed precincts show how governments from across the globe are using the creation of agricultural precincts to encourage and sustain agriculture in and around cities. The goal of these policies is to educate the community, reconnect the community to food production, ensure the viability of farmers and encourage sustainable farming practices. Most cities in Australia have, or are developing, green space networks through the regional urban planning of cities. The author believes that these networks could provide a land bank of government owned land to be used for future farming practices. This would allow urban farming to be more viable, be close to urban population and provide opportunities to innovate with no pressure to develop the land into housing. These precincts could be spatially positioned to allow cheap, efficient access to recycled water, house farmers markets and even provide agricultural education.

4.5 Agro-tourism

Agro-tourism is the combination of agriculture and tourism. It is similar to eco-tourism, with culture at the centre piece of the attraction, not nature. Agro-tourism is described as the capitalisation of rural character and culture (Kasperek 2001). Agro-tourism is described by Catalino and Lizardo (2004, p. 90) as “*attractions and activities in and around agricultural communities that tourists participate in*”. The lure of adventure and the attraction of rural living is driving this important tourism sector (Connors 1997). Farmers are rich in assets but are poor in cash and agro-tourism can be used as an alternative income source for cash strapped farmers (Connors 1997). Agro-tourism includes farm stays, sampling local agricultural products to hands on working farms where city folk can experience rural life. In agro-tourism operations the farmers can demonstrate how farming works, and provide opportunities for education of children and adults alike.



Figure 4.7 Tractor rides Calmsley Hill Farm (Calmsley Hill 2012)

One of the benefits for agro-tourism is the economic gain of a region or country. In a 2002 study on the benefits of agro-tourism in the Dominican Republic, it was estimated that this sector could contribute between 9.8 to 12 percent of the gross domestic product of farming (Catalino & Lizardo 2004). One other outcome noted in this report is the high percentage of sustainable practices used in agro-tourism operations. This environmental benefit could far outweigh the economic benefits to farmers in the short term. In China, there has been a growth of tourism of agricultural land where city residents can experience and see how food is grown. Yang et al (2010) suggested that agro-tourism assisted agriculture in urban and per-urban areas in three key aspects:

- 1 Provide agricultural organic products and tourism dollars.
- 2 Provide recycling and environmental improvements.
- 3 Development of rural culture recognition by urban persons.

Mason (2006) suggested that in addition to the economic benefits of farmers, agro-tourism can assist with the preservation of land. In Lancaster County in the United States of America, rural land preservation has been advanced by the creation of many agro-tourism operations.

These operations have made the preservation of the Amish way of life and the sustainable farming practices that they employ a major tourist attraction. In 2005, the Amish community attracted over seven million visitors and contributed one billion American dollars to the local community. The advantage of agro-tourism to local economy is that any money spent by tourists is retained to benefit the local community. It is suggested that agro-tourism can be used effectively in a region which has a good cultural identification and can build on this identification to the public (Mason 2006b).

In Western Sydney parklands, Calmsley Hill city farm has operated since 1984 on an open space land lease. The goal of this farm is to give urban residents the opportunity to experience life on a farm, be educated on farming practices and support the local community (Calmsley Hill 2012). The farm also provides local employment to over 30 people and supplies some produce to local farmers markets. It is a commercial operation on a farm that was first producing food in the early nineteenth century for Sydney consumption.

There is potential in Australia to expand and use agro-tourism to preserve some agricultural land around our cities, while educating the community on sustainability and the importance of food production. In peri-urban Beijing, Xiedao Green Resort uses agro tourism on a small percentage of land, enabling the largest portion to remain as food production. This remaining portion of land remains more viable due to the agro-tourism when compared to urban development. The ratio of productive farmland to tourism is 9 to 1. This model may be able to be used in the peri-urban areas around Australian cities which have many farming experiences which tourist would enjoy.



Figure 4.8 Xiedao Green Resort Beijing China, the land is used for both production and tourism at a ratio of 9:1 (Yang et al. 2010)

4.6 Continuous Productive Urban Landscape

A continuous productive urban landscape (CPUL) is a landscape designed to facilitate urban agriculture and sustainable cities (Viljoen & Bohm 2005). The authors argue that urban agriculture is an important piece of infrastructure for a sustainable city, just as important as roads and open space (Viljoen & Bohm 2005). A CPUL is a network of connected productive spaces inside a network of open space. The urban resident can move through this open space and be connected with the production of food and all the benefits that it can bring to a sustainable city.

Viljoen & Bohm (2005) suggest the benefits of a CPUL are:

- Social.
- Economic.
- Community building.
- Health improvements.
- Combine sustainable transport within open space.
- UA offers more than just the agricultural returns without much additional cost.
- Potential to maintain density while providing UA in open space.

Most perishable foods can be produced with little refrigeration and storage before making it to the consumer reducing food miles

A CPUL is a new idea of connected parklands, allowing the integration of recreational and leisure facilities, with areas utilised urban farming, ecological corridors, non-motorised transport such as cycle and pedestrian routes. CPUL produce food economically, improving the quality of life both socially and culturally and improves urban landscapes environmentally in terms of reduced carbon emissions, provision of heat sinks, improvement of air quality and increased natural biodiversity (Viljoen & Bohm 2005).

The implementation of UA into Cuba by government policy has made this country a laboratory for CPUL (Viljoen & Howe 2005b). The Cuban government responded to the need for more local food production in the nineteen nineties by planning and supporting food production in and around its cities. The government has implemented reforms in the form of a national alternative agriculture model (NAAM). This model of food production replaced the large percentage of food being imported into the country by the local production of food. The ultimate goal is to have more people involved in a less mechanised and more intensive food production close to urban populations. In the 10 years since the introduction of NAAM, the production of food has become more organic and less reliant on fertilizers. The most popular form of farming is the organoponicos (popular organic orchards), which are essentially large community gardens (Diaz, J. P. & Harris, P. P. 2005).

In Cuba, many plots are CPUL. They are adjacent to roads and provide open space in cities with views of the garden landscape. Some of the UA sites, such as the organoponico in Cienfuegos have cycle paths implemented as part of the design. The CPUL adjacent to the

university in Cienfuegos is utilised to produce food for university students, provide passive recreation and has active recreation in the form of sports fields implemented into its design (Viljoen & Howe 2005b). The production of food in organoponicos the Cienfuegos region has grown from 261 tons in 1994 to over 14,000 tons in 1999. The yields from production have increased from five kilograms per square meter to over twenty four kilograms per square meter (Simovic & Taboulchanas 2000).



Figure 4.9 Organopónico in Cienfuegos Cuba, Showing the typical raised beds full of organic composted material (Alejandro R. Socorro Castro nd)

There are many examples of CPULs around the world such as in Gaborone, Botswana. The government has set aside sites for UA with the goal to the city becoming self-sufficient in food production. Gaborone has traditionally been reliant on the importation of food and the government is planning to integrate food production within the city utilising the reuse of wastewater to irrigate crops. This plan is an example of the creation of integrated open space and productive land use within the city (Viljoen 2005).

Lea Valley in the United Kingdom is targeted as a growth area for London, with this area expected to contain 21,000 new housing units by 2016. It is also the site of the London Olympics and historically the market garden of London. A study reported that the planned green grid of open space could be utilised to create a CPUL. The study suggested that the

CPUL could feed as much as 4000 persons using traditional methods, but with the experience of the yields from UA in Cuba it could be expected to feed up to as much as 39,000 persons (Viljoen & Bohm 2005).

In Australian cities, CPUL do not yet exist, there are some small examples of UA integrated into the city such as the Chinese market gardens of Sydney. These gardens have been in existence for over 100 years and in 1999 the Phillip Bay gardens were listed on the heritage register in NSW. They were considered to have significant historical, agricultural and social significance to NSW (Cross 2008). These are commercial farms on Crown land leased from the government, they are highly intensive, have minimal erosion or contamination problems (Cross 2008) and are adjacent to open space.



Figure 4.10 Phillip Bay Market Garden adjacent open space, cemetery and a school

Another example in Sydney is in Kyeemagh, located 9.5 kilometres south of the Sydney CBD. The four market gardens are to adjacent housing and open space with bicycle and pedestrian pathways. This CPUL also has playing fields and playgrounds integrated within the open space network. It allows the local community to enjoy the open space and rural outlook with an interesting landscape close to the CBD. These market gardens have been traditionally used for food production since at least the early eighteenth century (*Heritage Council of NSW* 2009) .



Figure 4.11 Kyeemagh Market gardens open space close to the CBD, this image shows the market garden, active recreation, airport and CBD.



Figure 4.12 Kyeemagh Market Garden showing the close interaction with residential land



Figure 4.13 Kyeemagh Market Garden showing open space pathways which allows residents to enjoy the changing landscape of the market gardens through the seasons.

A third example in Sydney, is the market gardens at Matraville, located 10 kilometres south of the CBD. These market gardens are located adjacent to medium density residential and are part of a network of open space. They provide an example of a CPUL in a network of open space, providing recreational opportunities and food production.



Figure 4.14 Bunnerong market gardens showing pathways and views



Figure 4.15 Bunnerong market garden with equestrian centre and open space



Figure 4.16 Bunnerong market garden adjacent medium density urban development



Figure 4.17 Bunnerong Market garden part of the open space network at Matraville (Nearmap 2012)

Further examples can be found in other capital cities of Australia such as in Melbourne's South East green wedge, at Kingston twenty kilometres south east of the CBD. The market gardens are part of the open space network which also includes recreation, industry and mining.



Figure 4.18 Kingston Green wedge, urban farming as part of a network of open space (Nearmap 2012)

The author believes that in cities of Australia and around the world, the planning of networks of open space can allow for the implementation of a CPUL into these networks. It is evident in current planning strategies of the capital cities of Australia that there is an opportunity to allow UA into the cities as part of a network of open space. The author sees examples such as the South East Queensland Regional Plan which allows for the maintenance of inter urban breaks, gives an opportunity for UA to be implemented and remain in these areas. Perth is planning for networks of connected open space to facilitate movement networks, these open space corridors could allow for the implementation of UA into these networks. The Melbourne Green wedges policy is currently allowing for UA to be implemented but new release areas could have an opportunity to maintain a percentage of the open space as a network of productive landscapes. Sydney's regional planning has also allowed for networks of open spaces, including in the growth centres where biodiversity corridors are being planned (*Metropolitan Plan for Sydney 2036* 2010). The existence of the existing open space of the Western Sydney Parklands could also allow UA to be implemented into this network to provide a CPUL surrounding the city.

5.0 PROPOSED PLANNING MODEL

5.1 Introduction

In the previous chapters the sustainable benefits of urban and peri-urban agriculture were explored. The triple bottom line contribution of urban agriculture towards sustainability, the economic, social and environmental benefits were also described.

The efforts being made in and around cities in North America, Europe and developing nations to protect the essential infrastructure of food production were highlighted in Chapter Four. In spite of the benefits to cities and some efforts in North America and Europe to protect and develop UA, planners are not being educated or have little education on the benefits of designing urban spaces to include UA. Of the 93 planning schools in North America no school specialises in food system planning and only 12 percent of the schools cover rural planning (Pothukuchi & Kaufman 2000). This lack of education and specialisation in food planning may be the reason that UA has little recognition in Australia in planning applications.

In Australia, there is a perception of abundance of land but as a nation, 85 percent of the population live on the most productive land on the eastern seaboard (Houston 2005). There is little acknowledgement in the regional urban planning of our cities of the protection and enhancement of agricultural land for food production in urban spaces. All the protection of agricultural land is left to large scale productive rural areas such as in Queensland through State Planning Policy 92, Good Quality Agricultural Land. This planning policy concentrates on protecting the best land which has traditionally been used for agriculture (State planning policy 1/92, Development and conservation of Agricultural land 1992).

Even with such policies, there is limited planning to protect or enhance agricultural land in urban areas. The regional urban plans of the capital cities rely on the creation of urban growth boundaries (*Melbourne 2030: a planning update Melbourne @ 5 million* 2009; *Metropolitan Plan for Sydney 2036* 2010) to protect productive landscapes on the edges of cities. The evidence of shifting boundaries shows that the creation of an arbitrary boundary or line on a plan does not protect agriculture from all the external forces that exist. This line is a constantly moving line subject to the political will of the government at any time (Nicholls & Moore 2011). The Victorian government is an example of this moving target, the growth boundary was shifted in 2009 to accommodate more greenfield development for the expected population growth pushing agriculture further into the fringe and away from the population (*Melbourne 2030: a planning update Melbourne @ 5 million* 2009). In fact the government in Victoria has shifted the growth boundaries on four occasions since 2002 with the latest in 2012 (Millar 2012) In Sydney, the importance and benefits that resource lands on the fringe poses is recognised in the Metropolitan Plan for Sydney 2036 (2010). Objective F2 of the plan was designed to protect agricultural and resource land, to accomplish this the plan states a goal to “consider” an agricultural policy and for local governments to map agricultural lands. In contrast to this policy, the NSW government has set a goal to increase greenfield

development and has eight separate growth centre precincts under planning by the Department of Planning at present in an attempt to accelerate development. The Department of Planning has also has requested developers to nominate sites outside growth centres to speed up land release with a target of 52,000 new lots by 2016 (Black 2012). Various interests groups who lobby the government, such as the Urban Development Industry Association (UDIA) are calling for an increase in housing to fight the affordability crisis in NSW. All the pressure on the government is pointing to an increasing volume of urban greenfield development, all without recognizing the benefits of UA to creating sustainable urban environments and little recognition in planning on the agricultural activities which will be displaced in these greenfield areas.

The desire of governments to develop land on the fringes of cities across Australia could in part be attributed to the political pressure by the community and the development industry to increase housing supply and attain greater affordability in housing. Any planning model that is designed to implement UA into Australian cities has to acknowledge supply and affordability demands in order to not impede the release of land or increase development costs. The pressure for more urban development and the actual increasing of urban footprints makes the need for a model to implement UA into cities more urgent. Once agricultural land has been developed into urban spaces it would very unlikely be returned to productive agricultural land (Mason & Knowd 2010). The Australian community has taken for granted the availability and suitability of fruit and vegetable production on the fringes of our cities and loss of this needs to be considered (Carey, R et al. 2011). Merson et al. (2010) and Jeffs (2009) suggest that urban food production should be considered a vital piece of infrastructure, just like roads or sewer are considered an important part of the framework within an urban environment. There is a great need for a planning model to be designed to enable the retention of agriculture on the fringes of the cities that also allows for new urban growth that will be required in the future.

In the following parts of this chapter, the goals and actions of a proposed planning model are outlined which is designed to meet the competing demands of the new urban growth areas. These goals and actions draw from the experience from around the world of different tools as discussed in Chapter four. The planning model is simple and is outlined in a series of tables and images in section 5.2. Section 5.3 will explain in detail the origins of the objectives and how they will be reached in the individual actions. The model has a series of expected outcomes and these are formulated into checklists which will be utilised when implementing the model into the case study of Western Sydney in chapter 6.

The model is designed for new urban release areas on the urban fringe of our cities. It is not designed to have all food production from within urban areas but to enable some production of food where it currently exists. There will always be a need for large scale agriculture and in no way is this model attempting to replace this agricultural production. This model is a first step that will enable some production of food in our cities in an attempt to get the sustainable benefits for cities from the local and season production of food.

5.2 Planning Model Rationale

5.2.1 Objective A1: Creation of Opportunities for Local Food Production and Distribution

The creation of opportunities for UA in and around cities will increase the sustainability of these cities (Giradet 2005; Viljoen et al. 2005). The proposed outcomes based planning model proposed below highlights the objectives of the model, details specific suggested actions in order to achieve the desired outcomes or goals. The plan is not prescriptive in nature but the actions can be used as a guide to reaching the goals. The actions should not be limited to those that are mentioned but should be used as a base to create innovation and adaptability as agriculture has shown it is capable of over many years. The planning model was created to fit in the context of the existing regional urban plans of Australian Cities. The model will assist in the introduction of productive landscapes into new urban release areas where up 50 percent of new growth of cities will occur in the near future. The figure below creates an overview of the objectives and actions of the proposed planning model.

Objectives	Actions			
A1:Local food production & distribution	Community Gardens		Community market space	
A2:Creation of city farms	Open space farming	Waste reuse	Retention of Traditions	Farming as a Buffer
A3:Economic Stability of Farming	Open space Purchases		Reduced land taxes	

Figure 5.1 Overview of the planning model

5.2.2 Action 1: Community Gardens

Regional urban planning in Australia recognizes that neighbourhoods should be designed to be compact, walkable, have access to open space and transport (Melbourne 2030 2002; South East Queensland Regional Plan 2009-2031 2009; Directions 2031 and beyond 2010; Metropolitan Plan for Sydney 2036 2010). Objective A1 of the planning model uses the

compactness of new neighbourhoods with higher population densities to enable the creation of local food production and distribution. All new neighbourhoods should allow for local food production and distribution. The objective is to have the distribution of locally produced food central to the neighbourhood unit.

The community garden should be accessible by walking for the majority of residents in a new urban precinct. Using the neighbourhood unit, as described by Perry in 1929 and as practiced in Canberra for the past 30 years, the goal is to create a community garden within 500 metres of all residents in new urban areas. In the United States of America, community gardens are being used to reduce food insecurity, where for example Cleveland, Ohio has the goal to have all urban dwellers within 400 meters of a community garden (Reimagining Cleveland 2012). The garden should be the part of the facilities at the centre of the neighbourhood which include other community facilities such as schools, meeting places and squares. The current planning methodology allows for increased densities at the centre of neighbourhoods closer to community facilities. The increase in density does not allow for traditional backyard gardens and vegetable plots which were envisaged by planners of the typical quarter acre block (Bunker & Holloway 2002). Providing opportunities to residents of the higher density units close to the community gardens will encourage the production of food and all its benefits as suggested by Viljoen et al. (2005). Providing access to land for those community members who desire to grow and produce and a percentage of their own food will increase the food security of the disadvantaged portions of the community (Howe et al. 2005).

