



ACCARNSI DISCUSSION PAPER

NODE 3 – BUILT ENVIRONMENT, INNOVATION AND INSTITUTIONAL REFORM

**AGEING, THE BUILT ENVIRONMENT AND ADAPTATION TO
CLIMATE CHANGE**

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EXECUTIVE SUMMARY

Population ageing and climate change are two of the most pressing issues for Australia, yet there has been little attention given to the relationship between the two and the role of the built environment in ameliorating or amplifying impacts. Older people, because of a range of physiological, psychological and socio-economic dispositions, are more vulnerable to the impacts of climate change and extreme weather events. By understanding the link between climatic exposures on health and other sensitivities of the senior cohort, a range of interventions can be adopted within the built environment to reduce vulnerability and therefore increase the resilience of this group.

Through a review of international and Australian literature, this paper - funded by the University of New South Wales based Australian Climate Change Adaptation Research Network for Settlements and Infrastructure - identifies the generic sensitivities of older people to climate induced exposures and the capacity to adapt the built environment to ameliorate this cohort's vulnerability to climate change. Secondly it examines Australia's response to climate change and population ageing. What is revealed is that these issues have been addressed in isolation, with little attention paid to the compounding effect each has on the other. Current policy has failed to adequately consider the consequences of older persons being more vulnerable to the impacts of climate change in comparison to younger cohorts. Given that Australian society is rapidly ageing, the implication is that the vulnerability of the community as a whole to climate change will escalate unless action is taken to build the adaptive capacity of older persons in coping with the impacts of climate-induced exposures, simply due to the increasing percentage of older persons in the population.

The key findings on this discussion paper are:

- The range and magnitude of climatic impacts predicted to be experienced in Australia will be highly variable and unique to this continent's geographical context, demographic trends and settlement patterns;
- Heatwaves pose the most immediate threat to public health and ageing, including via heat sensitive infrastructure. This is also an exposure to which older persons are particularly vulnerable;
- While tropical cyclones, floods and bushfires have the potential to cause significant damage to property and loss of economic production, severe thunderstorms and hail present a more significant economic threat given the wider distribution across the Australian continent and often lack of preparedness given the difficulties in predicting their occurrence and rapid formation limiting the ability to broadcast early warnings to affected communities;
- Flooding and the threat of storm surge will pose an escalating risk due to sea level rise;
- An older person's sensitivity and risk of injury or loss increases in proportion to their level of physical and/or cognitive impairment, level of social isolation and financial dependency;
- Given pre-existing health condition and level of physical and/or cognitive impairment are major determinants of sensitivity to a range of environmental exposures, supporting older persons to maintain good health and be physically active is a key strategy in building resilience and reducing vulnerability to climate change;

- The ability for older persons to obtain assistance, and conversely surveillance of older persons, can improve their level of preparedness including modifying behaviour in response to a threat of an extreme weather event or environmental exposure. Supporting older persons to remain socially engaged and active (avoiding becoming socially isolated) can significantly reduce vulnerability to climate change;
- Older cohorts are more reliant on traditional modes of communication (telephone, newspaper/print media, radio and television). While this reliance will likely change with the entry of the Baby Boomer cohort into retirement, this needs to be considered when formulating strategies for early warning and information about climatic-induced threats;
- There is a distinct advantage in local government playing a key role in developing adaptive capacity to climate change impacts given that the risks and types of climate-induced exposures will be highly variable depending on the geographic location and settlement patterns across the nation therefore demanding local responses. This equally applies to adaptive strategies aimed at supporting the creation of age-friendly environments; land use planning and development controls, working in concert with the BCA have proven successful in increasing community resilience to climate change impacts through improving the structural performance of buildings, landscapes and other public infrastructure in the face of predicted environmental exposures (cyclones, severe storms, floods and storm surge, bushfire, heatwaves, etc);
- Adaption of existing building stock for climate change and to support ageing-in-place is a more significant issue within the Australian context than new development, given the requirement to comply with the performance standards set by the Building Code of Australia, in addressing issues for extreme weather events, thermal comfort and energy efficiency as well as disability access;
- Exclusion of mainstream housing from being required to be designed for disability access and/or incorporating adaptive capacity to be readily modified to support physical and cognitive impairment contradicts the need to encourage successful ageing-in-place; and
- Creating 'age-friendly' environments, which promote positive ageing and encourages older persons to remain social active has the potential to deliver the added benefit of also reducing the sensitivity of older persons to the impacts of climate change and hence the overall vulnerability of the community to climate change.

It is hoped that this paper will provide a platform for further research on this important topic and obtain primary Australian data.

CHAPTER 1: RESEARCH OUTLINE

Despite there being a vast amount of literature dealing with the effects of global climate change on one hand and the repercussions of population ageing on the other, very little research exists addressing the compounding impact resulting from these occurring simultaneously. The purpose of this discussion paper is to bridge the knowledge gap between the impacts of climate change, the vulnerabilities of older people and the capacity of the built environment to influence levels of resilience through adaptation.

1.1 Research aims

The aims of this discussion paper are to identify:

- the broad range of climate-induced exposures predicted to impact the Australian continent as a consequence of global climate change;
- the generic vulnerabilities of older persons to the range of climate-induced exposures predicted to impact Australia as a consequence of global climate change;
- how through developing adaptive capacity, the vulnerability of older persons living within the Australian context to climate change might be reduced;
- the current response of various levels of government in Australia to climate change as well as population ageing, with specific focus on adaptation of the built environment to address both issues; and
- opportunities to exploit the synergies while also avoiding the potential for conflict between public policy aimed at adapting the built environment to ameliorate the impacts of climate change and that are designed to support an ageing society.

1.2 Methodology

A comprehensive literature review was undertaken, which includes both Australian and international sources, in three broad areas of investigation. The first sets the context of global climate change and explores in detail the predicted consequences for Australia, focusing in particular on how the pattern of population distribution and urban development will affect the nation's vulnerability to climate change.

The second examines the implications of global population ageing and what this demographic shift means for Australian society. Given that population ageing is happening concurrently with climate change, it also explores the potential vulnerability of older persons aged 65 years and older to the consequences of global warming, discussing not only the obvious physiological risks but also the psycho-social and economic implications of climate change to older persons. Specifically it looks at how conditions within the physical environment can be used to assist in developing adaptive capacity of older persons to cope with climate change impacts.

Thirdly a review of current public policy aimed at both mitigating and adapting for climate change was undertaken. The focus was to analyse policy trends given the context of an ageing society and how through adapting the physical environment to address the generic sensitivities of older persons to environmental exposures can also assist in reducing the vulnerability of the community as a whole to the impacts of climate change.

1.3 Contribution of this research

The value of this discussion paper is in its exploration of the combined effects of population ageing and climate change and how this represents a compounding problem which has been described as the 'double whammy' effect (Haq, 2010). By juxtaposing the

sensitivities of older people with the predicted impacts of climate change, it is possible to identify actions and/or measures that can be taken to build adaptive capacity at a community level that can effectively reduce either the level of climate-induced exposures or reduce the sensitivities of older persons to them, thereby increasing overall resilience to climate change. From this perspective, it points to how synergies in public policy aimed at adaptation within the built environment for climate change as well as to support population ageing can be exploited and the potential for conflict between them avoided in order to reduce the vulnerability of the community as whole.

1.4 Structure of the paper

This paper is divided into six chapters.

- **Chapter 1** provides an introduction and explanation of the aims, methodology and contribution of the study.
- **Chapter 2** sets the context of global climate change and explores in detail the predicted consequences of global warming on the Australian continent. It examines how human activities are exacerbating climate change and in particular why the design of cities and their movement of people, goods and services has a significant impact on energy consumption and greenhouse emissions.
- **Chapter 3** examines the phenomenon of population ageing identifying that this is a global trend and discusses the significance of this demographic shift in the Australian context. It explores the concepts of age and ageing including how western society's response to older people is changing in light of the greater number of older persons in its demographic profile, as well as identifying the range of generic sensitivities of older persons to environmental exposures.
- **Chapter 4** examines the vulnerability of older people to climate change impacts predicted within the Australian context based on generic sensitivities to climate-induced exposures. It also identifies how through developing adaptive capacity aimed at reducing either the level of exposure to climatic-induced risks or an older person's sensitivity to these range of exposures, vulnerability can be reduced.
- **Chapter 5** reviews the current response by various levels of government within Australia in dealing with the consequences of both climate change and population ageing, with specific focus on strategies aimed at adapting the built environment. It discusses mitigation verses adaptation in relation to climate change policy and why these two approaches are inextricably linked despite the potential for contradictions and overlap in their intent. It also explores the potential to exploit the synergies between policies aimed at adapting the built environment for both climate change and population ageing as a way of building resilience within the community to climate change.
- **Chapter 6** presents the key findings from the literature review together with recommendations for future research and policy development aimed at reducing vulnerability of Australia's ageing society though focusing on continued adaptation of the built environment.