5.2.3 Action 2: Farmers' Markets

The overall objective is to create open market spaces for local farmers to sell locally produced food directly to the residents on a more frequent basis. This action uses the proximity to the market which is one of the strengths ensuring sustainability of urban agriculture (Paxton 2005). To build on this strength, this action will see the creation of a space at the centre of a neighbourhood, for members of the community to purchase locally produced food. This place will also increase the economic sustainability of local food producers by providing a space for direct marketing that is central to the community. Heimlich and Anderson (2001), Jarsoz (2008) and Mason and Knowd (2010) all suggest that direct marketing allows local farmers to access higher profits. Currently, farmers markets in Australia have been located centrally in large commercial centres on a monthly or bi-monthly schedule (Australian farmers market association 2012). Carey, Rachel et al. (2011) and Pires (2011) suggest more regular markets are needed to access the full potential of urban agriculture.

Providing a secure location central to the community is aimed at encouraging more regular market days. The growth of farmers' markets at present in Australia (Australian food statistics 2010-11 2012) predicts a need to increase the space provided for this activity in new urban communities. This action item aims to provide space for continued growth to this

sector of food distribution. This action will provide opportunities for the residents who do not wish to, or have no time to grow their own food, access to fresh local food. These local market spaces would allow for the locally produced food to be directly marketed to the consumer, allow for an increase of profit share to the local farmer and therefore increasing the viability of these local farms, along with the sustainable benefits of local food production and distribution.

5.2.4 Objective A2: Creation of Areas of Local Food Production.

The second objective of the model is to facilitate the creation of city farms to produce local fresh seasonal food for local consumption. The sustainable advantages to local food production would be more employment (Jeffs 2009), more economic returns to the local economy (Pothukuchi & Kaufman 2000), health benefits from fresh food consumption (Brown 2002), environmental benefits of decreased food miles (Paxton 2005) and increased recycling of wastewater and closed nutrient cycles (Giradet 2005).

5.2.5 Action 3: City Farm Creation as part of Open Space

The creation of what could be described as “city farms” as part of the open space network will allow for urban residents to have access to locally produced fresh food. The concept of a “city farm” builds on the desire and need amongst the community to reconnect with food production (Lynch 2010). New urban growth areas in Australia have planned, connected open space to allow for pedestrian and cycle networks (*Sydney's Growth Centres* 2012). This action utilises this connectivity with the community and maintains some of that open space as urban farming. Viljoen et al. (2005) suggest that the integration of rural landscapes into urban spaces will allow for the reconnection of the origin of the food consumed and contribute to a better understanding of the farmer and consumer.

The objective suggests a figure of 10 percent of open space land should be used for city farming in new urban precincts. The value of 10 percent is based on a similar scheme for the Western Sydney Parklands (*Western Sydney Parkland Plan of Management* 2020 2010). This 10 percent equates to only one percent of land in an urban precinct based on the 1929 neighbourhood unit envisaged by Perry and will not have any major impact on the production of residential land as it utilises land already designated for open space. This action will introduce the productive landscape into urban areas while providing opportunities for interaction with residents through cycle/pedestrian networks with views and vistas of a changing landscape as suggested by Lynch (2010) and Viljoen and Bohm (2005). Yokohari and Bolthouse (2011) suggest that the introduction of working green space and leisure will improve sustainability of cities. This action will also provide an opportunity for increased education of urban dwellers on the seasonal cycles of food production (Lynch 2010). There are examples already in existence in Sydney and in Melbourne Green Wedges. Action Three will build on the experiences of these farms and on new city farms being planned for central

Sydney and other urban centres. This action will provide opportunities for employment in the agricultural sector which has traditionally been undervalued in urban areas (Jeffs 2009). The Sydney region currently employs 11 percent of the total agricultural workforce of the state (Jeffs 2009).

5.2.5 Action 4: Reuse of Waste

The new city farms should be positioned in small clusters of two or three farms to allow for the efficient use of recycled water. Yokohari and Bolthouse (2011) suggest the huge potential of recapture of wastewater for reuse in farming exist in urban centres across the world. In the face of climate change in Australia and potential prolonged periods of drought the reuse of wastewater has the added benefit of a permanent reliable water source (Choy et al. 2008). This will see the viability and sustainability of the urban farms increase. The potential for the nutrient capture and use on city farms as suggested by Giradet (2005) by the reuse of wastewater and collection of organic wastes for compost will see the importation of fertilizers decrease and a move to more organic and sustainable practices in these city farms.

Current technology is available to create small wastewater water recycling plants which would eliminate the expensive duplicate infrastructure that is required for large water recycling systems (The Water factory 2011). These small wastewater recycling plants would serve a neighbourhood size area and provide a continuous supply of recycled water to the city farms.

5.2.6 Action 5: Retention of Existing Farms

Farming has been a traditional land use of land on the fringe of cities (Butt 2011). This land is also the area of urban expansion of cities (Butt 2011; Houston 2005). New city farms clusters will be positioned so as to retain some of the existing areas which are already being farmed. Such areas can become associated with particular commodities and provides a marketing advantage to farmers of the region. The Hunter valley for wines, or the Bega Valley for cheese are examples of traditional farming areas. This action will provide protection of the tradition and heritage of farming in the peri urban areas as cities expand. Some examples exist in cities today where the same type of farming has existed for over 100 years. In Melbourne, the Merri Creek Market Gardens have been in existence for 150 years and is a model city farm today (Lynch 2010). Areas such as Kyeemagh Chinese market gardens in Sydney are heritage listed and provide a connection to the past while providing an opportunity for retention of city farms and continued economic return from land that would otherwise be vacant open space (Viljoen & Bohm 2005).

5.2.7 Action 6: City Farms as a Buffer

Ideally city farms as part of open space can be used as a buffer between different land uses as suggested by Merson et al. (2010). The city farms as part of the open space network would be used in areas more subject to flooding and can be used to separate urban landscapes from natural bushland. This would protect urban landscapes from bush fire and flooding hazards, protect the bushland from feral domestic animals and provide a transitional landscape to give a non-harsh edge to different landscapes. The city farms should be used in areas adjacent riparian zones to enable the recharge of groundwater to filtration of urban runoff and the protection of streams.

5.2.8 Objective A3: Economic Sustainability of City Farming

With urban agriculture in its infancy the economic sustainability of urban farming may need to be supported by government in the interim to ensure the protection and innovation in this new sector of agriculture. Brown (2002) suggested that in its infancy the small farmers cannot obtain finance to setup new urban farms. Access to funds to set up urban farming is just one action that could be taken to improve the direct economics of UA. It is not the intention of this objective to limit any one type of action but to equip the city planners with appropriate tools from which the goal could be accomplished. Action 7 and 8 are shown as examples of economic actions only and the specific economic requirements of a region should be used to assist agriculture.

5.2.9 Action 7: Purchase of open space for Agriculture

In the United States of America, the government has used the purchasing of development rights to enable farmers to maintain the economics of farming in peri-urban areas (Sinclair et al. 2004). This action would use a system similar to purchasing development rights except that the land would be purchased specifically for agriculture or provided by developers as an open space contribution for a proposed development. This specific agricultural land would be open space by definition but would allow for agricultural use.

Once the land is owned by local government, instead of the land being the traditional passive open space the land it would be considered open space agriculture. This designation would enable the land to be used as both passive open space and for agricultural purposes. The land would be leased to urban farmers using sustainable farming practices. The outcomes from this action would be that productive open space would be created in the public name, for the same economic outlay as passive open space. Instead of ongoing maintenance costs to local government the lease income will give local government an ongoing revenue stream which could be used to maintain other open spaces. The city farmer would benefit from the secure access to land on a long to medium term lease. Secure access to land in face of economic

pressures from urban sprawl is nominated by (Choy et al. 2008; Jeffs 2009)Choy et al. (2008) and Jeffs (2009) as one of the main items that UA needs assistance with.

5.2.10 Action 8: Reduced rural land rates

The last action of this model is based on attempting to reduce the costs borne by urban farmers. It has been suggested by James et al. (2010) that the economic viability of farming on the fringe and in cities should not only include the farm profits but also include the environmental and social advantages. To achieve this goal, UA should be assisted to be established and allow for innovation. This action plans to use land tax rebates and reductions from local government for city farmers who use sustainable farming practices on land. This action will make a small contribution to the overheads and give some traditional farmers the ability to compete with other land urban land uses. This action will provide the whole community with social and environmental benefits.

5.3 Proposed Planning Model assisting Urban Agriculture

Objectives	Actions			
A1:Local food production & distribution	Community Gardens		Community market space	
A2:Creation of city farms	Open space farming	Waste reuse	Retention of Traditions	Farming as a Buffer
A3:Economic Stability of Farming	Open space Purchases		Reduced land taxes	

Figure 5.1 Overview of the planning model

The proposed planning model outlines three main objectives for the incorporation of agricultural activities into cities. The realisation of these objectives will have wider sustainability implications than what is outlined in this model. The implementation of this model will assist in achieving the following outcomes, but are not limited only to those outcomes:

- Food security is maintained in times of drought, flood or conflict.
- Food security is increased for the poor and for marginalised sections of society.
- Education opportunities are created for community members with the ongoing visual stimulation and interaction with farmers and growers of fresh food.
- The health benefits of the local communities are increased with a more reliable and healthy source of food.

- By reducing transport of food and trips to supermarkets, carbon emissions from local food production are reduced.
- Local employment opportunities for the local community members are increased.
- Social inclusion opportunities are provided for a large proportion of new migrant community members.

Objective A1

Creation of opportunities for Local Food Production and distribution

The first objective is to create opportunities for urban agriculture and local food production and distribution within new urban precincts.

To achieve this objective, the following land uses or activities will be established:

- Community gardening
- Farmers markets

The outcomes of this objective would be:

- Increased ownership and sense of belonging to communities through interaction in community gardening.
- Access to land for community gardening and food production.
- Access to local fresh foods for all community members.
- Access to a local fresh food market through the provision of a space for farmers markets in town or village centres.

Action 1 Community Gardening

Action	√
Introduce a community garden at centre of each neighbourhood.	
Community garden is to be located on land designated as passive open space.	
Community garden to be position so as the majority of all new urban residents are within a 400m radius.	

The outcomes from this action would be:

- Increased food security for the disadvantaged.
- Community building and increased social interaction in new urban communities.
- Health benefits due to access to fresh food.



Figure 5.2. Community Gardens in the Indiana, USA and Sydney NSW are working examples of community gardens which are to be implemented at the center of new urban communities (City Of Sydney 2012; Indiana Community Garden 2012)

Action 2

Community Space for regular local fresh food Markets

Action	✓
Provide space for farmers' markets in town centre.	
Identify town squares or parks suitable for to house farmers' market	
Locate farmer's markets to enable the maximum reach of residents of the precinct.	

The outcomes from this action:

- Provision of a secure space for local food distribution central to the community.
- Increased frequency of the farmers markets
- Provision of space for growth of farmers markets.
- Provision of opportunities for interactions between growers and consumers.
- Improved food security of the local community.
- Improved health by providing fresh food to the community.
- Increased profits, contribution to the economic sustainability of local food producers due to direct access to the consumer.
- Decreases the food miles and carbon emissions due to no associated energy expenditure with transport and storage of food.



Figure 5.3 Penrith farmers' market, held the first Saturday of the month is a example of a farmers' market in a town centre. It is positioned on open space near community facilities.

Objective A2

Creation of areas of local food production

The second objective of the model would involve the creation of city farms to produce local fresh food for local consumption.

To achieve this objective, the following actions will be used:

- Creation of city farms as part of open space.
- Re-use of urban waste.
- Retention of existing farms.
- Use of City farms, as a buffer between less compatible land uses
- Use of City farms, as a buffer to safeguard residential land from natural disasters

Achieving this objective will result in:

- City farm creation as part of open space network, allowing interaction between urban residents and the rural cycle of seasons.
- Farms created in small groups or clusters to take advantage of wastewater recycling.
- Retaining existing agricultural land and incorporating this land into a city farm.
- Building on the traditional land use and the typical regional agricultural production.
- A buffer to flood prone land, bush fire risk areas, riparian zones and areas which require environmental protection.

Action 3

Creation of City Farms as part of open space

Action	√
Create city farms.	
Allocate 10 percent of open space to farming activities.	
Provide secure tenure to farmers.	

The outcomes from this Action:

- Interaction between the urban resident and the rural landscape.
- Increased education on food production.
- Creation of productive open space.
- Reduction of food miles and carbon emissions associated with transport.
- Creation of employment opportunities through local business creation.
- Provision of secure access to land for traditional farmers.



Figure 5.4 City farm as open space already in existence in Kyeemagh NSW May 2012

Action 4

Reuse of Urban Waste

Action	✓
Group City farms into small clusters.	
City farm to be located to enable efficient use of recycled water.	

The outcomes from this action:

- Reduction of environmental pollution and landfill through recycling household organics.
- Capture and re-use of nutrients through wastewater recycling.
- Reduction of the importation of fertilizers.
- Increased reliability of water for intensive agriculture in times of drought.
- Reduced cost of infrastructure with small neighbourhood plants supplying small specific areas.



Figure 5.5 Recycled wastewater can be delivered through irrigation systems even in times of low rainfall using overhead sprinklers (Going to seed: Growing organic seed in Eastern Canada 2012)

Action 5

Retention of existing farms

Action	√
Utilise some of the existing farmland for city farms	
Retain the culture and tradition of the area's food production	

The outcomes from this action:

- Retention of traditions and culture associated with agriculture.
- Utilisation of existing land use and farm infrastructure.



Figure 5.6 The traditional market gardens in Phillip Bay NSW , are an example of the retention of existing agricultural land use as designed in this action.

Action 6 City Farms as a buffer

Action	√
Locate city farms on land subject to possible maximum flood liable land.	
Locate city farms as a buffer to natural bushland for bushfire hazard reduction for urban areas.	
Locate city farms adjacent riparian corridors to enable groundwater recharge.	
Locate city farms so as they can filter urban runoff to protect streams.	

The outcomes from this action:

- Provision of a buffer to environmental hazards.
- Provision of a buffer for environmental protection of sensitive areas.
- Filtration of urban stormwater runoff.
- Recharge of groundwater.



Figure 5.7 Farming as a buffer in Austral NSW between residential development and ecological sensitive and riparian land.

Objective A3

Economic sustainability of city farming

The third objective of the model is to increase the economic sustainability of city farming. This objective does not attempt to define all possible actions to improve the economic sustainability of city farms, but provides an example of possible actions which can be adapted to the regional planning circumstance.

The following actions are used as examples:

- Purchase open space land for farming.
- Reduce land rates of urban farming.

The sustainable advantages of the objective:

- Increase the economic sustainability of farming.
- Access to land at a reasonable cost to new city farmers.
- Reduction in running costs of farming land.
- Reduction in maintenance costs of open space.
- Creation of productive open space.

Action 7

Purchase of open space for Agriculture

Action	√
Open space land for agriculture identified by LGA and purchased by LGA for inclusion into open space.	
Open space land for agriculture identified by LGA and provided by developers for inclusion into open space.	
LGA lease open space land for agricultural use.	
LGA to provide long term leases for secure tenure of farmers of open space land.	

The outcomes from this action:

- Secure access to land for city farmers.
- Establishment of productive open space landscapes.
- Provision of an income stream for local government from leasing farmland.

Action 8

Reduced rural land rates

Action	√
Reduce rating costs to sustainable farms.	
Provide tax incentives for sustainable farming in urban areas.	

The outcomes from this action:

- Increase in economic viability of farming.
- Provision of incentives to sustainable agriculture as a land use.
- Increase of sustainable practices of agriculture.

6.0 WESTERN SYDNEY CASE STUDY

The previous chapter was used to propose a planning model which could be implemented into the new urban growth centres in the capital cities of Australia. This section is the practical application of the planning model to the urban release precinct of Austral in Western Sydney. The Austral precinct in the South West Growth centre is typical of peri-urban spaces around the capital cities of Australia. The application of the model will show how UA can be implemented into urban spaces without a detrimental effect on the release of land, while improving the sustainability of the urban area and retaining of some of the existing peri-urban farmland.

6.1 Austral Precinct

The Austral precinct is located 37 kilometres west of the CBD of Sydney and is in the Local government area of Liverpool City Council. The precinct is inside the South West Growth Centre (SWGC), the planning for its urban release is being co-ordinated by the Department of Planning & Infrastructure NSW. Overall, the SWGC will have 18 precincts and the potential for 110,000 houses and 300,000 people (*Sydney's Growth Centres* 2012). It is part of the peri-urban area surrounding Sydney and is adjacent the Western Sydney Parklands. The Austral precinct was released for planning in October 2009. The draft planning documents have just undergone the public consultation phase (June 2012) and are due for release for development late 2012. The vision with the plan is to provide a diverse range of housing supported by related infrastructure, services and facilities in a sustainable manner (*Liverpool Development Control Plan* 2012).