CHAPTER 2: CLIMATE CHANGE

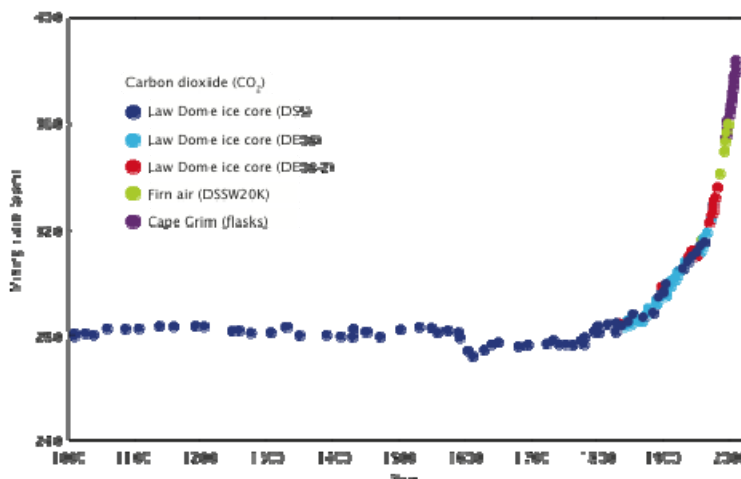
This chapter provides a context of climate change rather than a debate or assessment of the scientific evidence about its occurrence and will discuss in detail Australia's vulnerability to climate change. Through understanding the range of environmental consequences of climate change likely to be experienced in Australia, it allows the compounding impacts on social, health and economic conditions to be better understood.

2.1 Overview of the latest evidence

Climate change is defined as a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties that persists for an extended period, typically decades or longer (IPCC 2007). Climate change is nothing new. Historically the earth's climate has encompassed variation in temperature and carbon dioxide concentrations; however, there is now significant evidence that recent changes in climatic conditions are occurring much more rapidly. This accelerated warming of global temperatures is also directly attributed to human activity (IPCC 2007; The Global Humanitarian Forum 2009; CSIRO 2011).

During the 20th century the world population grew almost fourfold, accompanied by a 12-fold increase in global emissions of carbon dioxide (Haines et al 2006, p. 2107) primarily due to fossil fuel use and land use change. Similarly the rise in methane and nitrous oxide within the atmosphere has been the result of increased agricultural production (IPCC 2007, p. 2). Figure 1 graphically illustrates this rise in carbon dioxide levels from approximately 280 parts per million in the 800 years prior to the industrial era, and 386 parts per million in 2009 (CSIRO 2011). As a direct consequence of these increases in what are now commonly referred to as 'greenhouse gas' emissions, average global air and ocean temperatures have risen and as result, there is now evidence of accelerated and more widespread melting of the polar ice caps causing sea levels to rise worldwide.

Figure 1: Southern hemisphere atmospheric carbon dioxide levels over the past 1000 years.



Source: CSIRO 2011

The implications of these changes are starting to be realised and their impacts quantified. Haines et al (2006, p. 2106) estimate that climate change may have been responsible for around 150,000 deaths (0.3% of global deaths per year) in 2000. The Global Humanitarian Forum (2009) estimates that approximately 300,000 deaths per year are caused by weather-related disasters and gradual environmental degradation due to climate change and that this figure will rise to 500,000 by 2030. In addition, the findings

of the report indicate that 325 million people are currently seriously affected by climate change (increasing to 660 million people by 2030), and that it causes economic losses of US\$125 billion per year¹.

While most of the literature focuses on the negative consequences, climate change has also brought about positive impacts in some regions and for some industries. For example agriculture may benefit from changed climatic conditions in terms of temperature, precipitation, disease and pests. This is particularly true for countries further south and north of the equator that are receiving more rainfall and experiencing longer growing seasons and improved productivity (DARA 2010). In the agricultural sector, changes in climate will also give rise to new technologies and genetically modified plants to improve the resilience (CSIRO 2011).

Overall however there is now significant evidence to support that the earth's climate is changing more rapidly than it has in its geological history. Climate change is a global issue both in terms of the responsibility of reductions in emissions and where the impacts of climate change will be felt.

2.2 Global trends

The world's population is predicted to grow, and with it primary energy demand and emissions output globally are also expected to rise. However the level of both population growth and resource demand will vary significantly between developed and developing economies.

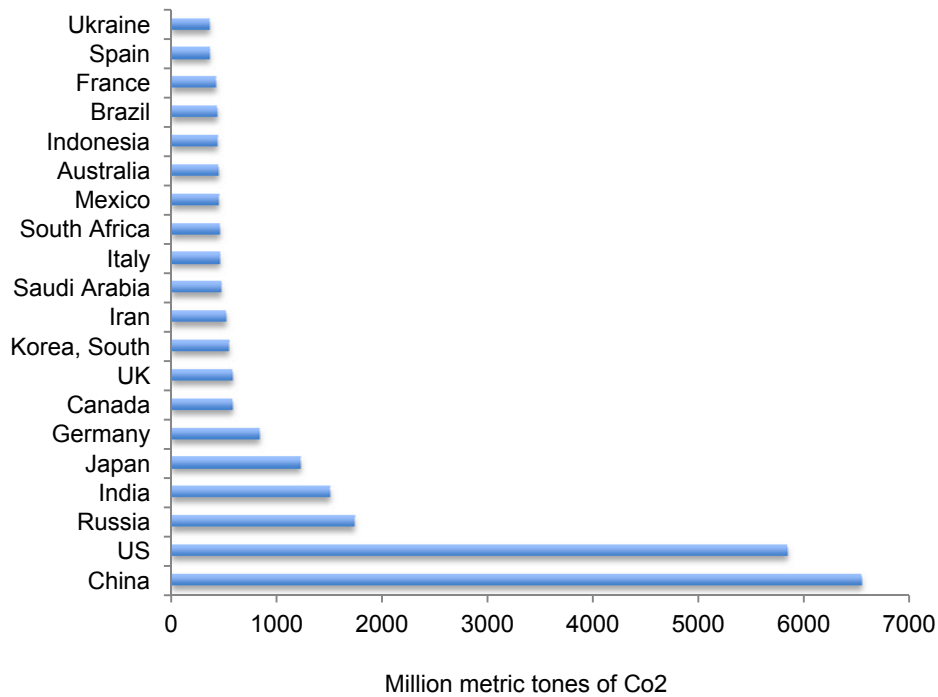
The 2010 World Energy Outlook Report found that non-OECD countries will account for 93% of the projected increase in world primary energy demand to 2035, reflecting faster rates of growth of economic activity, industrial production, population growth and urbanisation, particularly in the three fastest growing economies of China, India and Indonesia. An UNU report (Palanivel and Park 2002, p.6) identified that these three countries have a combined population of 2.5 billion and make up approximately 42% of the total world population as well as about 36% of the current population growth. Yet in stark contrast to these rapidly developing economies, the 50 least developed countries in the world currently contribute less than 1% of global carbon emissions.

There are also disparities in consumption demand within the developed economies. While energy demand in OECD nations has been curbed and is predicted to rise very slowly to 2035, the United States will continue to be the second largest energy consumer behind China. Figures 2 and 3 below show global emission trends for 2008 for the top 20 polluting countries and identifies Australia as having the highest per capita emissions amongst in the OECD.

This highlights the current polarisation in terms of the burden faced but also potential resilience to climate change between developed, developing and the poorest nations on earth, indicating that issues of political stability, social and economic inequities need to also be addressed if effective mitigating and adaptive strategies are to be successfully implemented.