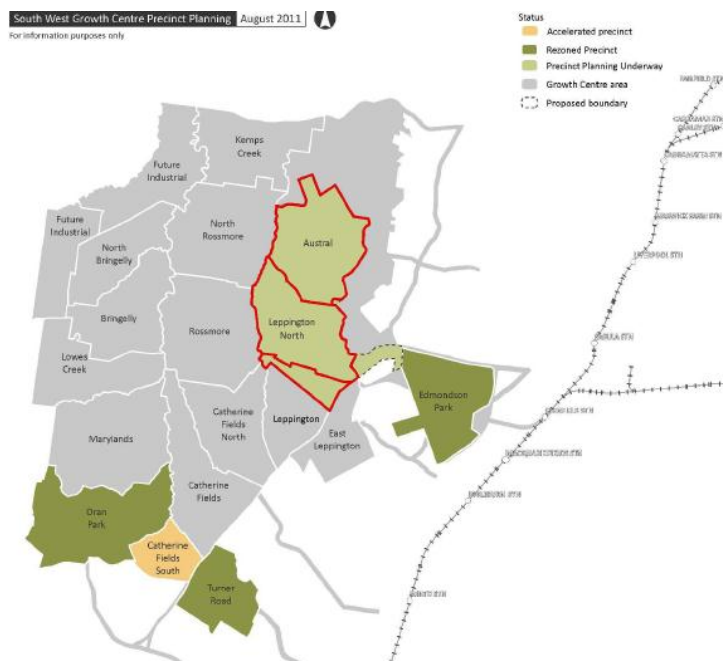


Figure 6.1 South West Growth Centre Sydney 2011 (Austral & Leppington North Pecint Planning Report 2011)

The precinct covers 928 hectares of land bounded to the west by Kemps Creek, Bonds Creek and Ninth Ave to the south, the water supply canal to the east and Western Sydney Parklands to the north. The current road network is a grid pattern running in a north-south and east-west direction. The land parcels are highly fragmented with most land parcels being of one to two hectares in size. The topography of the precinct is generally sloping from south east to north west from 104 meters to 58 meters above sea level.



Figure 6.2 Aerial imagery Austral Precinct (Austral & Leppington North Pecinct Planning Report 2011)

The precinct planning has identified some constraints in the development of the Austral precinct.

- Flood prone land exists along all streams and creeks in the precinct. The main area of constraint is the flood prone land adjacent to Kemps and Bonds Creeks. The flood study identified land up to 500m from Kemps Creek in the north western corner of the precinct.
- Remanent vegetation of high quality which is to be retained for its environmental and biodiversity benefits.
- Riparian zones of up to twenty meters wide will need to be managed under the *Water Management act 2000*.
- Existing electricity transmission lines and a gas pipeline crossing the precinct.

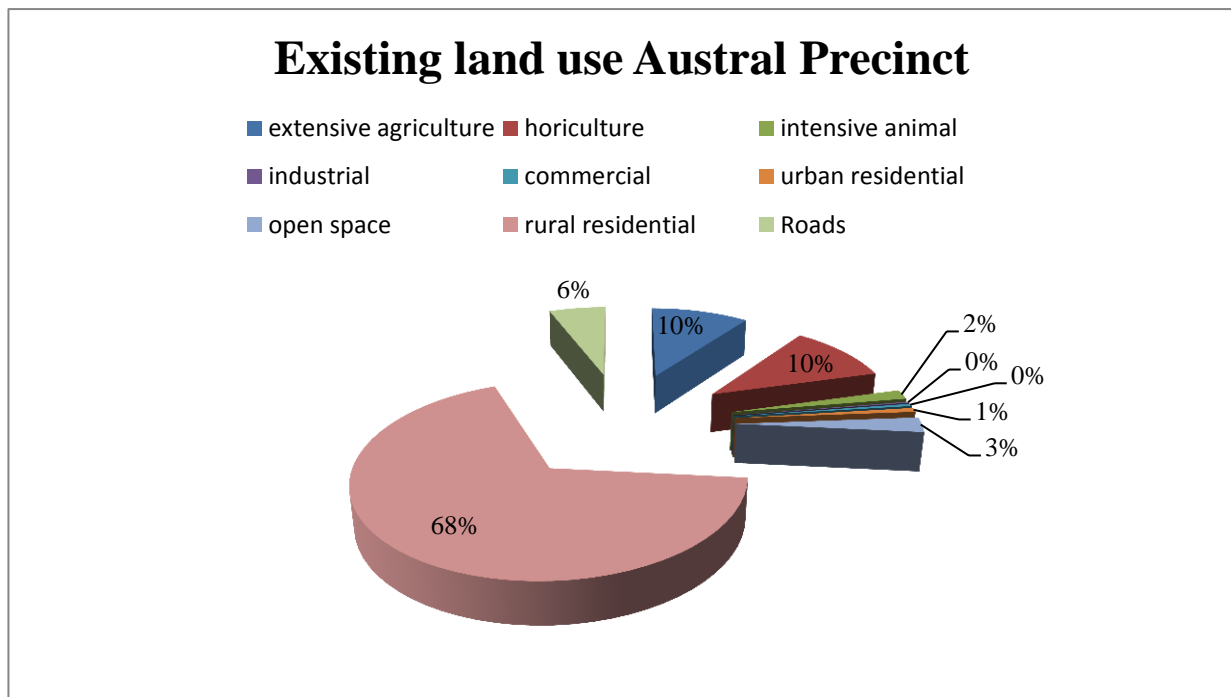


Figure 6.3 Austral Precinct Existing Land use compiled from aerial imagery May 2012

The majority of the land is currently zoned as Rural, with some small areas in the existing village of Austral being zoned Residential. Currently, the area is used for rural living, small urban centres, agriculture (both horticulture and intensive animals) and small business. As part of the application of the planning model the existing land use was surveyed in the Austral precinct. The survey was compiled from high resolution aerial imagery taken in May 2012, with the data being verified by ground-truthing through a windscreen survey in June 2012. Figures 6.3 and 6.4 show the existing land use compiled from this survey with the major portion of the land being used for rural lifestyle living. This is a similar result obtained by Sinclair (2004) in his land use survey of Western Sydney where he showed 71 percent of land being used in this manner. The survey did show that 21 percent of the existing land use is in commercial agriculture, ten percent is used in extensive agriculture (grazing), ten percent in horticulture (market gardens) and one percent in intensive animal production (poultry farms).

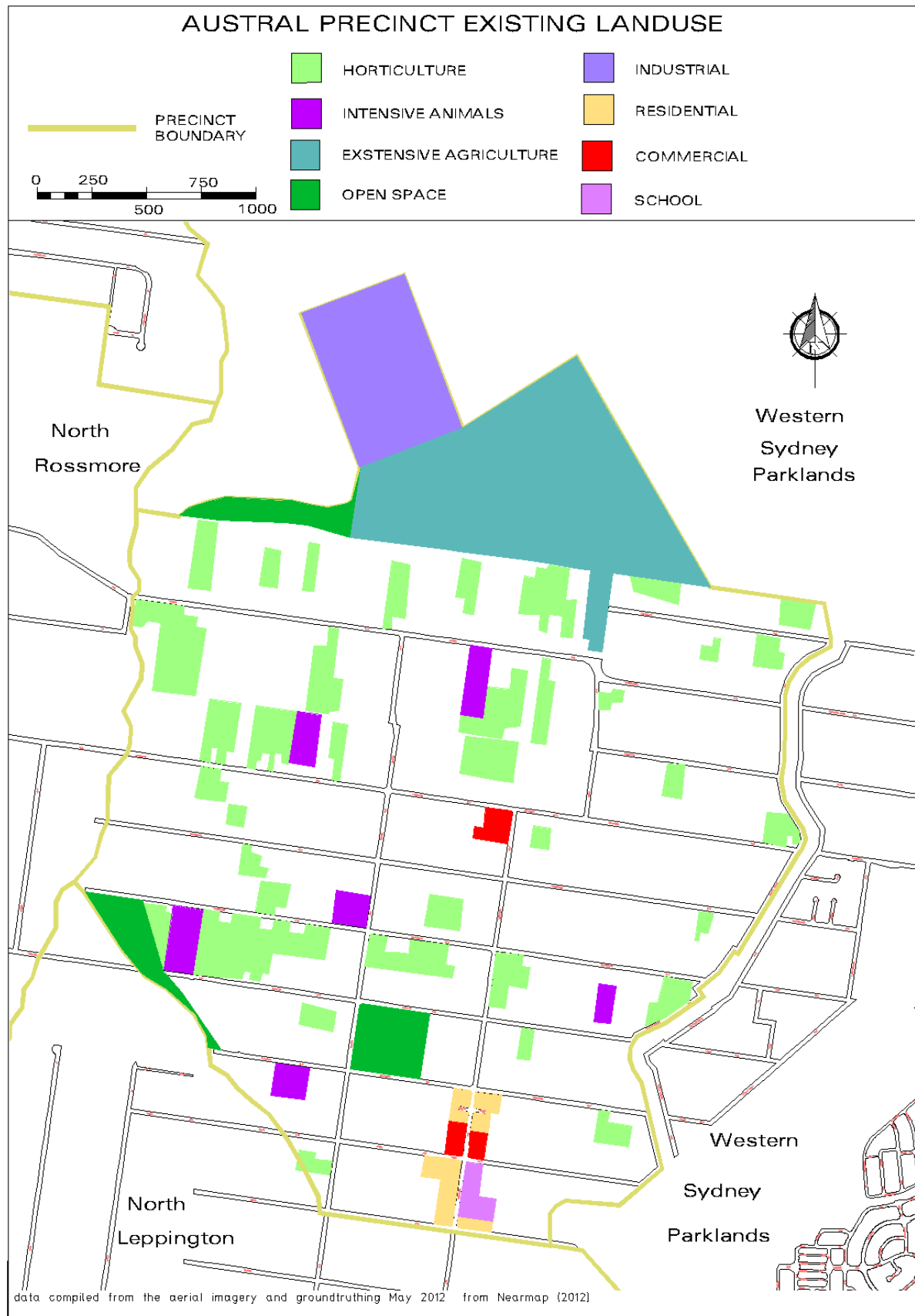


Figure 6.4 Austral Precinct existing Land use compiled from aerial imagery May 2012

6.2 Existing planning of Austral precinct

The Austral precinct is currently being planned as a new release area by the Department of Planning and Liverpool City Council. The draft planning documents have just completed the community consultation and the precinct will be released for development by the end of 2012 (*Sydney's Growth Centres* 2012). This section will describe what the current planning entails to enable the application of the proposed planning model to the precinct.

The precinct covers 928 hectares and is proposed to cater for a minimum of 8,000 dwellings and a projected population of 22,000 (Austral & Leppington North Pecinct Planning Report 2011). There will be a range of housing options with the majority of the housing being low density single dwellings on 550 square meter lots. There will be increased density around the proposed Austral town centre, which will be the centre of the community and services for the precinct. As part of the planning documentation, the Department of Planning and Infrastructure have prepared an indicative layout plan (ILP). The ILP has been prepared in accordance with the south west growth centre structure plan which is shown in figure 6.5 This plan shows the adjoining major centre of Leppington the proposed town centre of Austral, and the precinct in relation to the Western Sydney Parklands.



Figure 6.5 Part of the Sydney Structure plan showing the Austral precinct. (Austral & Leppington North Pecinct Planning Report 2011)

In response to the structure plan the draft ILP designates land as rural transition land or environmental living with minimum lot size of 2,500 square meters or open space (drainage) along the riparian corridors in response to the identified constraints of flooding (shown as blue in the structure plan) and revegetation requirements along these riparian zones of the precinct.

The major land designated in the ILP is to be low density residential. This low density urban development will mainly comprise of single dwellings on lots of 500 to 550 square meters typical to most growth areas of Sydney. With the minimum density of 15 dwellings per hectare as required in the planning documents. Twelve percent of land will be used for lower density residential of less than 15 dwellings per hectare. This large area of lower density residential is due in part to the land which is constrained by, flooding potential along the streams and creeks of the precinct, protection of the remnant vegetation and existing service corridor easements. These areas are zoned Environmental Living and Rural Transition. The density of the dwellings would be a minimum of ten and four dwellings per hectare or an average 1,000 to 2,500 square meter lots.



Figure 6.6 Bonds Creek Austral precinct which is modified from its natural state and is subject to flooding (May 2012)

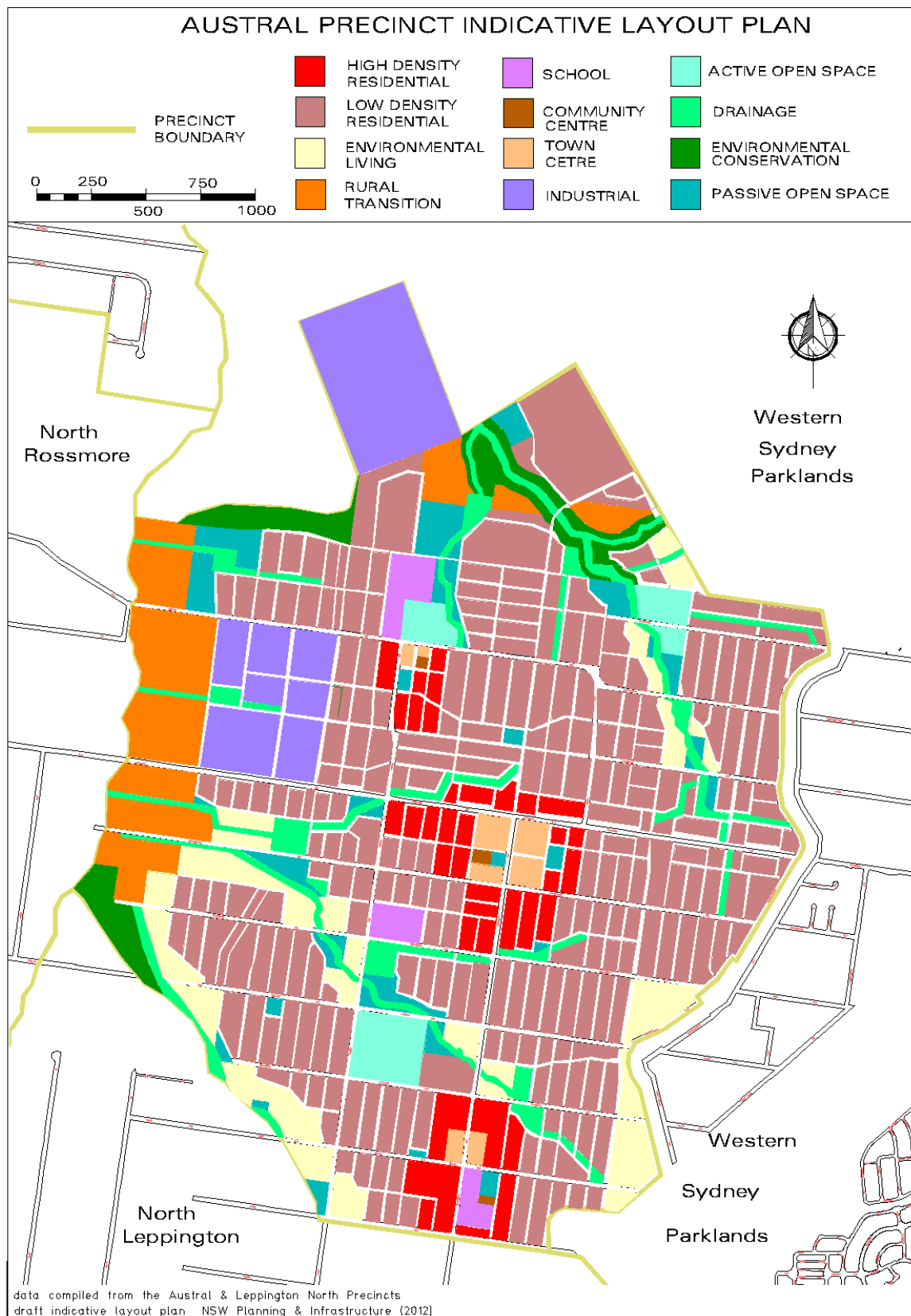


Figure 6.7 Indicative layout Plan (Austral & Leppington North Pecinct Planning Report 2011)

The ILP indicates increased density around town and village centres. The areas of increased density are within walking distance to the proposed town and village centres. The increased density at the town and village centres is designed to take advantage of the proposed public transport nodes located there. These higher density areas will be a minimum of 25 dwellings per hectare.

The total open space land will comprise of 14 percent of the precinct. The open space will comprise of environmental conservation areas, active recreation, passive recreation and drainage utilised for detention basins and channels. Due to the nature of the site there will be a network of open space coinciding closely to the drainage lines of the precinct allowing some creation of pedestrian and cycle networks through these spaces.

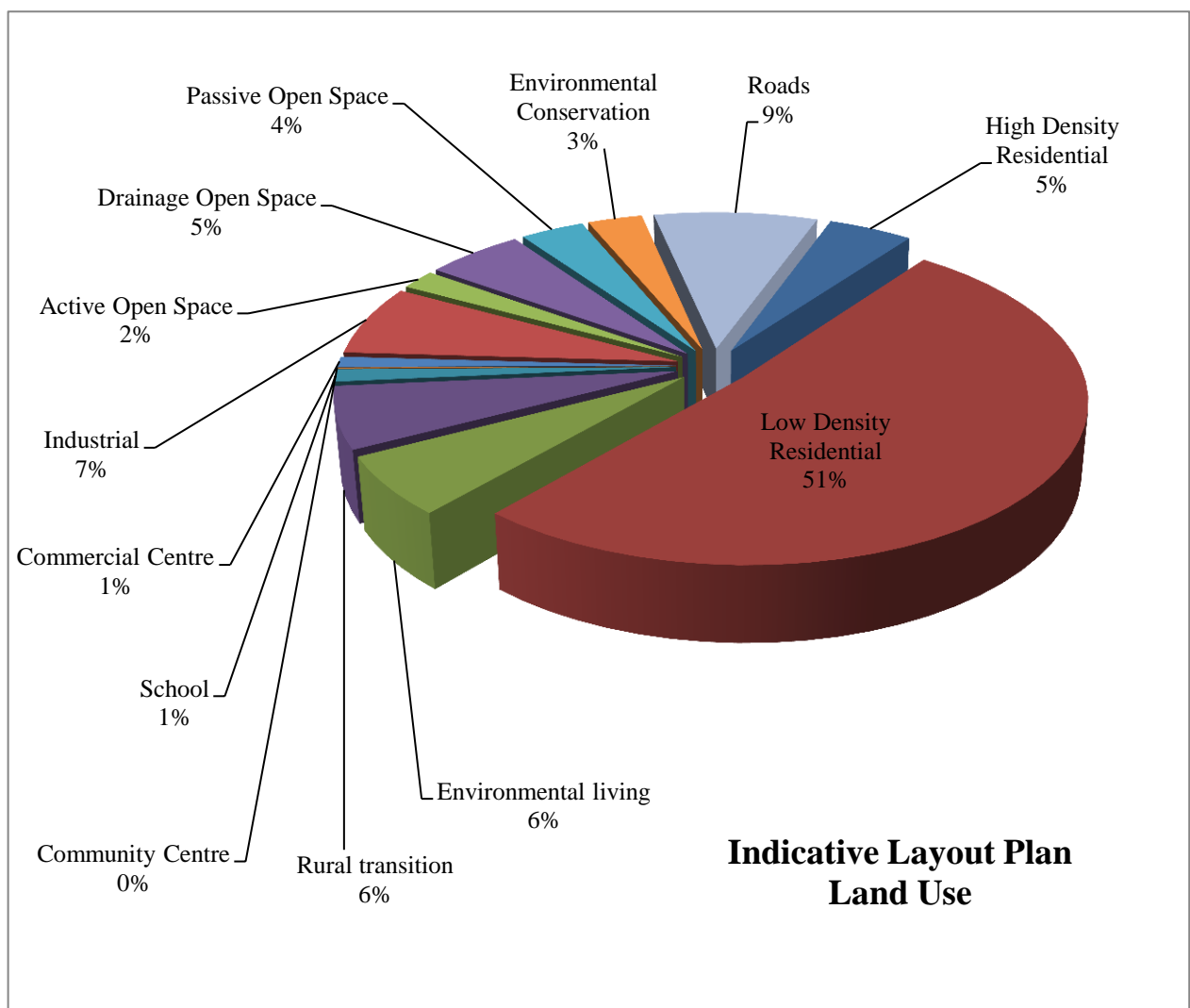


Figure 6.8 Austral Proposed indicted land use from the ILP

Using the projected dwelling density in the planning reports it indicates that there will be about 8,800 dwellings in the Austral precinct. It should be noted that the planning suggests that the minimum required density of dwellings is indicative only and a higher yield may be obtained upon final subdivision designs.