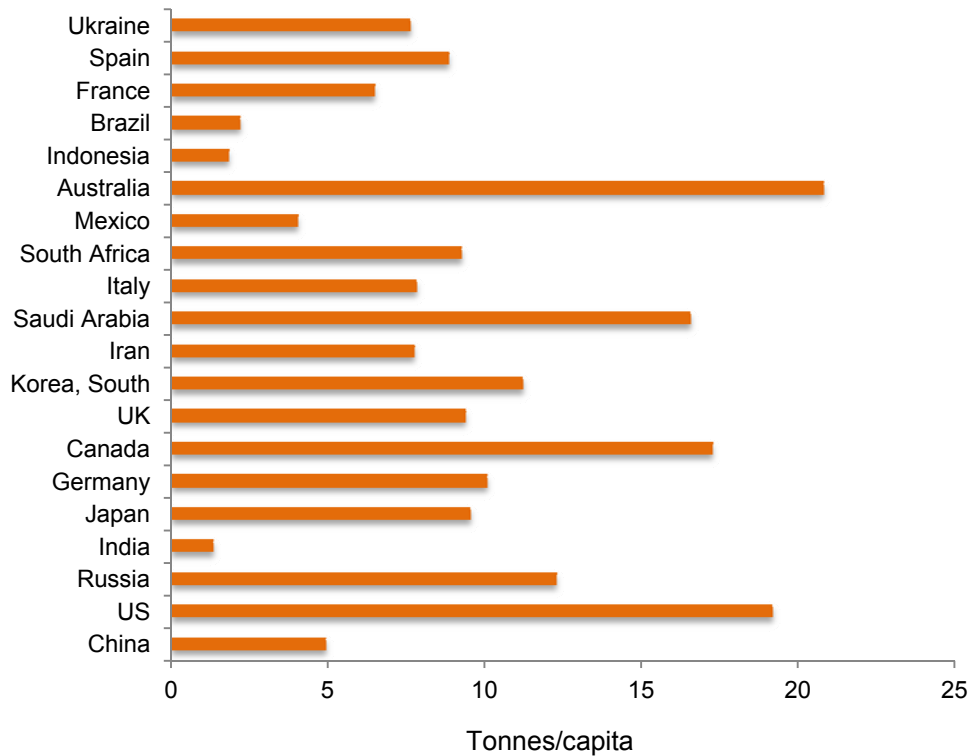
¹ The losses include asset values destroyed by weather-related disasters and sea level rise, lost income due to reduced productivity, and the costs of reduced health or injury (Global Humanitarian Forum 2009, pp19).

Figure 2: Total emissions per country (2008)



Source: Data from Energy Information Agency (Department of Energy), cited Union of Concerned Scientists 2010.

Figure 3: Global emissions per capita (2008)



Source: Data from Energy Information Agency (Department of Energy), cited Union of Concerned Scientists 2010.

2.3 Why are cities so important in the climate change debate?

Not only is population growth a significant factor in generating primary energy demand, but so too is where and how the world's population will be living. Recent analysis by the International Energy Agency (IEA) estimated that between 60 – 80% of the world's energy use currently emanates from cities and urbanised areas (IEA 2008) reflecting the fact that 50% of the world's population now reside in these environments, coupled with a corresponding concentration of economic activity and production within cities (OECD 2009). By 2050 the OECD forecasts, based on the current trend of urbanisation particularly in the developing economies, that this percentage will increase to 70%, while in developed economies 86% of the population will be living in cities (OECD 2010). In terms of climate change, continued urbanisation (again predominately within the developing economies) will increasingly shift the world's reliance from CO² neutral energy sources (biomass and waster) to CO² intensive energy sources, leading to continued growth in greenhouse emissions from cities (OECD 2008).

“It is not cities and urbanisation per se that contributes to greenhouse emissions, but rather the way in which people move around the city, sprawling urban development; and the amount of energy people use to light and heat or cool buildings that makes cities the great consumers of energy and polluters that they are” (OECD 2010 p.18). However cities can be seen to be contributing to climate change in three major ways:

- direct emissions of greenhouse gases that occur within a city's boundaries;
- greenhouse gases emissions that originate outside the city's boundaries but are embodied in civil infrastructures (production of concrete, steel, glass, etc) and urban energy consumption (electricity generation); and
- city-induced changes to the earth's atmospheric chemistry and surface albedo.

(OECD 2010, p. 50).

Current research suggests that variance in emissions output of cities is influenced just as much by how a city's electricity supply is being produced as how this supply is used. Secondly, emissions output appear to be strongly related to urban density and the spatial arrangement of cities, which directly influences transportation systems. These systems being not only how people move around the city, but also the efficiency of utility and other service infrastructures needed to support the population and economic activity of the city. There is now mounting evidence suggesting that “lower energy consumption correlates with higher urban density” (OECD 2010, p. 38).

2.4 Consequences of global climate change

In addressing the impacts of global climate change, the Copenhagen Accord set the target of limiting global temperature increases to two degrees Celsius relative to pre-industrialised temperatures. However, even a two-degree increase in global temperatures will result in significant impacts that are likely to disrupt ecological and social networks alike. At a global scale, such impacts will include:

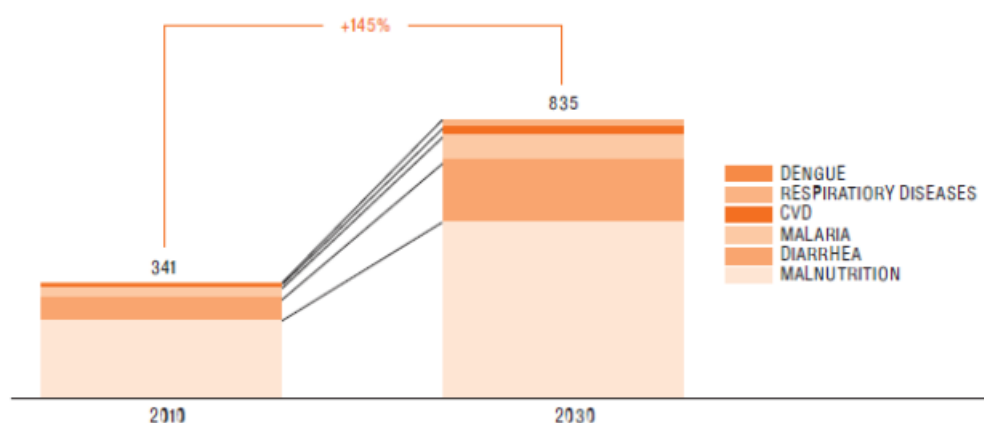
- melting of the polar ice sheets resulting in sea level rise;
- disruption to food supply and water resources;
- damage to physical infrastructure;
- increased public health risks; and
- modified global biogeochemical cycles, as well as oceanic and atmospheric circulation patterns.

(IPCC 2007).

While the magnitude of these impacts continues to be debated, there is general agreement that low lying and island nations, as well as those located closer to the equator where temperatures are already hotter will be most affected by climate change, and that the affects will be compounded if the nation's economy and supportive infrastructure is poorly resourced and less able to cope with the fiscal and social consequences. But what also needs to be highlighted is that many of the world's largest cities (and therefore concentrations of economic activity and production) are located in coastal areas, historically linked to sea-port development, and will therefore also be vulnerable to sea level rise and storm surge; and this represents an unprecedented risk to livelihood, property and urban infrastructure within the developed economies (OECD 2010, p.17). The consequences of these impacts are starting to be felt around the globe. Appendix 1 provides a brief summary of recent examples of events now being attributed to climate change.

There is also acknowledgement that climate change is and will have direct and indirect impact on human health. Direct impacts include injuries and death caused by extreme weather events such as flooding, bushfire and cyclones (Greenough et al 2001). Indirect impacts include changes in incidences of chronic disease and illness, resulting from changes in temperature, food and water supply and pollution levels as well as the habitat of vectors impacting disease transmission (Haines et al 2006, Bernard and Ebi 2001). Equally the impact and cost of physiological trauma and stress linked to natural disasters as well as the economic uncertainty induced by climate change is now to be counted (Berry et al, 2008, Morressey and Reser, 2007). The consequences of climate change to human health are likely to be significant, with DARA (2010) predicting a 145% increase in the human mortality rate between 2010 and 2030 directly attributable to climate change. The literature points to the fact that many of these health impacts will particularly affect those with pre-existing health conditions or weakened immune and metabolic resistance as a result of age, meaning those who are very young and older will likely be more vulnerable (McMichael and Woodruff 2006, McMichael et al 1996).

Figure 4: Global health impact to 2030



What is also becoming evident is the relationship between the conditions presented within the built environment and a population's level of vulnerability or resilience to climate change impacts. While direct impacts on living conditions due to sea level rise and extreme weather events are obvious, suggesting why perhaps these issues have attracted most attention and action by Governments, there are also a number of indirect

consequences of urbanisation that appear to be amplifying the impacts of climate change and posing an increasing threat to public health.

A major concern is urban heat island (UHI) effect resulting in higher temperatures in the urbanised context compared to rural areas due to the absorption and release of heat from built surfaces; namely buildings, paving and infrastructure, as opposed to natural and porous surfaces. The annual mean temperature of a city with over one million people has been found to be 1 to 3 degrees Celsius hotter, and in clear, calm night-time conditions, can result in as much as 12 degrees difference from surrounding areas (Environmental Protection Authority 2008).

Two types of heat islands have been identified by the US Environmental Protection Authority (2008); namely surface and atmospheric UHIs. Surface UHIs refer to the heating of non-porous surfaces substantially above air temperature and tend to be strongest during the day. Atmospheric UHIs refer to warmer air in urban areas compared with rural surroundings. This type is often weaker during the late morning and throughout the day, becoming pronounced after sunset due to the slow release of heat radiating from urban infrastructure. In both cases the design of the city environment comes into focus, specifically the proportion of green open space and vegetation cover to heat absorptive surfaces becomes a critical factor in ameliorating the UHIs affect.