Land Use	Area (Ha)		Dwelling Density	Projected Dwellings
Active Open Space	19			
Drainage Open Space	52			
Passive Open Space	34			
Environmental Conservation	29			
Total Open Space	134			
High Density Residential	45		25	1125
Low Density Residential	453		15	6795
Environmental Living	58		10	580
Rural Transition	60		4	240
Total Residential	616			
School	12			
Community Centre	1			
Commercial Centre	10			
Industrial	68			
Roads	87			
Total	928			8740

Figure 6.9 Calculated areas and projected dwellings from the ILP for Austral, utilising the projected dwelling densities.

6.3 Objective A1

The first objective of the planning model is to create opportunities for urban agriculture through local food production and distribution for its sustainable benefits to the new urban precincts. These opportunities will be through community gardens and provision of farmers markets within the precinct.

The case study will apply this objective to the Austral precinct using the actions suggested in the planning model. Each action suggested in the planning model has a specific checklist which will be used to verify the success or non-success of the application of the model and to ensure that the projected dwelling and population of the precinct are not affected by the application of the model.

The ILP and data from the land use survey undertaken by the author will be used in the application of the actions in the case study.

6.3.1 Community gardens

The first action in the planning model is the creation of community gardens accessible to all residents. In the Austral precinct it is proposed to have space created for the community to develop these gardens. The action also called for the community gardens to be within a 400m radius, or walking distance of all residents of a neighbourhood. The model does not suggest how to create the community gardens but is designed to allow space for the creation of the gardens.

The local community would be responsible for the creation of the garden. Providing space, will allow for innovation by developers and community members in creating community gardens. Such as developers creating community gardens as part of the open space contribution for that development.

The following guidelines were utilised in the selection of the locations of the community gardens:

1. The streams and major roads within the precinct create neighbourhoods which were used to spatially locate the individual locations of the community gardens. Each neighbourhood will have access to at least one garden, with higher densities areas having the possibility of accessing multiple gardens.
2. The locations were chosen so every resident within the Austral precinct is within walking distance of a proposed garden. Stipulated in the model as 400 metres radius as depicted in figure 6.10.
3. The community gardens are to be located on land designated as passive open space in the ILP or on land constrained by service easements to minimise any reduction in dwelling projections.
4. The garden is to be of sufficient size to allow for a number of individual plots, it is suggested that 40 meters by 35 meters for areas within higher density areas while smaller areas of 30 meters x 25 meters can be used for all other gardens.

5. The locations are to be positioned for maximum visual access and ease of access by pedestrians.

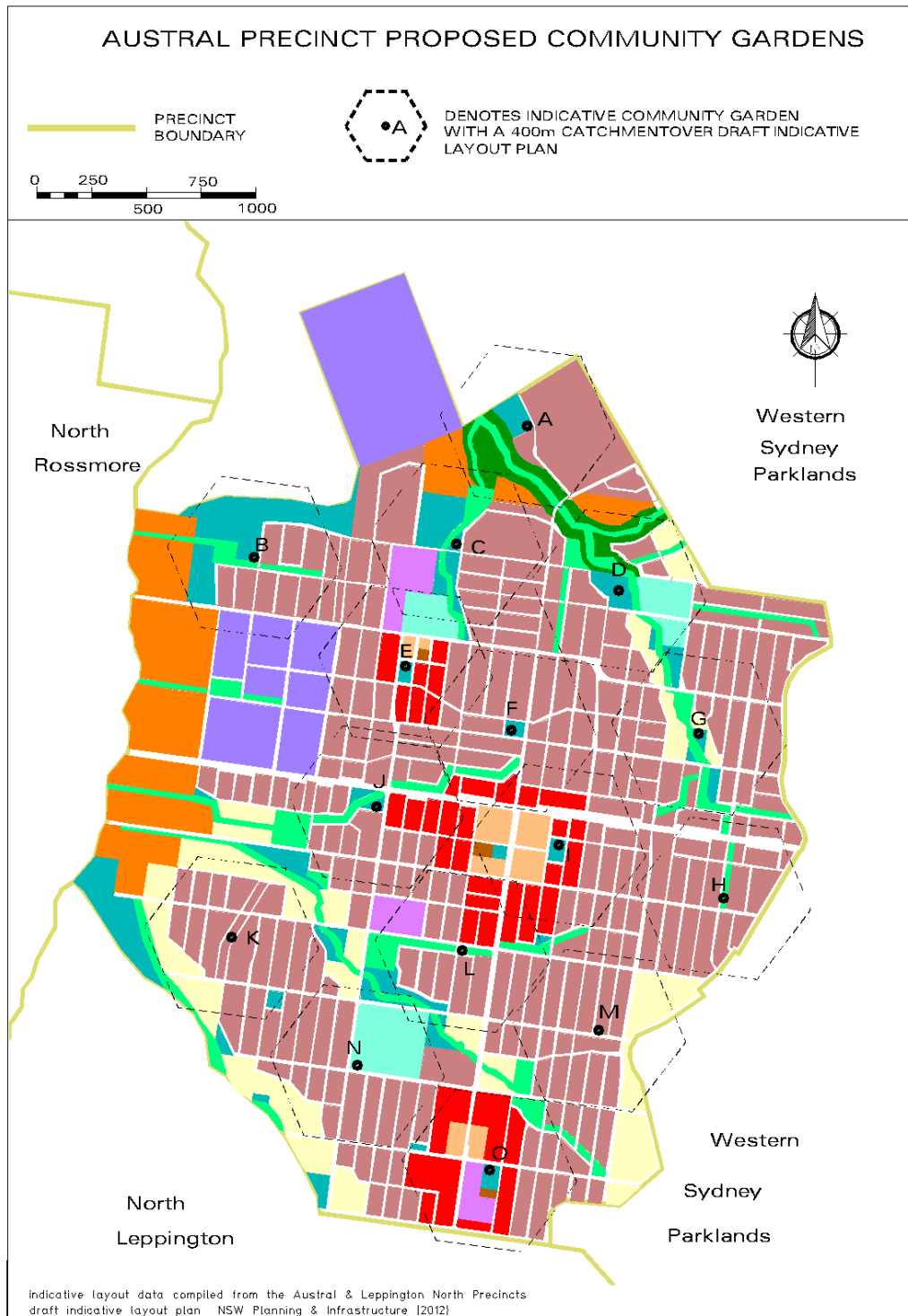


Figure 6.10 Location of proposed community gardens with 400m walking radius of residents of a neighbourhood.

To follow the proposed model, fifteen locations will need to be reserved. The following diagrams illustrate the proposed locations relative to the proposed density of development as designated in the draft ILP. Figure 6.11 indicates that the typical location of these gardens are

within passive open space. The examples show the proximity to the adjacent the higher density developments. It should be noted that the locations of the community gardens are indicative only and could be adjusted to suit the needs of the local community

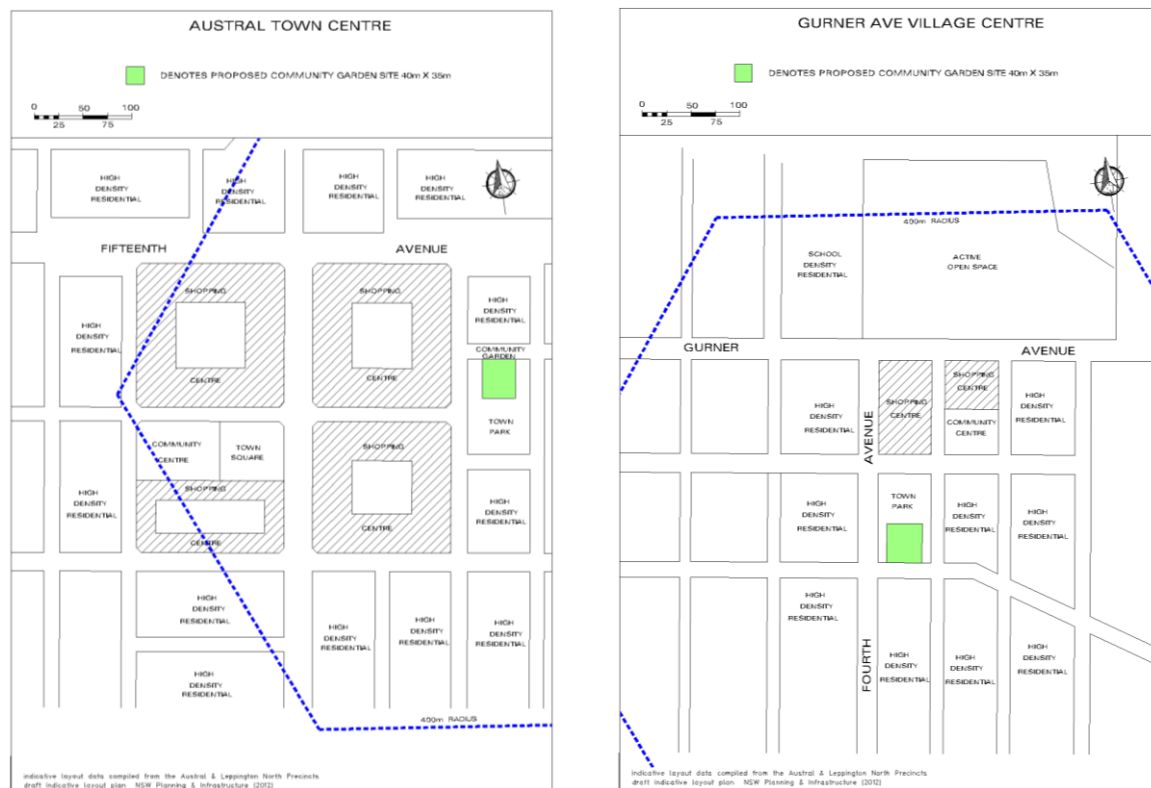


Figure 6.11 Austral and Gurner Ave community garden locations in relation to the higher density housing surrounding the commercial centres

The following checklist from the planning model was used to confirm that the action of creating the community gardens complied with the planning model. The checklist showed that not all community gardens can be created in the open space designated land. The case study found that it could not apply this requirement and still have a community garden accessible to all residents.

Action	√
Introduce a community garden at centre of each neighbourhood.	√
Community garden to be part of open space.	X
Community garden to be within 400 meters of the majority of all new urban residents.	√

The case study found that the application of this action failed for three gardens in lower density development areas.

- Garden H which is positioned within drainage open space not passive open space.

- Garden K which is positioned within a transmission line easement.
- Garden M which is positioned within low density development area.

Garden K is on land indicated as low density residential but is constrained by an electricity transmission line so will not reduce dwelling projections. Garden M will need to be positioned on low density developable land. These three examples would not contribute to the loss of developable area within the precinct with the exception for garden M. The reduction of overall developable area equates to 0.16 percent of the low density urban land in the ILP. The developer of the land may utilise the location of the garden to offset any open space monetary contribution for the development.

The case study application of this action has shown that this action can increase the sustainability of these new urban areas with very minimal cost or intrusion to normal development and little change to the ILP.

6.3.2 Farmers Markets

The second action in the planning model is to provide a space for direct marketing of food to consumers through farmers markets. These markets are to be located in the town centre in a permanent position to provide the opportunity for local farmers to utilise this location in a regular manner.

The model does not give specific actions as to how the markets are to be created or maintained, the model is designed to cater for the projected growth in this sector into the future. The model defines the desired frequency of at least weekly but does not suggest how to maintain that frequency of the market to a weekly schedule. The application of the model in this case study does not attempt to define these answers. By providing an opportunity and securing a space for potential growth inside new town centres, will allow the city farmers who are traditionally innovative, space to be innovative in the distribution of local food to consumers.

The following guidelines were utilised in the selection of the location of the farmers markets:

1. The farmers market is to be located in town/ village centres.
2. The location is to provide access to the majority of the residents of the precinct.
3. The location is to use high trafficable areas adjacent to other community facilities.

In the Austral precinct space for a farmers market would be created in the town centre of Austral as depicted in Figure 6.12. The town centre is located on Edmondson Avenue along the proposed transit boulevard between Austral and Leppington as depicted in the structure plan (figure 6.5). The town centre will hold up to 30,000 square meters of retail and will provide, retail and commercial uses, employment and community facilities. The development of the town centre will provide an east west link between the town square and park. This link will encourage vibrant street activity potentially with outdoor eating and entertaining areas. The commercial/ retail adjacent the town square will be oriented towards the town square

(Liverpool Growth Centres Development Control Plan: Austral and Leppington North Precinct 2012).

The case study found that the location of the proposed Austral town centre along with its attribute of a vibrant centre, transport connectivity and higher density living an ideal location for the farmers market. All of these attributes of the proposed town centre enhance the location of the farmers market to this spatial location. The location of a farmers market in the town square will enable the objectives of the action as shown in the checklist to be fulfilled. These objectives can be fulfilled without any additional land or significant infrastructure. The application of this action will enable the local food produces a permanent location for direct marketing to the maximum number of local residents. It will provide access to fresh local food and increase food security of the most disadvantaged of society. The creation of this space will enable the growth of these markets to be fulfilled without the need for costly infrastructure at a later date when no space can be found without large costs such as hire fees of commercial premises.

Action	√
Introduce space for farmers markets in town centre	√
Farmers market space to be in town squares or parks	√
The farmers market available for local producers to direct market	na
The farmers markets to be of at least weekly frequency	na

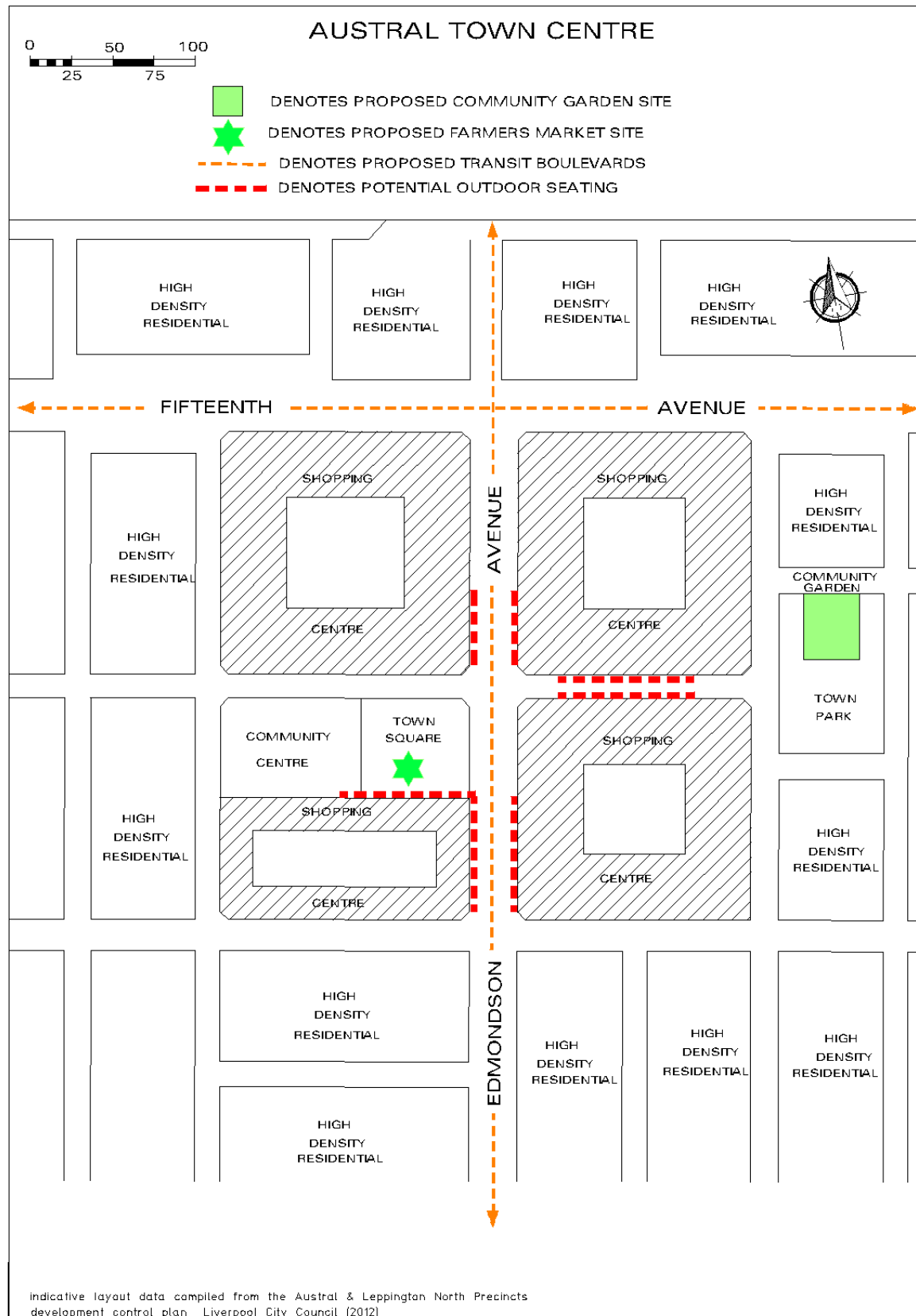


Figure 6.12 Austral Town centre showing the prosed farmes market in relation to the outdoor eating areas, community facilities and transit boulevard.