This amplifying effect presents a major public health risk due not only to the population's exposure to hotter temperatures but also the associated increase in pollution levels (i.e. elevated production of ground-level ozone). Add to this an increasing proportion of older persons due to population ageing, who as a cohort are more susceptible to health impacts given their disposition to pre-existing medical conditions and physiological impairment, and excessive urban heat starts to become a significant threat. But UHIs also have an indirect impact on energy consumption within cities, promoting emission production, especially if cities continue with their current reliance on mechanical systems to maintain environmental comfort.

Haines et al (2006) observe how the assessment of the impact of climate change has tended to occur in isolation of other global and local problems, including population growth and ageing, extent of urbanisation and other land use changes, and depletion of fresh water resources. As demonstrated by the issues of UHI effect in amplifying the impacts of increased temperatures in our cities, attention needs to shift towards understanding the cumulative impacts of climate change given that the implications for society stretch beyond the immediately or direct consequences.

2.5 Trends in Australia

Australia generates only 1.5% of global emissions however on a per capita basis is the highest emitter of the OECD nations and one of the highest worldwide (Australian Department of Climate Change; Sartor 2010, p. 5). This high per capita output is the result of several factors. Australia is an exporting nation of primary resources including agriculture, mining and metal products (such as aluminium). Secondly the nation's energy sector is reliant on coal-fired electricity production (Infrastructure Australia 2010). This combines with the Australian population being highly urbanised with three quarters the nation's citizens residing in seventeen (17) cities with populations greater than 100,000 (Infrastructure Australia 2010). Australian cities can however are also characterised by their sprawling nature and comparatively low urban density. This, combined with vast spatial distribution of the nation's metropolitan centres, as well as the physical separate of primary production and ports facilitating overseas export, contributes to the nation's high transport energy demand. Emissions from the transport sector are expected to increase by 1.58% per year over the period 2007-2020, reflecting high levels of private vehicle use but also haulage of freight by road (Infrastructure Australia 2010).

Table 1 illustrates the breakdown of greenhouse gas emissions by sector. The building sector is not exclusively identified in this analysis, rather it is considered integrated into the other sectors. The Australian Government (2010b) reports that approximately one fifth of Australia's energy is consumed within buildings through heating, cooling, water heating and electrical appliances.

Given Australia's contribution to global emissions, reductions in national energy consumption and therefore greenhouse emissions cannot drastically alter climate change impacts likely to affect the nation. Nevertheless as part of a global response and responsibility in helping combat climate change, both the current Australian Labor Government and opposition have agreed to reduce pollution by at least 5% from 2000 levels by 2020, which will require cutting net expected pollution by at least 23% by 2020 and 80 per cent below 2000 levels by 2050 (Department of Climate Change and Energy Efficiency 2011).

Table 1: Net greenhouse gas emissions by sector – Australia

	1990	2008	% Change 1990-2008	% Emissions 2008
Energy (total)	286.4	415.0	44.9%	71.2%
<i>Energy – Stationary²</i>	195.1	293.0	50.2%	50.3%
<i>Energy – Transport</i>	62.1	82.0	32.0%	14.1%
<i>Energy – fugitive emissions³</i>	29.2	40.0	37.0%	6.9%
Industrial processes	24.1	34.0	41.1%	5.8%
Agriculture	86.8	91.0	4.8%	15.6%
Land use, land change and forestry	131.5	28.0	-78.7%	4.8%
Waste	18.8	15.0	-20.2	2.6%
Net emissions	547.6	583.0	6.5%	100.0%

Source: Department of Climate Change 2009, cited in Infrastructure Australia 2010

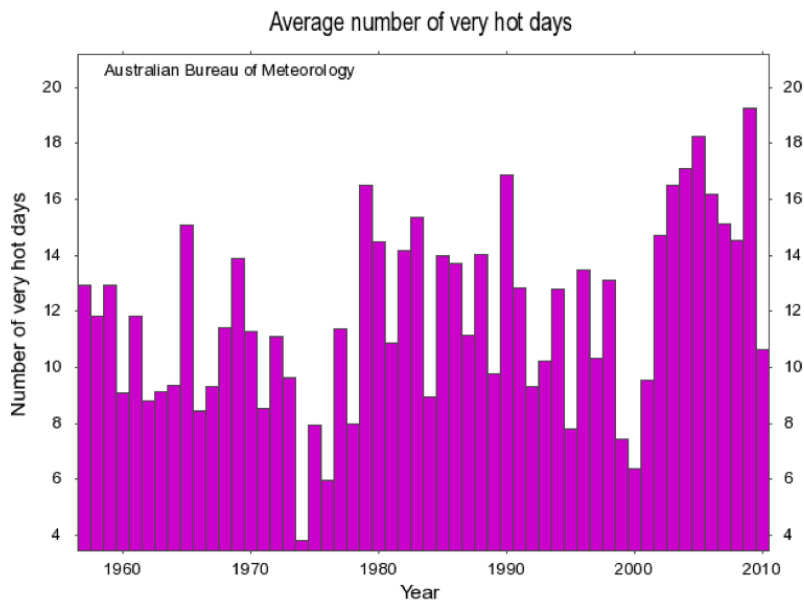
2.6 Consequences of climate change in Australia

Australia's geographic location combined with the vast size of the continent, means that the nation already experiences a highly variable and diverse climate. Changes to temperature, precipitation and sea level anticipated as a result of global warming are forecasted to increase the frequency and intensity of droughts, bushfire, floods and coastal erosion already experienced across various regions within Australia. Signs of change in the Australian climate are already evident in meteorological data. Figures 5 to 8 illustrate some of the changes in climatic patterns noted in various sources and include rising temperatures and increasingly variable rainfall patterns over the past decades (refer to Productivity Commission 2009; IPCC 2007); CSIRO 2011).

² Stationary energy includes emissions from fuel consumption for electricity generation, fuels consumed in the manufacturing construction and commercial sectors and other sources like domestic heating (Infrastructure Australia 2010, pp 79).

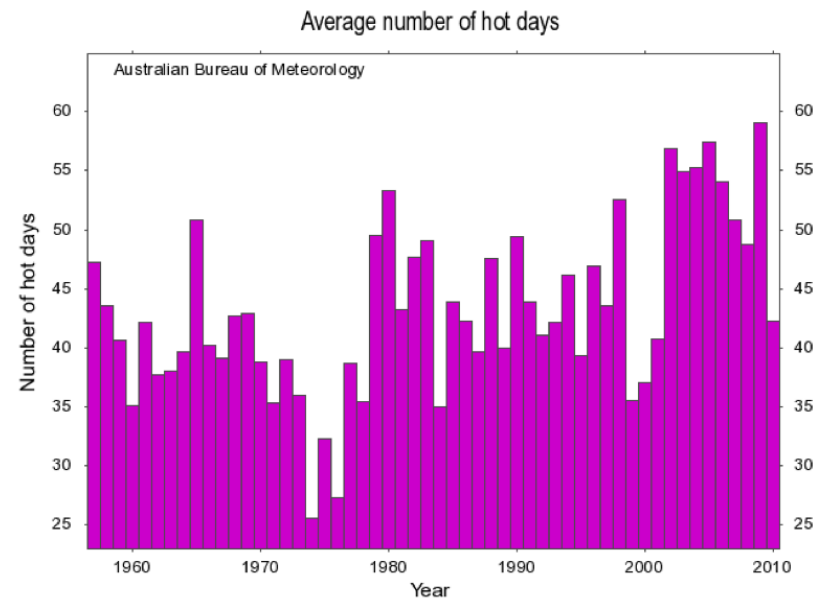
³ Release of emissions such as gas or vapour that typically result from leaks (Infrastructure Australia 2010, pp 79).

Figure 5: Annual count of days with maximum temperature >40°C



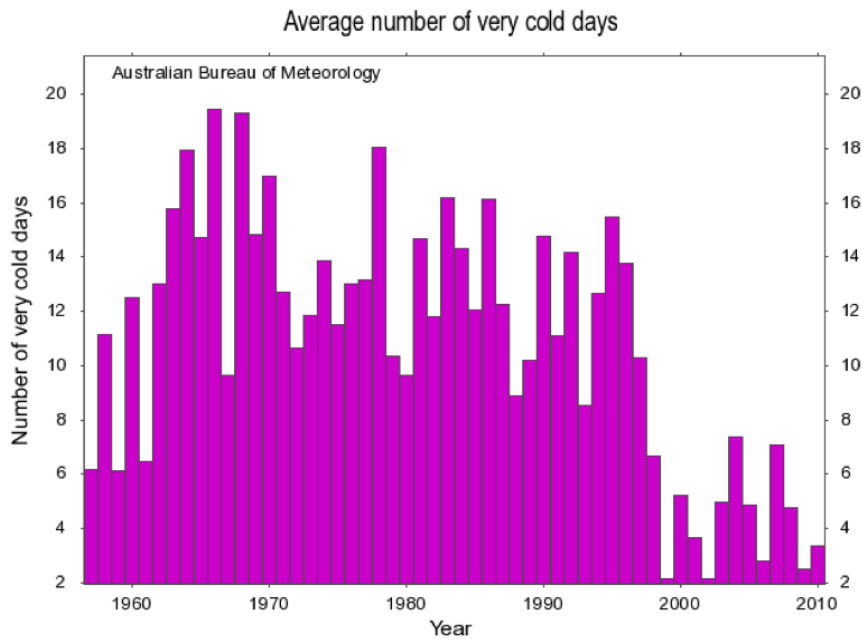
Source: Australian Bureau of Meteorology

Figure 6: Annual count of days with maximum temperature <35°C



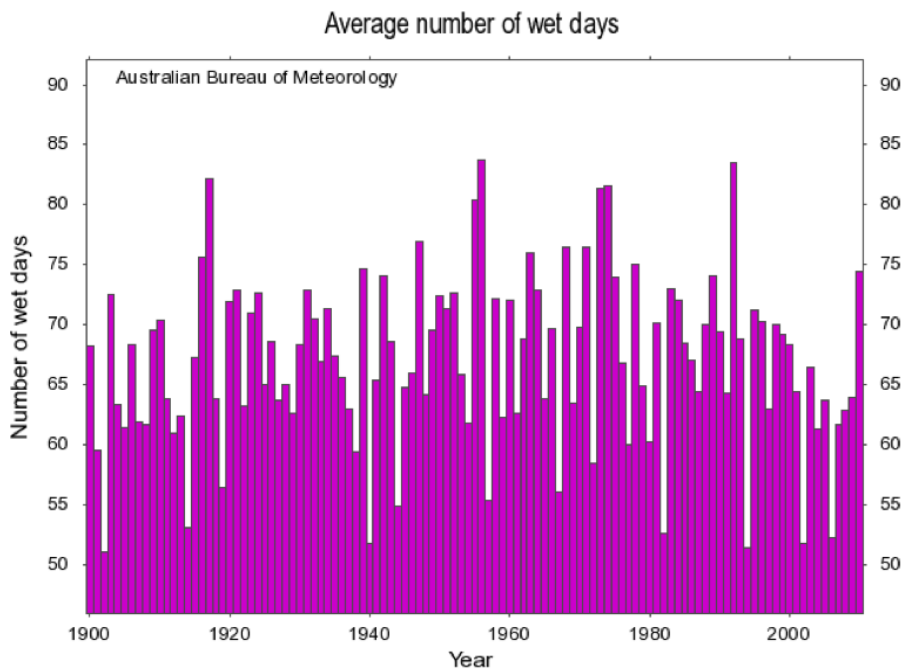
Source: Australian Bureau of Meteorology

Figure 7: Annual count of days with maximum temperature < 10°C



Source: Australian Bureau of Meteorology

Figure 8: Annual count of days with daily precipitation ≥ 1 mm



Source: Australian Bureau of Meteorology

2.6.1 Temperature increases

The CSIRO (2011) estimates that by 2030 Australia's temperature will have increased annually by 1.0°C on average (above 1990 temperatures) with warming of 0.7–0.9°C in coastal areas and 1–1.2°C inland. By 2050 temperatures are projected to increase by between 0.8 to 1.8°C (low greenhouse gas emission scenario) or 1.5 to 2.8°C (high

greenhouse gas emission scenario). By 2070 warming is expected to increase by 2.2°C (low emission scenario) or 5°C (high emission scenario).

What this will mean in terms of seasonal patterns, and in particular the distribution and intensity of rainfall, is the subject of intensive research currently in Australia. Research conducted by the CSIRO (2011) indicates that there is likely to be less rainfall in southern areas of Australia, especially in winter, and in southern and eastern areas in spring. Findings concerning the future changes in summer tropical rainfall in northern Australia are less conclusive. Drought is a recurring feature of Australia's climate, however this is expected to worsen as temperatures increase and, for some regions, as precipitation declines (Productivity Commission 2009). Drought will have a significant impact on farming, and therefore food supply and cost of domestic food products, and will require innovative and sustainable practices to adapt to global warming. What is in general agreement is that seasonal rainfall will remain highly variable across the continent, and be difficult to predict.

The three quarters of the Australian population that live in 17 major cities with populations greater than 100,000 (Infrastructure Australia 2010) will amplify the impacts of rising temperatures due to the urban heat island effect.

2.6.2 Sea Level Rise

The IPCC (2007) predicts that the sea level will rise by 18-59cm by 2100, with a possible additional contribution from melting glaciers of 10-20cm. Storm surges occurring in conditions of higher mean sea levels will cause inundation and damaging waves to travel further inland, increasing the risk of flooding and erosion (CSIRO 2007). Being an island continent, this has severe implications for immediate coastal settlements and infrastructure, particularly given that approximately 85% of the Australian population lives within a coastal region (Department of Climate Change 2009).

In their initial assessment, the Department of Climate Change (2009) predicts the following climate change impacts in Australia's coastal regions:

- of the 711,000 existing residential buildings across Australia which are located close to the water, between 157,000–247,600 properties are identified as potentially exposed to inundation with a sea-level rise scenario of 1.1 metres;
- almost 39,000 buildings are located within 110 metres of 'soft' shorelines and at risk from accelerated erosion due to sea-level rise and changing climate conditions;
- the current value of existing residential buildings at risk from inundation ranges from \$41 billion to \$63 billion (2008 replacement value); and
- community services located within 200m of the coastline include 258 police, fire and ambulance stations, 75 hospitals and health services, 41 landfill sites, 11 emergency services facilities, 120 ports, 5 power stations/substations, 3 water treatment plants, 170 unidentified industrial zones and 1,800 bridges.

2.6.3 Extreme weather events

Climate change is also expected to affect the frequency and intensity of extreme weather events, which in the Australia context refers to cyclones and the development of low pressure systems, not only in the tropical north during summer but also in the southern regions during winter, triggering intensive rainfall as well as severe thunderstorm activity. While Australia is not immune to tornados, these are relatively rare climatic events and tend to present as water spouts visible from the coastline rather than destructive system over the landmass.

While agreement about the impact of global warming on cyclone activity is still being debated, recent studies including modelling by the CSIRO seem to agree that there will be a “marked increase in severe Category 3 to 5 storms, with a pole-ward extension of tropical cyclone tracks” (ABCB 2010). Similarly there are predictions of increased intensity of the severity of storm activity across Australia but particularly in what has been identified as the ‘hot spot’ along the coastal strip of south-eastern Queensland extending through to the central New South Wales. This has particular significance given that this region is highly populated (Kuleshov, de Heedt et al, 2002) but also plays an important role in agricultural production and other economic activity.

2.6.4 Impacts on physical infrastructure

Climate change is likely to cause widespread negative impacts on a wide range of transport and service infrastructure. Not only are the individual impacts of climate change a concern but it is cumulative impacts that can have devastating consequences – cyclones for example not only result in high winds but are also accompanied by flooding.

Infrastructural impacts caused by climate-induced change in the Australia context will likely include as follows (McLean et al. 2001, Nicholls & Lowe 2004, CSIRO & BOM 2007, Lynch et al. 2008, Maunsell 2008, Nicholls 2008, Koetse & Rietveld 2009, CSIRO & BOM 2010, cited in Philp & Taylor 2011):

- Temperature increases in the expansion stress and movement experienced on steel bridges, rail tracks, causing the expansion of concrete joints, protective finishes, and resulting in the softening of asphalt. Surface cracks can also cause water to infiltrate, leading to further degradation. These impacts will particularly affect road, rail and pedestrian traffic. Air transport may be further impacted by severe thunderstorms, strong winds lightning, hail and heavy precipitation. In the long term, changes in temperature will require investment in alternate materials, structural design and a higher level of maintenance;
- Decreased precipitation may result in increased ground movement, changes in the water table and associated increases in the salinity of soils. These impacts may accelerate the degradation of materials, structures, reinforcement and foundations and reduce the life expectancy of transport infrastructure. Extreme rainfall may also cause flood damage to road, rail, bridge, airport, port and tunnel infrastructure. Short-term adaptations may include targeted maintenance schemes and redesign of pavements and drainage. Longer-term adaptations may require changes in culvert design and the design and materials specifications of roads;
- Sea level rise and increase risk of storm surge may affect transport infrastructure in coastal areas, for instance through tall waves and flooding. In the long term more rigorous design standards for flooding and construction of infrastructure in saturated or corrosive soils may be necessary; and
- Changes in coastal winds which are a risk factor for airports, ports and bridges. In the long term these materials may need to be substituted by those with greater strength.