6.4 Objective A2

The second objective in the planning model is to create city farms, designed so as they produce local food for local consumption. This objective will create city farms as:

- Part of passive open space in the ILP.
- In a cluster to enable efficient re-use of urban waste.
- Retain some of the existing farmland.
- Be a buffer to sensitive or constrained land.

The case study application will use the checklist as a framework for the application of the model. The checklists will be used along with a recalculation of projected dwelling and population figures for the Austral precinct to ensure that projected dwellings are not affected by applying the model. Additionally the area of land which is maintained as agricultural due to this objective will be compared to what area is being utilised currently for agriculture. The quantity of food capable of being produced by the city farms will be calculated from projected yield data.

This model suggested four different actions for the creation of city farm areas. The case study applied the actions not in isolation but where possible by using a number of the actions to create a city farm site. By using multiple actions for the creation of these city farms it would be anticipated that the sustainable advantages to these farms could be increased.

In creating the city farms in open space a new land use designation will be required. The author suggests the land should be designated as open space (agriculture). Currently the ILP and planning documents do not designate this type of land use. For the creation of the city farm sites in the case study it will utilise the suggested ten percent of open space land for agricultural purposes.

The following guidelines were used in the creation of city farms:

1. Positioned to provide interaction between the urban resident and the rural landscape.
2. Positioned to allow for the increased education in the community of food production.
3. Positioned on proposed passive open space creating productive open space.
4. Positioned in cluster for efficient reuse of waste reducing environmental pollution.
5. Positioned for the capture and reuse of nutrients.
6. Positioned to access recycled water for a more reliable water source for intensive agriculture in times of drought.
7. Positioned to reduce cost of recycled infrastructure with small neighbourhood recycling plants supplying small specific areas.
8. Positioned to retain existing agricultural land.
9. Positioned as a buffer to flood prone land.
10. Positioned as a buffer to bush fire risk areas.
11. Positioned as a buffer to riparian zones.
12. Positioned as a buffer to areas which require environmental protection.

The following combined checklist was used in the creation of the city farm areas, this checklist shows the overall performance of the Austral precinct in the case study.

Action	√
Create city farms as 10 percent of total open space	√
Positioned on passive open space as designated in ILP.	√
Positioned to utilise some of the existing farmland.	√
Positioned in small clusters.	√
Positioned to allow pedestrian/ cycle visual access	√
Positioned to allow access recycled water.	√
Positioned as a buffer to flood liable land.	√
Positioned as a buffer to bushfire risk areas.	√
Positioned a buffer to environmental land.	√
Positioned adjacent riparian corridors.	√

The application of this objective in the Austral precinct provided 23 hectares of city farms. A total of seven separate farms were created utilising various actions. They were able to be created without significant reduction in the developable land. The locations of the city farms are shown in figure 6.14 and are located right across the precinct to allow for a large interaction between farming processes, the seasonal cycles of food production and the urban resident.

The model suggested that 10 percent of open space land be utilised for city farming and that it utilises land designated as passive open space in the ILP. The case study would need to provide 13.4 hectares of land to comply with this model. But what the model does not account for is that there is only 34 hectares of passive open space in the whole precinct. The case study would need to utilise a third of this land which proved difficult to apply. The location and small irregular shapes of the passive open space makes some of the passive open space designated land unsuitable for city farm sites. Some of these difficulties may be overcome by adjusting the ILP to suit or when creating the ILP allowing for some larger more regularly shaped areas of passive space more suitable for city farming, while not increasing the actual area of passive open space.

The case study found that locating city farms in a cluster was difficult in this case study due to the proposed locations of the passive open space and the majority of the passive open space being small areas not suitable for farm cluster creation. It would be anticipated that city farms would be of one to two hectare size equivalent to the existing city farms located in Sydney and Melbourne. The difficulties with the shape and size of passive open space may not be the case in other new urban release areas, to maximise the recycling opportunities a cluster situation would be more sustainable and should be considered when creating areas of possible open space agricultural land.

The case study found that the existing agricultural land in Austral, although extensive it did not always coincide with the proposed passive open space of the ILP. This enabled only 14 hectares of the existing farmland to be retained for agricultural purposes. The retention of some traditions would be more suitable than creating new farms due to the existing infrastructure and traditions that exists on the existing farms.

The case study was able to use the city farm areas to be a buffer to riparian, environmentally sensitive and flood liable land. Due to the constraints on the land these areas were not designated as residential in the ILP and by creating these as city farms they would provide additional environmental benefits to these area such as bushfire protection and groundwater recharge.

An important consideration for city farming is the production quantities of food from this land. The ABS collects data on current yields from vegetable production in Australia, which varies from 1.6 kg/m² for lettuce to 7 kg/m² for tomatoes (ABS 2009). These figures include large vegetable farms (more than 70 hectares) with no specific data on smaller farms in the peri urban or urban areas of Australia. It would be expected that yields in the city farms would be higher, as the production is more intensive with better water access as suggested by Houston (2005) and Viljoen and Bohm (2005) . It has been shown by the intensive urban and peri urban farming in Cuba that yields from 8kg/m² up to 24kg/m² are achievable (Diaz, J. & Harris, P. 2005) but even if using the lower end of this scale the city farms created in this precinct could potentially produce up to 1800 tonnes of food annually from the 23 hectares of city farms.

The city farms created in the case study comprise of 1-2 hectares. One of the arguments against the creation of smaller city farms is that the size of these farms would be uncommercial. ABS (2009) data suggests that more than 20 percent of vegetable farms in Australia fit into the category of between 0-5 hectares.



Figure 6.13 Existing agricultural land use of the Austral precinct 14 hecatres will remain after the application of the model

The flowing sections will describe each of the city farm locations and the individual checklists for their creation.

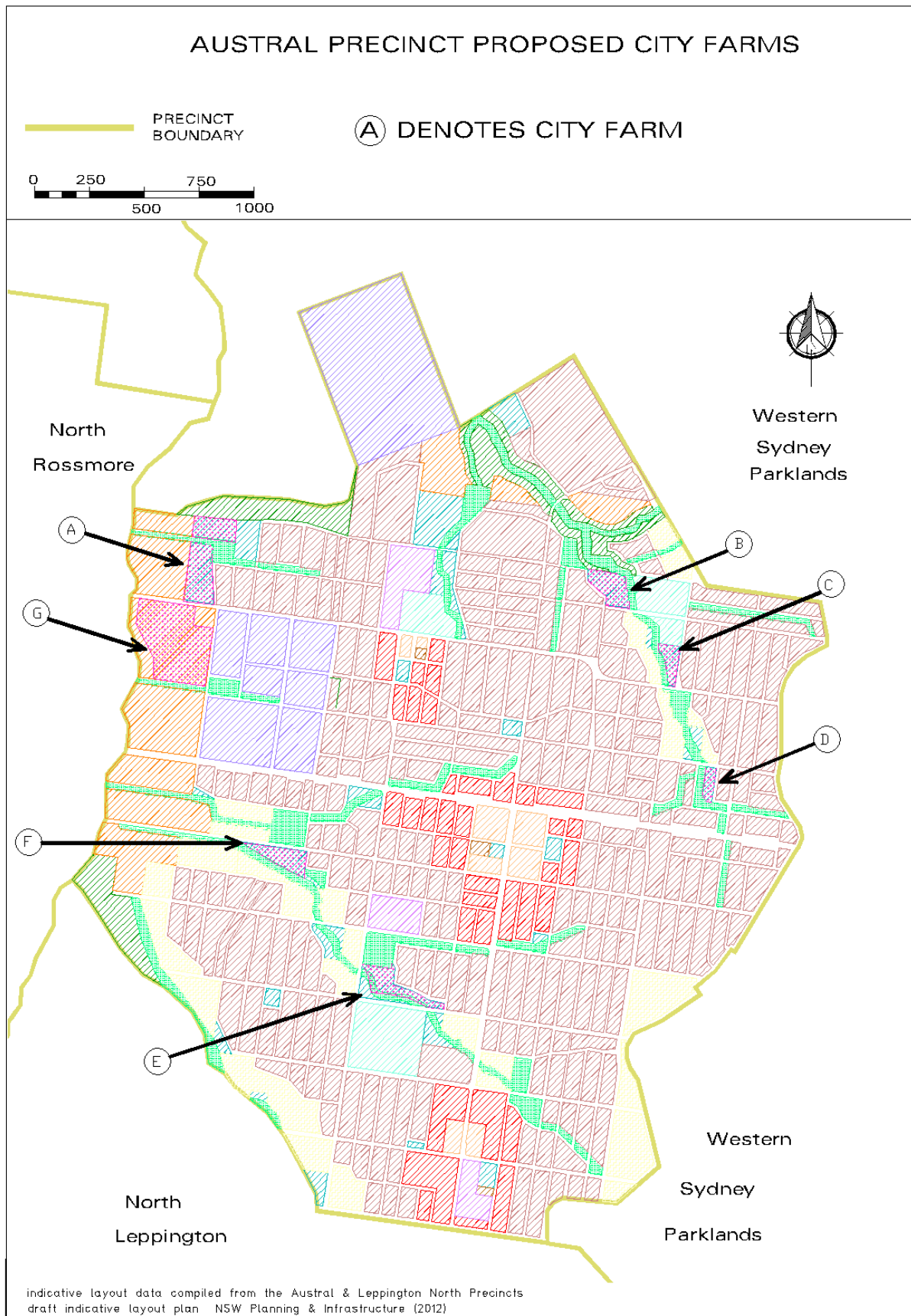


Figure 6.14 Austral precinct city farm sites

6.4.1 City Farm Sites A & G

This section will describe the selection criteria and how these sites met the actions proposed in the model for city farms creation. The creation of sites for a city farm utilised the existing land use in conjunction with the proposed land use. The location of Farm A and G are shown on figure 6.16 overlaid with the aerial image and the ILP.

City farm A is located north of Gurner Avenue with the site occupying five hectares. This location utilises some of the existing horticultural farmland. It is to be located adjacent remnant bushland to the west and north, providing a buffer to the residential land to the east from the risk of bushfire. The land is located on identified flood liable land from Kemps Creek and would be a good location for groundwater recharge being adjacent the riparian corridor. The location is able to be accessed visually by residents of the adjoining land; there is a possibility of a cycle/ pedestrian pathway along the drainage corridor to further enhance this visual access to the farm. The farm is located close to the proposed alignment of the sewer carrier to enable the creation of a recycled water factory. The size of the site may allow for a number of small intensive farms to operate as a cluster, similar to examples at Kymeegah (Sydney) where three farms operate on 4.5 hectares of land. This farm will not reduce any developable land and no additional infrastructure is required as the land is on proposed passive open space. The checklist below shows how this location met the actions proposed in the model.

Action	✓
Positioned on passive open space as designated in ILP.	✓
Positioned to utilise some of the existing farmland.	✓
Positioned in small clusters.	✓
Positioned to allow pedestrian/ cycle visual access	✓
Positioned to allow access recycled water.	✓
Positioned as a buffer to flood liable land.	✓
Positioned as a buffer to bushfire risk areas.	✓
Positioned a buffer to environmental land.	✓
Positioned adjacent riparian corridors.	✓



Figure 6.15

Existing horticultural land use of the proposed city farm site A (July 2012)

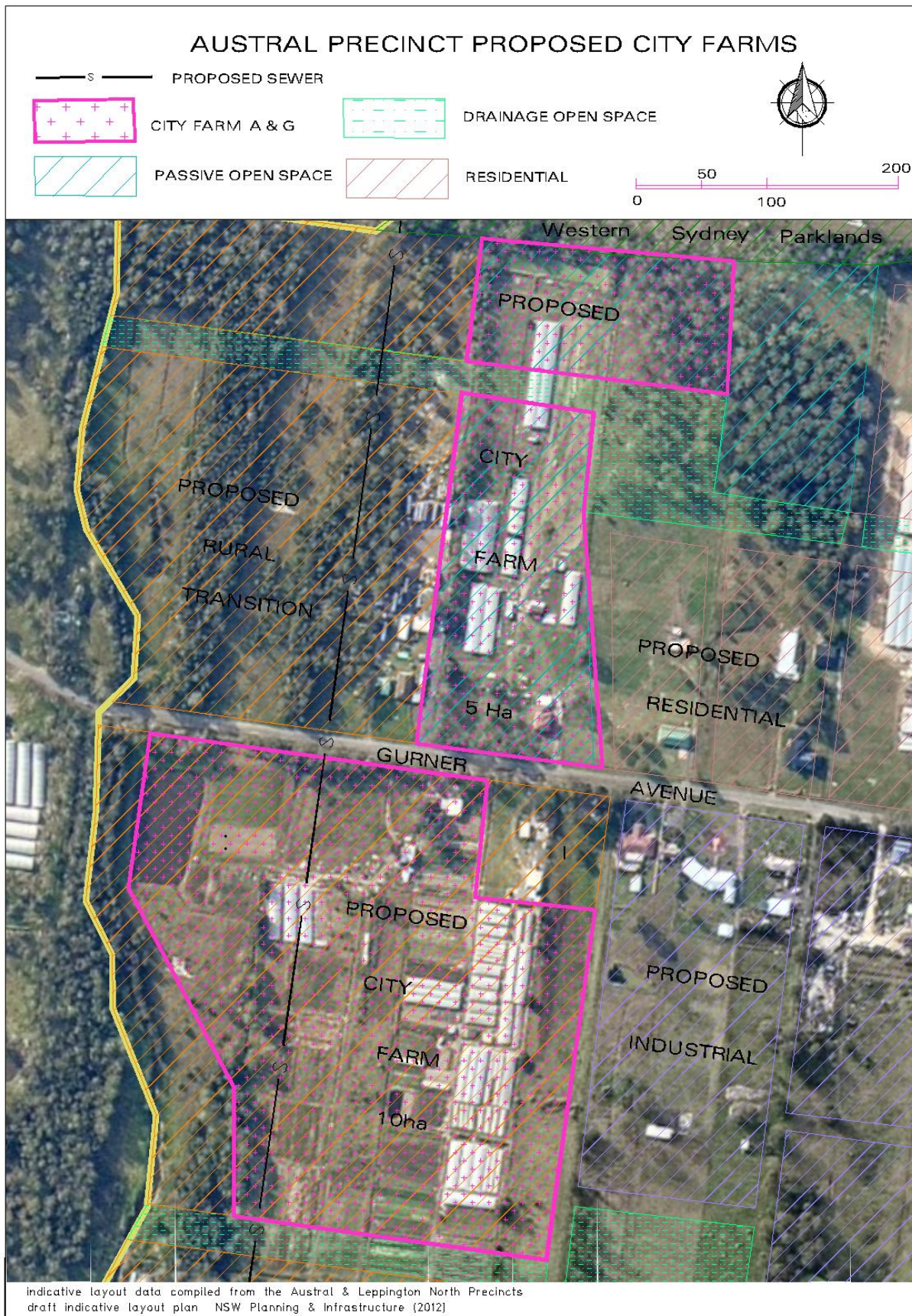


Figure 6.16 Proposed City Farm sites A & G

City Farm G is located to the south of Gurner Avenue with the site occupying 10 hectares. This farm does not comply with the model as it is positioned on land designated as rural transition land. But this farm location has been included as a good example of the ability for the model to be adjusted to suit a local conditions.

The Austral precinct has large areas of land which are flood liable from both Bonds and Kemps Creeks. In response the ILP has not designated this land as residential but has created a very low density land use of 4 dwellings per hectare to enable a gradual transition from residential to rural landscapes. This land use while valid could be amended without any significant reduction of developable residential land. The case study is only attempting to implement the land after the ILP has been created, if the land use suited open space agricultural as suggested in the model this land may be considered to be better utilised this way instead of rural residential.

This farm utilises existing horticultural farmland and is of a significant size and adjacent to site A which would enhance the recycling efficiency. The location would enable either a large farm to continue or has the capacity for four to five smaller intensive farms in a cluster. The farm is located between industrial land to the east and the riparian zone of Kemps Creek to the west enabling it to be a buffer for stormwater runoff and enable groundwater recharge. The farm is positioned that some of the land if classified as open space could be utilised as a north- south route for cycle/pedestrians between Gurner and Fifteenth Avenues, adding to the access for the community. The checklist below shows the suitability of the site with the proposed model.

Action	
Positioned on passive open space as designated in ILP.	x
Positioned to utilise some of the existing farmland.	√
Positioned in small clusters.	√
Positioned to allow access recycled water.	√
Positioned to allow pedestrian/ cycle visual access	√
Positioned as a buffer to flood liable land.	√
Positioned as a buffer to bushfire risk areas.	x
Positioned a buffer to environmental land.	√
Positioned adjacent riparian corridors.	√



Figure 6.17

Existing horticultural land use of the proposed city farm site G (July 2012)

6.4.2 City Farm Site B

The location of city farm B is shown in figure 6.19 to the north of Seventeenth Avenue with the site occupying two hectares. It utilises some of the existing grazing land. It is to be located adjacent remnant bushland to the north, providing a buffer to the residential land to the west from the risk of bushfire. The land is located along an unnamed stream and is a good location for groundwater recharge being adjacent this riparian corridor. The location is able to be accessed visually by residents of the adjoining land to the west, there is a possibility of a cycle/ pedestrian pathway along the drainage corridor to further enhance this visual access to the site. The farm is located close to the proposed alignment of the sewer carrier to enable efficient use of recycled water, and is close to two other sites (sites C & D) to enable more efficient use of recycling. This farm will not reduce any developable land and no additional infrastructure is required as the land is on proposed passive open space. The checklist below shows how this location met the actions proposed in the model.

Action	
Positioned on passive open space as designated in ILP.	√
Positioned to utilise some of the existing farmland.	x
Positioned in small clusters. (along with farms C & D)	√
Positioned to allow access recycled water.	√
Positioned to allow pedestrian/ cycle visual access	√
Positioned as a buffer to flood liable land.	√
Positioned as a buffer to bushfire risk areas.	√
Positioned a buffer to environmental land.	√
Positioned adjacent riparian corridors.	√



Figure 6.18 Existing site B showing the remnant bushland to the north (July 2012)

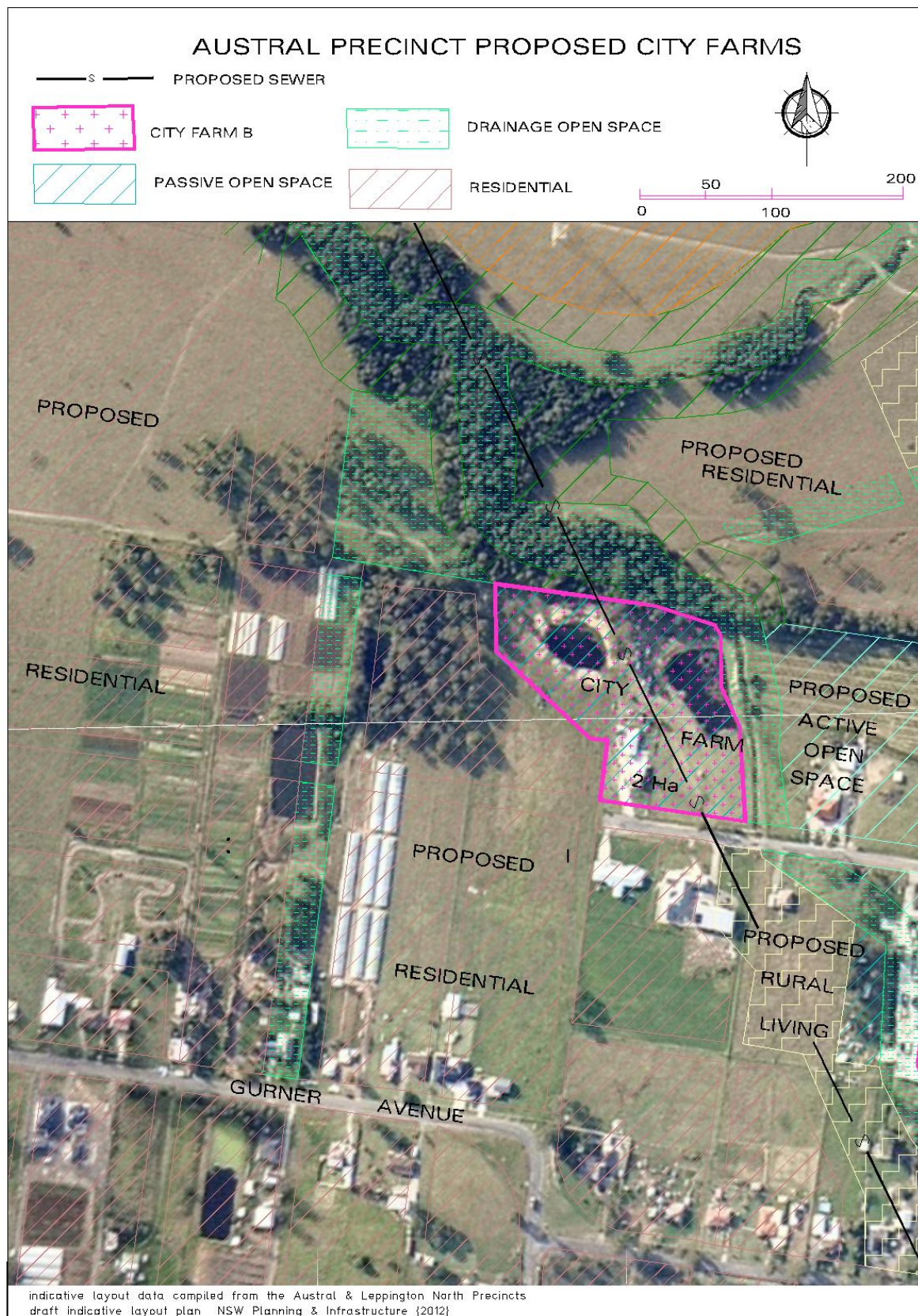


Figure 6.19 Proposed City Farm site B

6.4.3 City Farm Site C & D

The location of city farm sites C & D are shown in figure 6.21, they are to the south of Sixteenth Avenue and north of Gurner Avenue, with both sites occupying 1 hectare. It does not utilise existing farmland but the land is open and vacant. It is located next to an unnamed stream and is a good location for groundwater recharge and to filter urban runoff being adjacent this riparian corridor. City farm C is located on flood liable land and is located close to remnant bushland and would be a good buffer to reduce bushfire risk. The location is able to be accessed visually by residents of the adjoining residential land to the east, there is a possibility of a cycle/ pedestrian pathway along the drainage corridor to further enhance this visual access to the farm. Both farms are along the proposed sewer carrier and along with site B could be considered a small cluster of farms which are able to more efficiently access recycled water. These farms will not reduce any developable land and no additional infrastructure is required as the land is on proposed passive open space designated in the ILP. The checklist below shows how this location met the actions proposed in the model.

Action	
Positioned on passive open space as designated in ILP.	√
Positioned to utilise some of the existing farmland.	x
Positioned in small clusters. (along with site B)	√
Positioned to allow access recycled water.	√
Positioned to allow pedestrian/ cycle visual access	√
Positioned as a buffer to flood liable land.	√
Positioned as a buffer to bushfire risk areas.	√
Positioned a buffer to environmental land.	√
Positioned adjacent riparian corridors.	√



Figure 6.20 Existing site D showing open land suitable for urban farming (July 2012)



Figure 6.21 Proposed City Farm site C & D

6.4.4 City Farm Site E

The location of city farm E is shown in figure 6.23 to the north of Twelfth Avenue with the site occupying 2 hectares. The shape and size of the passive open space indicated in the ILP does not allow for a large regular shaped farm site. An adjustment of the drainage corridor would be required to enable the city farm to be located and shaped to be more efficient. The site is adjacent active open space, drainage open space and residential land. The land is adjoining existing horticultural farms and is open and clear of remnant vegetation. It is located next to an unnamed stream and is a good location for groundwater recharge and to filter urban runoff being adjacent to this riparian corridor. The location is easily accessed visually by residents of the adjoining land to the east; there is a possibility of a cycle/ pedestrian pathway along the drainage corridor to further enhance this visual access to the farm. The site will be part of a large area of open space in this vicinity with various uses and will give the residents of the precinct a large open area in the centre of the precinct. Site E is located on land designated as flood liable. This farm will not reduce any developable land and no additional infrastructure is required as the land is on proposed open space land. The checklist below shows how this location met the actions proposed in the model.

Action	
Positioned on passive open space as designated in ILP.	√
Positioned to utilise some of the existing farmland.	x
Positioned in small clusters.	x
Positioned to allow access recycled water.	x
Positioned to allow pedestrian/ cycle visual access	√
Positioned as a buffer to flood liable land.	√
Positioned as a buffer to bushfire risk areas.	x
Positioned a buffer to environmental land.	x
Positioned adjacent riparian corridors.	√



Figure 6.22 Existing site E adjacent existing farms (September 2012)

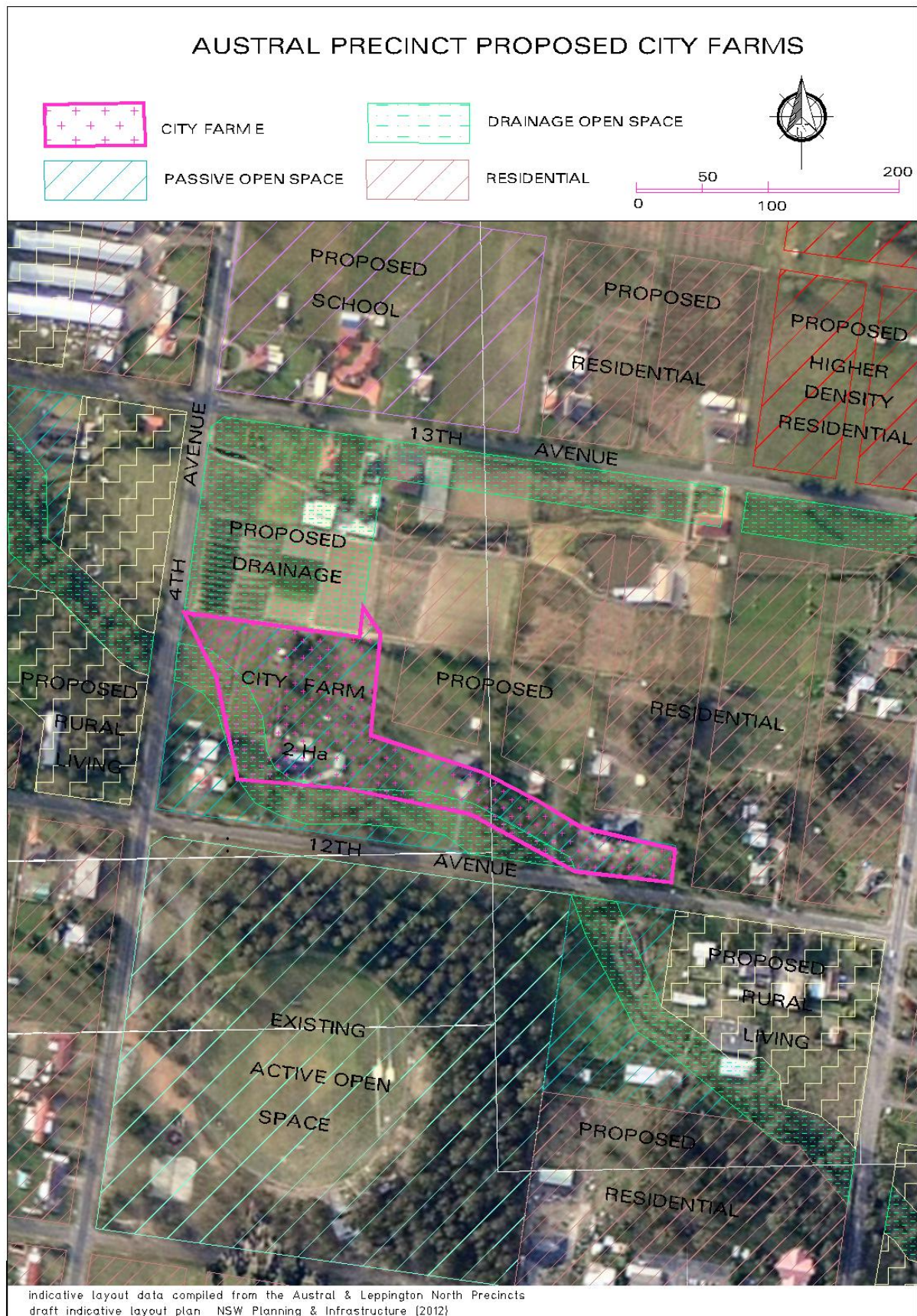


Figure 6.23 Proposed City Farm site E

6.4.5 City Farm Site F

The location of city farm F is shown in figure 6.25 to the south of Fourteenth Avenue, West of Fourth Ave with the site occupying 2 hectares. It is adjacent drainage open space and residential land to the east. The site is adjoining existing horticultural farms and is open and clear of remnant vegetation. It is located next to an riparian corridor on flood liable land, is a good location for groundwater recharge and positioned to filter urban runoff. The location is easily accessed visually by residents of the adjoining land to the east, there is a possibility of a cycle/ pedestrian pathway along the drainage corridor to further enhance this visual access to the farm. This farm will not reduce any developable land and no additional infrastructure is required as the land is on proposed open space land. The checklist below shows how this location met the actions proposed in the model.

Action	√
Positioned on passive open space as designated in ILP.	√
Positioned to utilise some of the existing farmland.	x
Positioned in small clusters.	x
Positioned to allow access recycled water.	x
Positioned to allow pedestrian/ cycle visual access	√
Positioned as a buffer to flood liable land.	√
Positioned as a buffer to bushfire risk areas.	x
Positioned a buffer to environmental land.	x
Positioned adjacent riparian corridors.	√



Figure 6.24 Existing site F, open underutilised land adjacent drainage corridor (September 2012)



Figure 6.25 Proposed City Farm site F

6.5 Objective A3

The last objective of this planning model is to implement financial aids to farming in the new precinct. This assistance would assist developers and new farmers in starting and maintaining economically viable agricultural activities within the precinct.

Before any actions are undertaken as part of this objective the economic viability of the city farms will be increased by the ability to direct market the locally produced fresh food in the farmers markets created as part of objective A1. This will continue the tradition of the farmers in the Austral precinct where currently the vegetable growing sector direct markets by the use of roadside stalls and farm gate sales as illustrated in figure 6.26.



Figure 6.26 Direct marketing of agricultural production in Austral (July 2012)

The first action of this objective suggests that land designated as open space could be leased for farming by the local government to farmers with sustainable farming practices. A version of this model exists where a government authority controls land and leases the land for food production. The Western Sydney Parklands utilises land that it owns for agricultural food production where it is envisaged that ten percent of the parklands will be utilised permanently for food production. Additionally more farmland is leased to farmers while the parklands await development for recreation (*Western Sydney Parkland Plan of Management 2020 2010*). This minimises the maintenance costs for the authority and allows land awaiting further development into parklands to be used in the interim as food production. Currently two percent of land (105 hectares) in the Western Sydney Parklands are utilised this way. The parklands trust is developing leases with farmers along with educating farmers on more sustainable farming practices. This practice enables the education, increased recognition of the importance of farming in the area while developing an urban farming model (*Western Sydney Parkland Plan of Management 2020 2010*). It is anticipated that the application of this action of leasing open space in Austral would work in a similar manner once the land is owned or controlled by local government.

There are two ways that local government can acquire open space land, the first being by direct purchase of the land designated and zoned as open space in the ILP. The local government authority purchases the land from the owner for the provision of large drainage or open space

infrastructure projects. Once the land is purchased it can be dedicated to the public as reserves or open space. The second method which is most commonly used in new greenfield areas is by direct contribution of land from the developer under section 94 of the *Environmental Planning and Assessment Act* (1979). Section 94 allows the consent authority to charge a developer a fee if there will be an increase in demand for public amenities and services as a consequence of a development. This requires a fee to be paid by the developer or a dedication of land at no cost to the consent authority for use in providing public uses and amenities. The types of infrastructure which are required to be paid for or contributed towards by developers are (*Liverpool Contributions Plan 2008: Edmondson Park 2008*):

- Community facilities.
- Recreation facilities.
- Transport (bike, pedestrian paths and bus stops).
- Drainage infrastructure.

The provision and dedication of open space land as part of the contribution by a developer gives the local government authority land and infrastructure ownership without capital costs. This open space land is vested in council and is for public use. This land when provided will require maintenance and will have ongoing maintenance costs. Leasing some of the land in the Austral precinct for agriculture will reduce this ongoing cost. It will enable the local government authority access to a revenue stream from the open space land for use in maintaining other areas of open space with its associated infrastructure such as play equipment and bicycle pathways.

The checklist for the application of the model proved difficult to apply but by utilising the example of leasing of farmland in the Western Sydney Parklands this action would be able to be applied to the Austral precinct.

The second action from this objective suggests the reduction of land rates for land used for agricultural purposes. Currently land can be exempt from land tax if the dominant use of the land is primary production. The land is required to be zoned rural ,rural residential or non-urban under a planning instrument (*Primary Production Land Exemptions 2012*). This exemption could be applied in the Austral precinct case study. This could be achieved by classifying the land zoned rural transition and environmental living as non-urban to enable the land to comply with the exemptions. To be eligible for the exemption the owners of the land would need to provide evidence that all the following conditions are met:

- Its dominant use is for primary production
- It has significant commercial purpose, size and character.
- The production has the intention of making a profit.

To comply with this requirement it may be difficult for the small city farmer to prove that his farm is substantial enough to warrant exemption from tax. It may prove to be beneficial to enable changes in practice or legislation to enable the small intensive farms, as is the practice on the urban fringe to qualify for this exemption. The exemption for land tax will assist city farms, such as site G. In the case study it would enable a further 118 hectares of land in the Austral precinct capable of exemption of land tax if the land is utilised for primary production. In fact it may ensure that farming will remain more economically sustainable on the land zoned rural transition and rural living in Austral. This action will also allow for the transitional use of land to be utilised as farming in Austral, reducing the tax burden of the newly zoned residential land and reducing the incentive for urban development.

The objective A3 suggests two economic actions but also states that these are examples of actions that could be applied. The application to the Austral precinct has shown that the city farmer could obtain assistance in reducing costs such as land tax. The case study further found that the provision of secure access to land for farming would be increased by the Local Government Authority leasing land to farmers. This secure access to land is considered a large impediment (Jeffs 2009; Mason 2006a) for new and innovative farming practices due to the high cost of land in urban and peri-urban areas.