Predicted reductions in the durability, stability and quality of public infrastructure will add restoration and maintenance costs. Adaptation of infrastructure will therefore be important in responding to the current and predicted impacts of climate change, whilst in the long term more profound changes are likely to be required, for instance to material composition and siting.

2.7 Summary

This chapter has provided a context of the latest evidence for climate change in order to understand the consequences globally, and for Australia. There is substantial evidence to support that anthropological actions contribute towards global warming. An understanding of patterns in energy consumption and trends in emissions between developed, developing and under-developed nations alarmingly points to an increasingly polarised climate-change burden, with many of the world's poorest nations being most at risk from the impacts.

Australia has a particular interest in effective mitigation and adaptation in response to climate change given that it is a country of climatic extremes that will continue to succumb to the impacts of climate change but also because it is located within a region of climate-vulnerable developing countries (Garnaut 2011b). The issues and range of climate-related impacts faced in Australia are also vastly different to those likely to be experienced by the developed world located predominately in the northern hemisphere and therefore it is vital that as a nation we develop research capacity and skills to deal with regional issues.

The latest research suggests that the Australian continent, as a result of warmer global temperatures and rising sea levels, will be subject to heat waves, bushfire, drought, coastal erosion and flooding on a more frequent basis, with such events likely to be more extreme in their intensity or duration. In addition to the risks this poses to public health and property, indirectly it brings into focus broader issues such as the nation's food security given that seasonal conditions will likely become even less predictable, but also the ability of the nation to cope with the losses of economic production and the repair bill if action to build resilience is not taken. Importantly, Australia's society is also ageing and this presents an increased level of vulnerability to climate change that needs to be better understood and factored into the national response. The following chapter looks specifically at the ramifications of population ageing and what this means within the Australian context.

CHAPTER 3: AN AGEING POPULATION

At the same time that the world is experiencing climate change, its population is also ageing. This means that the percentage of older people within the demographic profile is increasing as overall fertility and mortality rates decline and life expectancy significantly increases (Gavrilov and Heuveline 2003, p32). While population ageing must be viewed as “a mark of tremendous social achievement and a milestone of human progress” (Zelenev 2008, p1), brought about through advances in medicine, improvements in living and work conditions and the like, it will have considerable social and economic impacts. Before exploring the potential vulnerability of an ageing society to climate change and the implication this will have on the planning and the design of the built environment, this chapter will provide an overview of what population ageing will mean broadly and in particular, to Australia.

3.1 What is ageing?

Ageing is a fact of life. The reality is that ageing is the progressive functional decline or a gradual deterioration of physiological function over time, including a decrease in reproduction, until death (Partridge and Mangel 1999). The ageing process or senescence occurs throughout life although its impact becomes more obvious due to its accumulative effect as a person’s chronological age increases. However people age differently and while patterns of biological decline and vulnerabilities to chronic disease have been demonstrated and are useful in predicting the ‘geriatric condition’, it is important to distinguish these as generalisations.

In terms of assessing potential vulnerabilities of older persons, there is value in adopting the range of non-pathological changes, physical as well as some cognitive and behavioural functions in the performance of older persons when compared to younger cohorts (Rowe and Kahn 1987). Not only are these non-pathological changes a reflection of the ageing process, but in many cases are precursors of pathology (Rowe and Kahn 1987, p 143). These include impairment or loss of:

- hearing and vision performance,
- renal function,
- glucose tolerance,
- systolic blood pressure,
- bone density,
- pulmonary function,
- immune function,
- sympathetic nervous system activity, and
- memory.

3.2 Ageing verses old age

Distinction also needs to be made between ‘ageing’ as the process of decline and ‘old age’ that is essentially a descriptive term, that is it is relational in nature requiring a context of a larger population to be relevant. This brings into question – what is old and how should we measure or define it? Our understanding of the process of ageing has had significant influence on how society views old age and in turn our approach to older people.

Despite the reality that many older persons are ageing successfully well into advanced years as evident in population ageing, negative connotations about ageing persist. The genesis of this negative construct can be traced to the scientific preoccupation with the

pathology of ageing, which characterises the geriatric condition in terms of loss and deficit in performance. This resulted in “older persons’ have becoming stereotyped as frail, sickly and most of all dependant.

While this stereotype persists, population ageing is evidence of the robustness and potential of older persons to live happy, healthy and productive lives through to advanced age, but also suggests that the ability to remain healthy and to live independently is being influenced by a range of factors including environmental conditions and lifestyle.

Rapid extension in lifespan in the post war era, particularly in the developed world, has meant that what in the past was considered to be old is no longer valid and often at times our social constructs, including mental images as well as attributes reinforced through agency, conflict with the shift in demographics. Statistically ‘old age’ is typically set in relation to average life expectancy of the population, in other words a person will be old chronologically as they approach or exceed this age. While this is an accurate measure of the ‘oldest’ within a population, it is in no way a measure of how they have aged or their level of dependency. In the Australian context, the current average life expectancy for a man is 79 years and 84 years for a woman, yet ironically the qualifying age for the Age Pension and the socially accepted age for retirement from full time employment is age 65, noting that the current disparity in the qualifying age for women is being adjusted having risen from 60 to 65 years by 1st July 2013 (Cenrelink 2011).

3.3 Impact of the baby boomer generation

Adding to the complexity of the ageing debate is the significant difference between the Baby Boomer Generation (Born 1946 – 1964) beginning to enter into ‘old age’ compared to the earlier generation now commonly described as the ‘Depression Survivors’ or “Silent Generation” (Born 1925 – 1945). Huber and Skidmore observe that “what is missing from the ageing debate so far is any serious interrogation of the values and attributes that the Baby Boomers will bring to the table. At every stage of their lives, the Baby Boomers have been at the forefront of radical social, economic and political changes: within the family, within the education system and within the labour market. The way the members of this age group, the most influential generation in recent history, choose to adapt to their changing circumstances (i.e. entering into retirement and old age) will have a similarly dramatic impact” (Huber and Skidmore 2003, p 11).

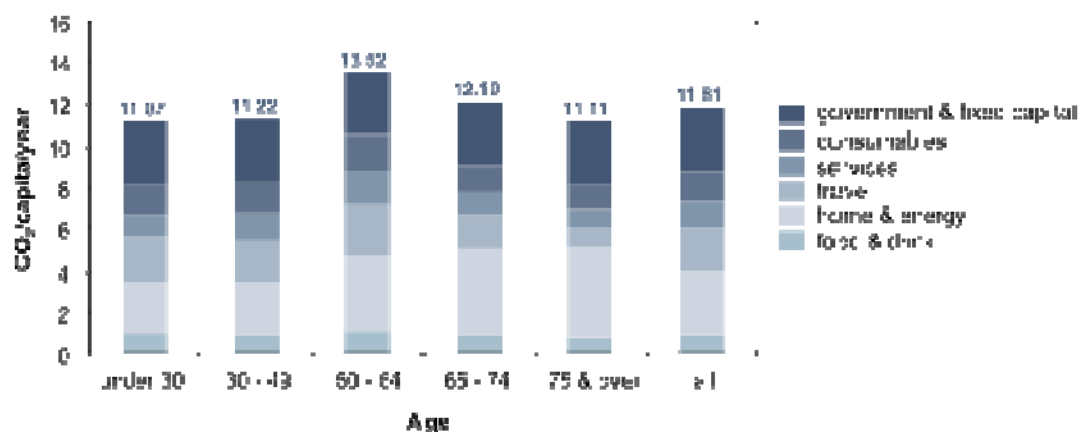
Haq et al (2008) in a study undertaken in the UK, analysing household expenditure on goods and services of cohorts at different stages of life, estimated average carbon footprints of different generations allowing the consumption patterns and attitudes across the different cohorts to be compared. What this study highlighted was the stark contrast between the consumption patterns of the Baby Boomers verses older generations.

Baby Boomers were found to have leisure-oriented lifestyles featuring a much higher level of consumption. This generation were also more dependent on private vehicles and were, in comparison to all other age groups, the cohort with the largest carbon footprint. In contrast, older seniors (75 years and older) were characterised by having lower income, in part due to their period in retirement, but were also prompt bill payers, debt adverse and disliked waste. Many of these characteristics were attributed to the fact that they grew up in a time of austerity during the Great Depression and World War II. The study also found that this group, in needing to cope with increasing care needs and declining health, displayed higher carbon emissions attributed to increased domestic energy use that was 40% higher than the national average. This was partly due to smaller household occupancy but also the fact that they were spending more time at home and therefore a higher demand for household heating. However, overall these older seniors recorded a slightly lower footprint than the UK average.

Such observations are obviously generalised, with significant variation in consumption patterns observed within each age cohort, as influenced by factors such as employment

and income, health and level of dependency etc. (Haq et al 2010). Nevertheless, it does point to significant patterns in terms of generational attitudes or possible responses in addressing climate change and the impact this may have on current consumption patterns.