The checklist for the application of the actions are shown below.

Action	√
Open space land for agriculture identified by LGA and purchased by LGA for inclusion into open space.	√
Open space land for agriculture identified by LGA and provided by developers for inclusion into open space.	√
LGA lease open space land for agricultural use.	√
LGA to provide long term leases for secure tenure of farmers of open space land.	√
Remove or reduce land tax for urban agricultural production	√

6.5 Conclusion

The planning model was designed to be implemented into new urban release areas on the fringes of Australian cities. It was anticipated that the application of the planning model in a case study of a newly planned release precinct would show the difficulties or problems associated with the proposed model. The application does not attempt to verify the effectiveness of the proposed model only show that its application is possible or not possible as the case may be. To prove the model it would require applications to different case studies which is outside the scope of this research.

The case study of the Austral precinct has shown that the planning model designed to assist agriculture did not affect the total amount of residential land and projected dwellings designated in the ILP and draft planning documents. Figure 6.27 shows the amended dwelling projection which was reduced by 40 dwellings by the reduction of the rural transition land utilised in city farm site G. This reduction is only a small reduction when considering the dwelling densities are the minimum required by development. The application of the model reduced significantly the amount of passive open space, the application of the model was able to increase overall open space with the introduction of a new category of agriculture open space.

Land Use	Area (Ha)		Dwelling Density/Ha	Projected Dwellings
Active Open Space	19			
Drainage Open Space	52			
Passive Open Space	21			
Environmental Conservation	29			
Agriculture Open Space	23			
Total Open Space	144			
High Density Residential	45		25	1125
Low Density Residential	453		15	6795
Environmental Living	58		10	580
Rural Transition	50		4	200
Total Residential	606			
School	12			
Community Centre	1			
Commercial Centre	10			
Industrial	68			
Roads	87			
Total	928			8700

Figure 6.27 Re-calculated lot and dwelling projections for Austral Precinct after the application of the planning model

The case study was able to apply the first action, the creation of community gardens to a high level of success. It found that in applying the community gardens it did not significantly

reduce residential land and it also created a new opportunity for developers to provide some open space land within developments. The creation of farmers' market space in the town centre of Austral fits within the desired outcomes of the planning documents and will provide opportunities for farmers and consumers alike in this growing method of food distribution.

The creation of city farms in the Austral precinct aimed to retain some of the land that was already used for agricultural production. The existing land use in May 2012 indicated that 99 hectares of land was under horticultural production. The application of the model in the case study was able to retain only 15 hectares. This may be considered only a small quantity of land. But when placed in context of the desired objectives of the planning model this portion of retained food production land is significant, when faced with the total disappearance of food production from the precinct. It is not the desired outcome of the model to replace the whole food system but to introduce the production of food into urban areas so cities can become more sustainable. The application of the case study has importantly found that the location and shape of the passive open space designated in the ILP was not suited on a whole to the creation of city farms. This may be overcome in the future if this is taken into consideration this when creating open space in planning for new release precincts.

The application of financial assistance to new city farmers will enable this type of land use to be more economically sustainable. In Austral the two actions were easily applied, the land tax exemption which is current today may actually increase the areas of agricultural production in the Austral precinct. With some small changes to the exemption criteria for land tax it may enable a significant portion of the urban release area to be under agricultural production. It was found that it may actually retain more of the land being used for agriculture in Austral as the farmers are shielded from any increase in land taxes when the land is designated as residential.

Overall the case study of Austral precinct in Western Sydney was successful in that it enabled the identification of parts of the model which worked efficiently and the parts of the model which require further investigation and verification before adoption. The case study importantly was able to show that on the fringe of cities where new urban release areas are occurring agriculture could be considered an important part of an urban landscape. It can be included with limited effect on the overall housing supply while providing other substantial benefits to these new urban areas. It will ultimately help these new urban areas become more sustainable into the future.

7.0 FURTHER RESEARCH

During the course of the research it became apparent that there are a number of avenues of further research which could add to the knowledge of this field and assist in planning of our urban living environments of the future.

The actual extent and agricultural use of farmland on the fringe of cities in Australia is debated in literature. The economical and spatial extent of farming on the fringe of our cities tends to be manipulated to the advantage of the end user of the information. The agricultural departments and bodies such as Farmers NSW report high levels of production and the NSW Department of Planning report lower levels of importance. In research by James et al. (2010) it was suggested that a more uniform and repeatable methods of measuring the economic and spatial location of agricultural production is needed in order to obtain useful trend information on farming in the urban fringe of Australian cities.

Specifically in the Metropolitan Plan for Sydney 2036 (2010) it is noted as an objective that existing rural resource land be mapped on the edges of Sydney to better enable planning to protect this resource land use. But importantly it needs to be mapped using cheap, reliable and repeatable method. Research and application of a method could provide a useful tool to planners so they can better understand the existing land use and trends of this land use.

More research is needed on the financial benefits to cities of UA. For cities will not implement UA without some sort of intervention by government of some catastrophe similar to the circumstances behind Cuba moving its agriculture to a more urban focus. More research into how to measure the economic benefits of UA. The possibility of creating a financial model and what would exist in this model? How far to measure the financial advantage of UA? Do you include the cost benefit in environmental savings and how do you measure this?

More research into the food miles in Australia. During the research it was difficult to find reliable data on the distance food travels in Australia from production to consumption. Some study of this would be useful in that potential carbon emissions and potential environmental cost could be applied to this type of agricultural production systems.

The planning model which is proposed in this paper has been applied to only one case study. To verify the workability of suitability of this model it will need to be applied in further case studies. In further research the model should be tested in different locations utilising the developed checklist to see if the model can be adapted to suit other urban release areas. This research would assist agriculture to be recognized as an important part of cities.

Planning is a constantly evolving field of work and research, it is a place that innovation is needed and will be needed more into the future as demand for resources becomes higher. The role of planning is to provide a better outcome for the community as a whole. To be beneficial more research is needed into the effects of planning the urban environments which most people in the world live. We need to make these environments more sustainable and research into how this can be achieved is needed so the government and planners can help cities to become more sustainable

8.0 CONCLUSION

This research project looks to define the sustainable benefits to cities of urban and peri urban agriculture. The research actually found that in some cases it is this type of agriculture which will enable cities to become more sustainable in the future. The current food production and distribution system use of resources is not sustainable. These current systems do not take into consideration the environmental cost, diminishing resources and associated higher costs of these systems. Agriculture in and around cities could be part of the answer to creating a more sustainable system.

Agriculture in and around cities benefit these cities environmentally, socially and economically. This research found that it is vitally important to the future sustainability of Australian cities that UPA contribution to this sustainability is considered. It should actually be considered a vital piece of infrastructure for cities, just as important as roads and services. The sustainable value to cities should be considered more on the long term benefits, not just the pure economic benefits of the free market system, as agriculture is considered.

The research found that the sustainable benefits of agriculture on the fringe of cities are discussed and generally agreed upon in the literature. But they are not being realised to their full potential. This may be due to the lack of education in the benefits and the practical application in urban design and planning of cities today. Since Howards' garden city concept, which acknowledged food production being vital to cities, the integration of agriculture in urban planning has not occurred in Australia. With the world facing an increase in food security issues due to the projected increase and urbanisation of the worlds' population. The research found that the projected population increase of five million, in the capital cities of Australia is going to put more pressure on land and resources. This has placed housing affordability as the main issue facing urban planning in Australia. Housing affordability is a real issue faced by a large portion of the low income earners of Australia. Any changes or implementation of new ideas and theories in urban planning in Australia needs to make sure that this supply of housing is not affected.

This research looked into how other parts of the world are dealing with the issue of depleting agriculture production from urbanisation and increasing population. The research looked into how they are attempting to assist agriculture in and around cities of the world. It looked into ways in which Australian cities could benefit from these methods used overseas. It was able to take some of these methods, adapt them to the Australian context to create a planning model to assist agriculture to be retained and integrated into the urban landscape. Importantly, the planning model does not attempt to create a new food production and distribution system. It is designed to start to implement some food production in new urban release precincts. These new urban release precincts are found on the edges of our cities where food production is under pressure and is being displaced by the urban expansion of cities. The proposed model is designed to help agriculture to be implemented into these new urban areas so they can receive the sustainable benefits of UPA.

The research used a case study application of the proposed model in Western Sydney. It was an important step in the research as it was able to show that the model could be implemented into a new urban release precinct without affecting the number of projected dwellings. The case study was able to implement community gardens as part of all new neighbourhoods. It has been found that these gardens can help build communities, increase food security to the most disadvantaged in society and increase health benefits as a whole to society. It was able

to create space for direct marketing of the locally produced fresh food by creating space for farmers markets central to the new urban release precinct. This enables both farmers and consumers to interact and get a better understanding of the importance of local fresh food production. The farmers markets enable access to fresh healthy food for residents who do not have space or time to grow their own food. The farmers markets encourage the use of fresh seasonal food and provide associated environmental benefits such as reduced food miles. The local city farmers in the case study are able to increase the financial sustainability of their farms by being able to keep more of the profits from sales.

The introduction of city farms in the case study was able to show that these farms could be created as part of open space utilising multiple benefits. This created a productive urban landscape increasing understanding between the farmer and consumer. These urban landscapes enable a better understanding of seasonal production of food by the community. Reduces food miles and creates opportunities for recycling of waste, reduces landfill and reduces the need to import fertilizer and nutrients by reusing wastewater. These farms were able to be created on open space land and would reduce risk of bushfires and flooding by creating a buffer. These city farms would increase groundwater recharge, be positioned to filter urban runoff and provide a barrier to environmentally sensitive areas. The city farms were able to retain some traditions of the existing agricultural production of Western Sydney in the case study area maintaining a link to its important historical role in feeding the city. The city farms would have multiple use of passive open space providing a feeling of openness and a pleasant visual experience to the surrounding residents. Plus these farms would provide an important piece of infrastructure of food production. The case study was able to create 23 hectares of farms which would be capable of producing up to 1800 tonnes of food annually.

By the application of financial assistance to farmers as part of the case study it would be able to create more secure access to land for farmers. This would be accomplished by leasing passive open space land on long term leases. The farmers could be educated on more sustainable production methods with the proceeds of leasing open space enabling local government to provide a better level of service and maintenance for other open space areas. This would alleviate a major impediment to farming in and around cities, the cost of land. The case study suggested the adaption land tax exemption to urban land which would increase the viability of UPA farming. The case study found that a further 113 hectares of land could access this exemption if land zoned environmental living and rural transition was treated as non-urban land. This land is highly constrained by asset protection zones, flood liability and environmental constraints. The case study found that by applying the financial assistance the financial sustainability of these new urban farms would increase.

The new urban environments which we are creating today need to stand the test of time it is the responsibility of the professionals creating these urban environments that these environments become more sustainable to reduce the burden of the future residents. Urban planners need to take into consideration what is best for the community as a whole over the longer term and it is time that food production is given the importance that this basic human right deserves. For the future urban environments to be more sustainable we need to consider the benefits of having some food production from within the urban landscape. This research has found food production on the edge of cities is important. This production of food in new urban and peri urban spaces could be considered a sustainable pathway into the future for cities striving to reach a sustainable future.

I finish this dissertation with a quote from Dr Samuel Johnson, a poet and author of the eighteenth century, his words on why it is important that agriculture in and around cities should be considered an important part of cities of the future.

“By Agriculture only can commerce be perpetuated; and by agriculture alone can we live in plenty without intercourse with other nations. This therefore is the great art, which every government ought to protect, every proprietor to practice, and every inquirer into nature improve” Dr Samuel Johnson 1709-1784 (Johnson 1756)

9.0 REFERENCES

References

21st Century Sustainable and Sustaining Cities, 2010, viewed 20.05.2012, <<http://studio-g-architects.blogspot.com.au/2010/11/sustainable-and-sustaining-communities.html>>.

ABS 2008, *Population Projections Australia 2001-2101*, Australian Bureau of Statistics.

---- 2012, *Regional Population Growth, Australia 2010-11*, Australian Bureau of Statistics.

Adams, DC & Salois, MJ 2010, 'Local versus organic: A turn in consumer preferences and willingness-to-pay', *Renewable Agriculture and Food Systems*, vol. 25, no. 04, pp. 331-41, viewed 2010,

Alig, RJ, Kline, JD & Lichtenstein, M 2004, 'Urbanization on the US landscape: looking ahead in the 21st century', *Landscape and Urban Planning*, vol. 69, no. 2-3, pp. 219-34,

Arman, M, Zuo, J, Wilson, L, Zillante, G & Pullen, S 2009, 'Challenges of responding to sustainability with implications for affordable housing', *Ecological Economics*, vol. 68, no. 12, pp. 3034-41,

Austral & Leppington North Precinct Planning Report, 2011, DoP Infrastructure, Department of Planning & Infrastructure, Parramatta NSW.

Australian farmers market association, 2012, viewed 24.06.12, <<http://www.farmersmarkets.org.au/>>.

Australian food statistics 2010-11, 2012, FaF Department of Agriculture, Department of Agriculture, Fisheries and Forestry, Canberra.

Birch, EL & Silver, C 2009, 'One Hundred Years of City Planning's Enduring and Evolving Connections', *Journal of the American Planning Association*, vol. 75, no. 2, pp. 113-22, viewed 2012/03/09,

Black, R 2012, 'Land Releases Sydney', paper presented to Cumberland Group Land Development seminar, Liverpool NSW.

Brown, KH 2002, 'Urban Agriculture and Community Food Security in the United States: Farming from the City Center to the Urban Fringe',

Brown, R, Collier, F, Danek, J, DiDonato, F & Frederick, C, *Re-Imagining a more sustainable Cleveland*, 2008, CCP Commission, Cleveland, Ohio.

Bunker, R & Holloway, D 2002, 'More than fringe benefits', *Australian Planner*, vol. 39, no. 2, pp. 66-71,

Butt, A 2011, *Functional Change and farming in the peri-metropolis: what does it really mean for agriculture and food systems*, Melbourne, <<http://soac2011.com.au/full-papers-list.php>>.

Calmsley Hill, 2012, viewed 01.07.2012, <<http://calmsleyhill.com.au/>>.

Carey, R, Krumholz, F, Duignan, K, McConell, K, Browne, J, Burns, C & Lawrence, M 2011, 'Integrating agriculture and food policy to achieve sustainable peri-urban fruit and vegetable production in Victoria, Australia', *Journal of Agriculture, Food Systems and Community Development*,

Carey, R, Krumholz, F, Duignan, K, McConell, K, Browne, J, Burns, C & Lawrence, M 2011, 'Integrating agriculture and food policy to achieve sustainable peri-urban fruit and vegetable production in Victoria, Australia', *Journal of Agriculture, Food Systems and Community Development*,

Catalino, AH & Lizardo, M 2004, 'Agriculture, Environmental Services and Agro-Tourism in the Dominican Republic', *Electronic Journal of Agricultural and Development Economics*, vol. 1, no. 1, pp. 87-117,

Chang, H-S & Zepeda, L 2005, 'Consumer perceptions and demand for organic food in Australia: Focus group discussions', *Renewable Agriculture and Food Systems*, vol. 20, no. 03, pp. 155-67, viewed 2005,

Chantrill, C 2012, *US Government spending*, viewed 06.06.2012, <http://www.usgovernmentspending.com/united_states_total_spending_pie_chart>.

Cheng, K 2012, 'The little guys do it tough', *Penrith Press*.

Choy, DL, Sutherland, C, Gleeson, B, Dodson, J & Sipe, N 2008, *Change and Continuity in Peri-Urban Australia: Peri-Urban Futures & Sustainable Development*, Griffith University.

City Of Sydney, 2012, viewed 01.08.2012, <<http://www.cityofsydney.nsw.gov.au/Residents/ParksAndLeisure/CommunityGardens/Default.asp>>.

Community Gardening - The benefits, 2007, viewed 06.06.2012, <<http://communitygarden.org.au/2007/10/11/benefits/>>.

Community Gardens 2011, Fc services, Housing NSW, Sydney.

Connors, T 1997, *Agro-Tourism in Australia a potential success story*, Asia pacific association of Agricultural research Institutions, Bangkok.

Council, PC 2012, *Penrith City*, viewed 14.03.2012, <www.penrithcity.nsw.gov.au>.

County of Cumberland Planning Scheme, 1948, City of Sydney archives, 04.03.1948.

Crompton, JL 2009, 'How well do Purchase of Development Rights Programs Contribute to Park and Open Space Goals in the United States?', *World Leisure Journal*, vol. 51, no. 1, pp. 54-71, viewed 2012/06/27,

Cross, D, *Draft Assessment Crown Land- Chinese Market Gardens, Phillip Bay*, 2008, Do Lands, Department of Lands, Sydney.

Daniels, TL 1991, 'The Purchase of Development Rights: Preserving Agricultural Land and Open Space', *Journal of the American Planning Association*, vol. 57, no. 4, pp. 421-31, viewed 2012/06/27,

Daubenmire, J & Blaine, T *Purchase of Development Rights*, Ohio State University, viewed 27.06.2012, <<http://ohioline.osu.edu/cd-fact/1263.html>>.

Delivering Melbournes newest sustainable communities, 2009, Department of planning Victoria, Melbourne.

Diaz, J & Harris, P 2005, 'Urban Agriculture in Havana : opportunities for the future', in A viljoen (ed.), *Continuous Productive Urban Landscapes* Architectual Press, London.

Diaz, JP & Harris, PP 2005, 'Urban Agriculture in Havana: Opportunities for the Future', in A Viljoen (ed.), *Continuous Productive Urban Landscapes*, Architectual Press, Londaon.

Directions 2031 and beyond, 2010, do planning, Department of planning, Perth.

Disney 2007, 'Affordable Housing in Australia : some key problems and Priorities for action', paper presented to National Forum on Affordable Housing, Melbourne.

DuPuis, EM & Goodman, D 2005, 'Should we go “home” to eat?: toward a reflexive politics of localism', *Journal of Rural Studies*, vol. 21, no. 3, pp. 359-71,

Elliss, F & Sumberg, J 1998, 'Food Production, Urban areas and Policy Responses', *World development*, vol. 26, no. 2, pp. 213-25,

Gallent, N 2006, 'The Rural-Urban fringe: a New priority for planning policy', *planning Practice and Research*, vol. 21, no. 3, pp. 383-93,

Giradet, H 2005, 'Urban Agriculture and Sustainable Urban Development', in *CPULs*, Architectual Press, Jordan Hill, Uk.

Glennie, C 2010, 'Seedlings sabotage devastates farmers', *ABC News*, 06.07.2010.

Going to seed: Growing organic seed in Eastern Canada, 2012, viewed 01.08.2012, <<http://goingtoseed.wordpress.com/category/uncategorized/page/2/>>.

Green Wedges, 2011, Department of Planning and Community Development, viewed 15.06.2012, <<http://www.dpcd.vic.gov.au/planning/plansandpolicies/green-wedges>>.

Gurran, N, Milligan, V, Baker, D, Begg, LB & Christensen, S 2008, *New directions in planning for affordable housing: Australian and international evidence and implications*, Australian Housing and Urban Research Institute Sydney Research Centre.

Hanley-Forde, J, Homsy, G, Lieberknecht, K & Stone, R nd, Transfer of Development Rights Programs, Cornell university,
<<http://government.cce.cornell.edu/doc/html/Transfer%20of%20Development%20Rights%20Programs.htm>>.

Harris, P 2012, 'Detroit Gets Growing', *The Observer*, 11.07.2010.

Healthy sustainable food for London, 2006, Mo London, London food, London.

Heimlich, R & Anderson, W, *Development at the urban fringe and beyond: Impacts on agriculture and rural land*, 2001, USdo Agriculture, Economic Research Service.

Heritage Council of NSW, 2009, NSW Office of Environment & Heritage, viewed 01.07.2012.

Higgins, V, Dibden, J & Cocklin, C 2008, 'Building alternative agri-food networks: Certification, embeddedness and agri-environmental governance', *Journal of Rural Studies*, vol. 24, no. 1, pp. 15-27,

Houston, P 2005, 'Re-valuing the Fringe: Some Findings on the Value of Agricultural Production in Australia's Peri-Urban Regions', *Geographical Research*, vol. 43, no. 2, pp. 209-23,

Howard, BC 2012, *Urban Farming is Growing a green future*, viewed 06.06.2012, <http://environment.nationalgeographic.com/environment/photos/urban-farming#/earth-day-urban-farming-victory-garden_51636_600x450.jpg>.

Howe, J, Viljoen, A & Bohm, K 2005, 'New Cities with more life: benefits and obstacles', in A Viljoen (ed.), *Continuous Productive Urban landscapes*, Architectural Press, London.

Hunt, T 2012, *Dig For Victory*, viewed 20.05.2012, <<http://wartimegardening.co.uk/dig-for-victory/>>.

Indiana Community Garden, 2012, viewed 01.08.2012, <<http://indianacommunitygarden.org/home/>>.

Ingo, Z 2011, 'Multifunctional peri-urban agriculture—A review of societal demands and the provision of goods and services by farming', *Land Use Policy*, vol. 28, no. 4, pp. 639-48,

James, S, O'Neil, P & Dimeski, B 2010, *Sydneys Agricultural lands an analysis*, urban research centre University of Western Sydney.

Jarosz, L 2008, 'The city in the country: Growing alternative food networks in Metropolitan areas', *Journal of Rural Studies*, vol. 24, no. 3, pp. 231-44,

Jeffs, A 2009, 'Sydney's Agriculture - Planning for the future Forum outcomes report',

Johnson, S 1756, 'Further thoughts on agriculture', *The visitor in March*, p. 111,

Kaiser, EJ & Godschalk, DR 1995, 'Twentieth Century Land Use Planning: A Stalwart Family Tree', *Journal of the American Planning Association*, vol. 61, no. 3, pp. 365-85, viewed 2012/06/13,

Kasperek, DM, *Agrotourism and agricultural diversity*, 2001, DGfTZ (GTZ), GTZ, Eschborn, Germany.

Lennartsson, DM 2005, 'Recycling Systems at the Urban Scale', in A Viljoen (ed.), *Continuous Productive Urban Landscapes*, Architectural press, London.

Liverpool Contributions Plan 2008: Edmondson Park, 2008, LC Council, Liverpool city council, Liverpool

Liverpool Development Control Plan, 2012, Lc Council, Department of planning and infrastructure.

Liverpool Growth Centres Development Control Plan: Austral and Leppington North Precinct 2012, LC Council, NSW Department of Planning & Infrastructure, Liverpool

Local Food Plus, 2012, viewed 01.07.2012, <<http://www.localfoodplus.ca/page/2>>.

Long, Y, Shen, Z & Mao, Q 2011, 'An urban containment planning support system for Beijing', *Computers, Environment and Urban Systems*, vol. 35, no. 4, pp. 297-307,

Lynch, L, *City farm feasibility study*, 2010, Co Sydney, City of Sydney, Sydney.

Malcolm & Fahd 2009, *Ground Truthing of the Sydneys Vegetable Industry 2008*, Horticulture Australia Ltd.

Mason, D 2006a, *urban Agriculture*, The Winston Churchill memorial trust.

---- 2006b, *To identify how sustainable urban agriculture can benefit the quality of life of Australian communities*.

Mason, D & Knowd, I 2010, 'The emergence of urban agriculture: Sydney, Australia', *International Journal of Agricultural Sustainability*, vol. 8, no. 1-2, pp. 62-71, viewed 2012/03/03,

Melbourne 2030, 2002, do Planning, Department of Planning, Melbourne.

Melbourne 2030: a planning update Melbourne @ 5 million, 2009, Do Planning, Department of Planning, Melbourne.

Merson, J, Attwater, R, Ampt, P, Wildman, H & Chapple, R 2010, 'The challenges to urban agriculture in the Sydney basin and lower Blue Mountains region of Australia', *International Journal of Agricultural Sustainability*, vol. 8, no. 1-2, pp. 72-85, viewed 2012/04/03,

Metropolitan Plan for Sydney 2036, 2010, Do Planning, NSW department of Planning, Sydney.

Millar, R 2012, 'Government Shifts Green Wedge Boundary', *The Age*, 13th June 2012.

Monfries, A 2012, 'Farming in Adelaide parklands could be a vision of the future', *Sunday mail*.

Morgan, H 2011, *Urban Farming Movement Sweeps across Havana Cuba*, viewed 20.05.2012, <<http://inhabitat.com/urban-farming-movement-sweeps-across-havana-cuba-providing-50-of-fresh-food/>>.

National Housing Supply Council, N, *State of Supply Report*, 2011, E Department of Sustainability, Water, Population and Communities.

Nearmap 2012, *Nearmap*, <<http://www.nearmap.com/>>.

New South Wales Household and Dwelling Projections 2006-2036, 2008, Sydney.

Nicholls, S & Moore, M 2011, 'Green light for urban sprawl', *Sydney Morning Herald*.

Page, G, Ridoutt, B & Bellotti, B 2011, 'Fresh tomato production for the Sydney market: An evaluation of options to reduce freshwater scarcity from agricultural water use', *Agricultural Water Management*, vol. 100, no. 1, pp. 18-24,

Paxton, A 2005, 'Food Miles', in *CPULs*, Architectual press, Jordan Hill, Uk.

Petts, J 2005, 'The economics of Urban and Peri-Urban Agriculture', in A Viljoen (ed.), *Continuous Productive Urban Landscapes*, Architectual Press, London.

Pires, V 2011, *Planning for Urban Agriculture Planning in Australian Cities*, Melbourne, December 2011, <<http://soac2011.com.au/full-papers-list.php>>.

Pothukuchi, K & Kaufman, J 2000, 'The Food System', *Journal of the American Planning Association*, vol. 66, no. 2, pp. 113-24,

Preiss, B 2012, 'Students cultivate and idea to feed body and mind', *The Age*, 27.03.2012.

Primary Production Land Exemptions, 2012, NOoS Revenue, NSW Office of State Revenue, Sydney.

Reimagining Cleveland, 2012, Neighbourhood Progress Inc, viewed 01.06.2012, <<http://reimaginingcleveland.org/>>.

Review of Potential Housing Sites, 2012, viewed 21.03.2012, <<http://www.planning.nsw.gov.au/HousingDelivery/HousingDeliveryOverview/ReviewofPotentialHousingSites/tabid/561/Default.aspx>>.

Reynolds, I 2010, Sydney Growth centre commision, Sydney growth Centre, <<http://www.gcc.nsw.gov.au/media/Pdf/101130%20SMH%20Fringe%20lands.pdf>>.

Simovic, N & Taboulchanas, K 2000, *Urban Agriculture: case study Cienfuegos Cuba*, viewed 01.07.2012, <<http://dp.biology.dal.ca/reports/ztaboulchanas/taboulchanasst.html>>.

Sinclair, I 2001, *Penrith Rural Lands Study*, Penrith City Council.

---- 2011, *Australian Rural Planning* viewed 01.02.2012, <<http://www.ruralplanning.com.au/ruralplanning/preserveagland.shtml>>.

Sinclair, I, Docking, A, Jarecki, S, Parker, F & Saville, L 2004, *From the outside looking in: The future of Sydney's rural land*, University of Western Sydney

Slow Food, 2012, <<http://www.slowfood.com/>>.

South East Queensland Regional Plan 2009-2031, 2009, DoIa planning, Queensland Government, Brisbane.

State planning policy 1/92, Development and conservation of Agricultural land, 1992, LgaP Housing.

SVY4203 Urban and Regional Planning, 2012, university of Southern Queensland, Toowoomba, QLD.

Sydney's Growth Centres, 2012, NSW Planning and Infrastructure, viewed 31.03.2012, <<http://www.gcc.nsw.gov.au/home-3.html>>.

Sydney Food Fairness Alliance, 2012, viewed 18.12.2012, <<http://sydneyfoodfairness.org.au/>>.

Tang, B-s & Tang, RMH 1999, 'Development control, planning incentive and urban redevelopment: evaluation of a two-tier plot ratio system in Hong Kong', *Land Use Policy*, vol. 16, no. 1, pp. 33-43,

Tregear, A 2011, 'Progressing knowledge in alternative and local food networks: Critical reflections and a research agenda', *Journal of Rural Studies*, vol. 27, no. 4, pp. 419-30,

UN 2012, *World Urbanization Prospects, the 2011 Revision*, United nations, Department of Economic and Social Affairs, Population Division, viewed 03.05.2012, <http://esa.un.org/unpd/wup/Maps/maps_urban_2011.htm>.

Van Dam, F, Heins, S & Elbersen, BS 2002, 'Lay discourses of the rural and stated and revealed preferences for rural living. Some evidence of the existence of a rural idyll in the Netherlands', *Journal of Rural Studies*, vol. 18, no. 4, pp. 461-76,

Viljoen, A 2005, 'Utalitarian dreams: examples from other countries', in A Viljoen (ed.), *Continuous Productive Urban landscapes*, Architectual Press, London.

Viljoen, A & Howe, J 2005a, 'Cuba: Laboratory for urban agriculture', in A Viljoen (ed.), *Continuous productive urban landscapes*, Architectual Press, London.

---- 2005b, 'Cuba: Laboratory for Urban Agriculture ', in A Viljoen (ed.), *Continuous Productive Urban Landscapes*, Architectural Press, London.

Viljoen, A & Bohm, K 2005, 'Continuous Productive Urban Landscapes:urban agriculture as an essential infrastructure', *The Urban Agriculture magazine*, vol. 15, pp. 34-6,

Viljoen, A, Bohn, K & Howe, J 2005, 'More Food With Less Space: Why Bother', in *CPULs*, Architectural press, Jordan Hill, UK.

Waroona Local Planning Strategy 2009, WAP Commision, Perth.

The Water factory, 2011, viewed 07.06.2012.

Watson, V 2009, 'The planned city sweeps the poor away...': Urban planning and 21st century urbanisation', *Progress in Planning*, vol. 72, no. 3, pp. 151-93,

Werribee South Green Wedge Policy, 2010, W City, Wyhndam City Council, Melbourne.

Western Sydney Parkland Plan of Management 2020, 2010, WSp trust, Western Sydney parkland trust, Parramatta.

Winston 1957, *Sydney's great experiment - the progress of the cumberland county plan*, Angus and Robertson, Sydney.

Wulff, M, Reynolds, M, Arunachalam, D, Hulse, K & Yates, J 2011, *Australia's private rental market: the supply of, and demand for, affordable dwellings*, Australian Housing and Urban Research Institute, Melbourne.

Yang, Z, Cai, J & Sliuzas, R 2010, 'Agro-tourism enterprises as a form of multi-functional urban agriculture for peri-urban development in China', *Habitat International*, vol. 34, no. 4, pp. 374-85,

Yates, J & Milligan, V 2007, *Housing affordability: a 21st century problem*, Australian Housing and Urban Research Institute, Sydney.

Yokohari, M & Bolthouse, J 2011, 'Planning for the slow lane: The need to restore working greenspaces in maturing contexts', *Landscape and Urban Planning*, vol. 100, no. 4, pp. 421-4,

Appendix A PROJECT SPECIFICATION

University Of Southern Queensland
Faculty of Engineering and Surveying
ENG 4111/4112 Research Project
PROJECT SPECIFICATION

For: **Craig Lonard**

Topic: **URBAN FRINGE AGRICULTURE AND ITS POTENTIAL CONTRIBUTION
TO SUSTAINABLE CITIES: A CASE STUDY OF WESTERN SYDNEY**

Supervisor: Marita Basson

Enrolment: ENG 4111-S1 2012
ENG 4112-S2 2012

Project Aim: This project aims to define the potential economic, social and environmental value of agriculture in an urban setting. It aims to define how planning can assist agriculture to fit into a city's urban footprint without causing land use conflicts. The project aims to design a planning model which incorporates agriculture in Western Sydney.

PROGRAM : ISSUE C 1st April 2012

1. A literature review on current economic, social and environmental value of urban agriculture in cities across the world
2. An analysis of how planning effects Urban Fringe agriculture in Australian Cities.
3. Research how to fit both agriculture and affordable housing into the same area of Western Sydney.
4. Create a planning model for Western Sydney to accommodate both urban growth and agriculture, concentrating on the growth centres.
5. Submit a dissertation on findings of research.

If time permits:

6. Evaluate public opinion on the possible changes to planning to assist urban agriculture, sampling from four western Sydney council areas, Penrith, Hawkesbury, Liverpool and Camden.

Agreed:

_____ (student) _____ (supervisor)

APPENDIX B PROJECT APPRECIATION

Project Timelines

The project stage will be finalised and before the commencement of the next stage and will include all documentation, plans and images including references.

Stage 1	worldwide literature review on agriculture and the benefits to cities on the 21 st century.	Completed
Stage 2	Synthesis, analysis of agriculture and compilation of agriculture applications in urban landscapes	1 st July 2012
Stage 3	Performance Planning model design	22 nd July 2012
Stage 4	Practical application of planning model	12 th August 2012
Stage 5	Calculation of areas and other performance Meeting guidelines	16 th September 2012

Project Effects and OH&S issues

This project is designed to contribute to the knowledge and education of government, planners and the community of the benefits of agriculture in and around cities. It will create performance criteria which can be used in the application of agriculture like any other essential infrastructure for a city.

During the project there will be minimal interaction with members of the public. There will be minimal use of technical equipment. Therefore there is minimal risk of injury and need for OH&S planning. The author will need to be aware of the time committed to tasks and effectively time manage any associated operations to ensure that safety is not breached due to lack of adequate rest periods, which may result in catastrophic injury at employment or residential places.

There will be some recording of digital images of various sites across Sydney. The author will need to be aware of the potential hazards to personal safety such as vehicle impact, natural biota, slip and trip hazards while completing these tasks. The impact from these hazards could be catastrophic while the likelihood is small. The author will complete a site risk assessment before commencing any task using the table below. The author will not complete any task when the likelihood of any risk is likely to cause harm or injury. The author will choose an alternate site or method for capturing of digital images.

Risk	Likelihood	Outcome
Vehicle impact		
Biota hazard		
Slip and trip		

APPENDIX C

PLANNING MODEL CHECKLIST

The following checklist is a combination of the checklists used to implement and confirm the application of the planning model.

Objective A1 Community Gardens & Farmers Market	√
Introduce a community garden at centre of each neighbourhood.	
Community garden to be on land designated as open space.	
Community garden to be within 400 meters of the majority of all new urban residents.	
Introduce space for farmers markets in town centre	
Farmers market space to be in town squares or parks	
Locate farmer's markets to enable the maximum reach of residents of the precinct.	
Farmers markets available for local producers to direct market	
Farmers markets to be of at least weekly frequency.	
Objective A2 City Farm Creation	
Allocate 10 percent of open space to farming activities.	
Positioned on passive open space as designated in ILP.	
Positioned to utilise some of the existing farmland.	
Positioned in small clusters.	
Positioned to allow access recycled water.	
Positioned to allow pedestrian/ cycle visual access	
Positioned as a buffer to flood liable land.	
Positioned as a buffer to bushfire risk areas.	
Positioned a buffer to environmental land.	
Positioned adjacent riparian corridors.	
Objective A3 Financial Assistance of Urban Agriculture	
Open space land for agriculture identified by LGA and purchased by LGA for inclusion into open space.	
Open space land for agriculture identified by LGA and provided by developers for inclusion into open space.	
LGA lease open space land for agricultural use.	
LGA to provide long term leases for secure tenure of farmers of open space land.	
Remove or reduce land tax for urban agricultural production	