Figure 9: Carbon footprint by age group



Note: This data is based on a UK survey conducted in 2006. Source: Haq et al (2007), cited Haq et al (2008).

The Baby Boomers will be the first consumer generation to enter old age, therefore replacing low carbon footprint habits and values typical of older generations with relatively high consumption habits. Whether or not the current Baby Boomers will want or be able to maintain high levels of consumption will be dependent on a number of factors including their level of retirement income, changes in behaviour resulting from current campaigns, level of health and fitness and future government policy. Conversely however, the increased wealth (level of saving for retirement), better health and higher level of education displayed by the Baby Boomers in comparison to the preceding generation also suggests that this cohort will be more resilient or perhaps more correctly, less vulnerable having both the resources and capacity to adapt more readily in the face of impacts induced by climate change.

3.4 Magnitude of the shift in demographic profile

Globally by 2050, the United Nations predicts that 20% of the population or 1 in every 5 persons will be aged 60 or older, with the percentage of the 'oldest of the old' (85 and above) expected to almost double. More staggering is the prediction that the number of persons reaching 100 years of age or older is to increase 14-fold over this same period (United Nations 2011).

There is however significant variation in the pace at which population ageing is occurring around the world and in the challenges faced by individual nations as a consequence. As a broad generalisation, those nations with developed economies, including Australia, have already started to experience population ageing; exhibiting higher percentages of older persons in their populations, resulting from the increased life expectancy and lower morbidity rate resulting from access to medical and other social infrastructures, but also lower fertility rates. These economies, having recognised and experienced a comparatively gradual ageing of their societies to this point and exhibited a greater degree of preparedness for social ageing, have begun to focus on capacity building to cope with the expected short to medium term acceleration in ageing induced by the entry of the "Baby Boomers" into the ranks of their aged population. Conversely, less developed economies, while currently having younger populations, are expected to

experience a rapid rate of ageing as a consequence of continued economic development, and are likely to be less prepared, and have less capacity to deal positively with the shift in demographic profile.

Figure 10: Extract from UN table on Population, Ageing and Development 2009

Country or area	Population aged 60 years or over					
	Number (thousands)		Percentage of total population		Share of persons 80 years or over	
	2009	2050	2009	2050	2009	2050
World	737 275	2 008 244	11%	22%	14%	20%
More developed regions	263 905	416 055	21%	33%	20%	29%
Less developed regions	473 370	1 592 188	8%	20%	11%	17%
Least developed countries	42 922	185 129	5%	11%	8%	10%
Australia	4 070	8 482	19%	30%	20%	30%

Source : (UN 2009)

3.5 Australian trends – demographic evidence

Australia's current and projected population trends follow that of other developed economies worldwide. By 2056, based on conservative population projections (ABS Series B projections), it is predicted that over 20% of the population, or one in every five people will be aged 65 years or older.

Table 2: Projections of population ageing in Australia

Proportion of population		2006	2011	2056
Under 15 years	%	19.6	19.9	16.6
15-64 years	%	67.4	67.2	60.5
65 years and over	%	13.0	14.0	22.9
85 years and over	%	1.6	1.9	14.9

Source: Based on Series B Projects: ABS 2006

Comparing the structure and lifestyle patterns of older persons in Australia, the following observations can be made. These mirror the global trends as identified in the UN Report into the Current Status of the Social Structure of Older People 2010 (UN 2010).

- Women will also continue to outlive men in Australia, with the gender disparity for mortality widening with age, however this gap is reducing with the average life expectancy in 2007 – 2009 being 86.8 years for women and 83.7 years for men (ABS 2011). Indigenous Australians however have a much lower life expectancy, being 17-years lower than non-indigenous Australians.

Table 3: Percentage of women in the older Australian population

Age band	% Women
65-74	51%
75-84	56%
85+	67%

Source: Australian Institute of Health & Welfare 2007

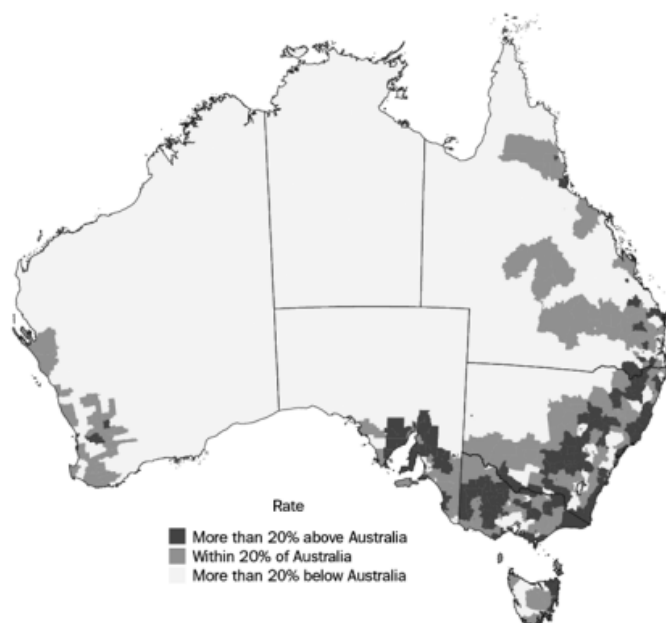
- The vast majority of older persons in Australia will be living in urban centres, with most living in or within reasonable proximity of the nation’s coastal capital cities. There is an observable trend of older persons becoming concentrated in coastal ‘sunbelt’ areas in the eastern states, where in some local districts, particularly in Queensland and northern New South Wales the percentage of older persons within local communities is as high as 30% (Australian Institute of Health & Welfare 2007, p. 6). This movement of significant numbers of people from metropolitan areas and regional cities to coastal areas has become known as the ‘sea change phenomenon’ (Burnley and Murphy 2004) and has been driven by preference for a milder climate and lifestyle.

Table 4: Location where older people reside in Australia

Location in Australia	% Population aged 65 years or older.
Major Urban Centres	12.5%
Other Urban Areas	14.4%
Larger Rural Communities/Towns	13.9%
Rural Balance	9.5%

Source: Australian Institute of Health & Welfare 2007, p 6.

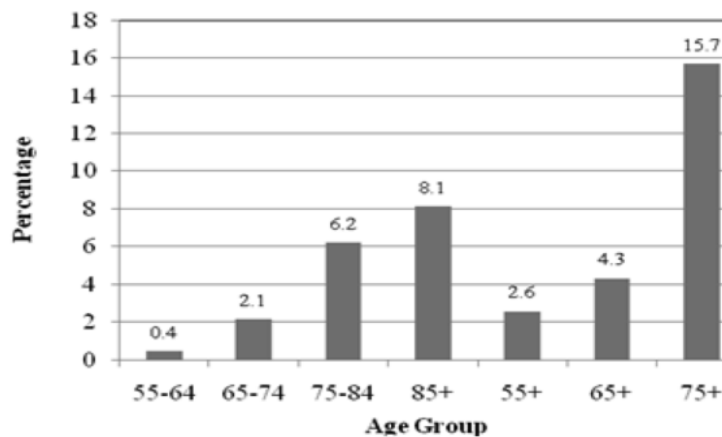
Figure 11: Location of older Australians by Statistical Local Area - 2001



Source: Judd et al 2010, p 60.

- The vast majority of older Australians will live in private dwellings (93.3%) within a community setting, which most will own outright or which 4.3% will be in retirement villages (see Figure 12). 6.7% will reside in non-private dwellings which includes nursing homes and public housing (ABS 1999, 2006.)

Figure 12: Older Australians living in retirement villages, 2006



Source: ABS 2006 Census of Population and Housing

- Around 44% of older persons (65 years of older) live alone and of these households, 72% are be women, with. 40% living as couples (ABS 2005).
- The 2009 OECD Report noted that 27% of older Australians 65 years or older had incomes below the OECD poverty threshold of 50% of the medium household income, which was the fourth highest level of older-age poverty in the OECD and more than double the OEDC average (OECD 2009).
- 100% of seniors reported some level of physical disability, the most common being vision or hearing impairment, however over half live with some form of chronic circulatory system dysfunction and/or condition affecting or limiting their mobility. Amongst the older indigenous population, the overall percentage of the cohort suffering from chronic diseases is much higher. In particular 36% of the older indigenous persons diagnosed with diabetes, 49% with arthritis and 61% with chronic heart and/or circulatory disease (ABS 2004 -5).
- Around 1 in 15 people aged 65 or older will be diagnosed with moderate to severe dementia and this will increase to 1 in 4 for the cohort 85 years and older. As noted by Alzheimer’s Australia, dementia is the term commonly used “to describe the symptoms of a large group of illnesses, which cause a progressive decline in a person’s mental functioning. It is a broad term, which describes a loss of memory, intellect, rationality, social skills and normal emotional reactions”. While there are various causes, Alzheimer’s disease is the most prevalent cause dementia in Australia (between 50 – 70%). It is also important to note that of those 65 years and older suffering from moderate to severe dementia, around half will continue to live within the community either within their own homes or with a family carer (Alzheimers Australia 2008).
- Older persons have a distinct preference for traditional forms of communication – television, radio, landline telephone and mail (ABS 2006) with only 31% of persons 65 years of older in 2008 using or accessing the internet (ABS 2009). However this will likely change overtime with the entry of the Baby Boomers into the senior cohort.

While this data points to the vulnerability of older persons and perhaps paints a picture of disability and impairment, it must be noted that a large number of older Australians are successfully living and engaging in the local community. It is however useful in design and planning terms, to assume a 'worse case scenario' in terms of vulnerability or capacity if equity for all older persons is to be achieved. Adaptive capacity to increase resilience to climate change and extreme weather events will be influenced by social, economic and environmental factors, including access to financial resources, level of social isolation, education and an awareness of their own sensitivities in relation to the local environment and climatic changes.

3.6 Positive or healthy ageing concept

Positive ageing is the ability to maintain three key behaviours or characteristics: low risk of disease and disease-related disability; high mental and physical functions; and active engagement with life." (Rowe and Kahn 1998, p.53). This definition, provided by Rowe and Kahn evolved from their work based in the findings of the 'MacArthur Foundation Study into Successful Aging' (National Institute on Aging 2010). This longitudinal study is today considered a milestone in understanding why some people and not others have the capacity to age more successfully. The critical finding was that what appeared to distinguish those ageing successfully, was what they were doing as they aged and their level of satisfaction with life, but also the link this had with their ability to maintain physical and mental health or ability. Subsequent research building on the findings of this study now suggest that having a 'sense of purpose' or 'being needed or valued' is a critical determinate of health and well-being in the later stages of life (Wong and Fry 1998; Eyles and Williams 2008). Coming from a slightly different perspective, Wallenius' concept of 'personal projects' or goal setting and how this motivates participation and engagement (Wallenius 1999) is equally pertinent.

Exploring these 'social' influences further, the research conducted by the American Association of Retired Persons (AARP) on the qualities of the environment in which people are ageing is particularly relevant (Kochera, Straight et al. 2005). It identifies how community engagement, including regular participation in social activities and relationships, volunteering and civic participation, while being important at any age, is especially critical for older persons in helping to compensate for the losses experienced, maintaining or re-establishing social networks, building self-esteem and sense of personal control as well as for physical and mental stimulation counteracting cognitive decline.

Increasingly the role of community and a person's sense of attachment to their community have also been seen as a vital influence in positive ageing. Such attachment is gained through the sharing of common experience and association allowing people to identify with a locality or place and to maintain a local group life. Where community attachment has been found to exist, quality of life was enhanced both at the community level, as well as for the individual (Berkman and Glass 2000; Kendig, Andrews et al. 2000; Sampson, Morenoff et al. 2002; Kochera, Straight et al. 2005). As argued by Beckman and Glass, "the degree to which an individual is interconnected and embedded in a community is vital to both the individual's health and well-being, and that of the entire community". Their research also highlights how "social networks influence health in important ways, through the provision of social support, social influence and through opportunities for social engagement" (Beckman & Glass 2000 as cited in Eyles and Williams 2008, p. 91).

The importance of a supportive social network in reducing the vulnerability of older persons to climate change should also not be under-estimated. For older persons, being able to call for assistance in the face of a warning of extreme weather events or simply having others concerned about their wellbeing and checking on them during periods of adverse conditions can significantly reduce the risk of injury as well as property losses.

3.7 Ageing and the built environment

The link between the quality of the built environment and people’s health has long been established, and in recent times the concept of designing ‘healthy communities’ and or ‘healthy planning’ have emerged. As noted by the Prime Minister’s Science, Engineering and Innovation Council (PMSEIC):

“Consideration of the built environment is essential to the achievement of the vision of increased healthy life expectancy. The built environment has a powerful impact on mobility, independence, autonomy and quality of life in old age and can also facilitate or impede the quest for a healthy lifestyle at all ages” (PMSEIC 2003, p.48).

Acknowledging that our climate is changing, a key question posed is: can the built environment be designed, or perhaps more appropriately, able to be adapted to assist older people to cope and maintain a healthy lifestyle given the climatic impacts of global warming and the urgent need to reduce greenhouse gas emissions? In exploring this question, it is important to firstly identify what the specific needs and/or sensitivities that older persons may have and to which the design of the build environment will need to respond.

The following table illustrates the potential of the built environment to respond positively to the range of physiological, sociological and economic sensitivities likely to impact people as they age. The sensitivities identified are based on the range of non-pathological deficient’s common across the older aged bands when compared to younger cohorts, and as such must be considered a ‘generalisation’ of the geriatric condition. What starts to become evident, as demonstrated in the following chapter, is the added benefit that designing to support an ageing society delivers. In catering to the likely sensitivities of older people, the residence of the overall community to climate change will likely be increased as well.

Table 5: Sensitivities of older people and adaptive capacity of the built environment

SENSITIVITIES	BUILT ENVIRONMENT RESPONSE
<p>Psychological</p> <p>Increased probability of pre-existing chronic disease and/or physical impairment resulting in:</p> <ul style="list-style-type: none"> • reduced mobility, physical strength and stamina; • difficulties thermo regulating body temperature placing older persons at a higher risk of hypothermia and/or heat stress; • difficulties perceiving risks or dangers due to impairment of senses including sight, sound but also temperature; • skin being more fragile with age; • an impaired immune system increasing the risk of infection and/or reaction to toxins and pathogens in the environment. 	<p>Ensuring the built environment can:</p> <ul style="list-style-type: none"> ▪ be negotiated independently by older persons with limited mobility, strength and stamina or to seek the assistance if required; ▪ protect or insulate against adverse temperature exposures; ▪ pre-warn or making changes in conditions and/or threats of potential dangers. ▪ ability to filter or protect against adverse changes in air quality or other conditions that may introduce toxins or pathogens into the environment.

<p>Sociological</p> <p>Higher risk of becoming isolated and/or disengaged from society as a result of:</p> <ul style="list-style-type: none"> • retirement from full-time employment (purpose for engagement as well as loss of income supporting or allowing engagement in activities); • loss of friends or a spouse; • reduced mobility due to physical or cognitive impairment. 	<p>Ensuring the built environment can:</p> <ul style="list-style-type: none"> • support older persons to remain in their own homes or to find suitable housing opportunities within a family neighbourhood/community setting as they age; • encourage and provide opportunities for social encounters and/or interaction for older persons; <p>be negotiated easily by older person, including those suffering a physical or cognitive impairment, to encourage mobility and access to goods and services catering adequately to their daily needs.</p>
<p>Economic</p> <p>Increasing risk of financial stress and/or loss of economic independence with age due to retirement from full time employment.</p>	<p>Ensuring the built environment can:</p> <ul style="list-style-type: none"> • offer affordable choices for housing, transport and recreational opportunities for older persons who may be welfare dependant or subject to financial stress is self-funded retirees; • be as robust and/or requiring a minimum of upkeep to reduce maintenance, retrofit and/or repair costs.

3.8 Attitudes of older persons

There is increasing interest in patterns of consumption and lifestyle expectations of older persons and how these may be affecting attitudes of acceptance or skepticism of climate change. As the Baby Boomers move into retirement, how such attitudes might change is equally an important question for future policy makers.

There is however conflicting evidence as to whether age is an influencing factor in making a person more or less accepting of climate change and/or their willingness to adapt as a result. The IPSOS Mori Survey (2010) into public perceptions of climate change conducted for the University of Cardiff (Spence et al 2010) suggested that “while older people (55 and older) were concerned about climate change, this age group generally did not feel they would be affected by it and nor did they feel that they are able personally to take action to stop it” (Haq, Brown & Hards, 2010 p. 7). In contrast, research commissioned by CSIRO in 2011 which evaluated and compared the findings from 22 attitudinal surveys recently conducted within Australia, concluded that within the Australian context, ‘beliefs about climate change were strongly related to political preferences, voting behaviours and gender, but that no clear relationship between these beliefs and location, age or income could be established (Leviston et al, p.i).

Regardless of the influence ageing may have on attitudes to climate change, as highlighted by the Stockholm Environmental Institution in their recent project report: *Older People and Climate Change: the Case for Better Engagement*, most national campaigns aimed at promoting sustainability or climate change education have failed to target the older audience and therefore their potential to contribute may not have been capitalised upon. This report makes specific recommendations regarding engagement with older persons, which commences with the call to abandon the stereotype of “older persons being incapable, passive or disinterested” in participating in the debate about or modifying their lifestyle to become more resilient in the face of climate change (Haq, Brown & Hards, 2010 p. 11).

Opportunities to harness the capacity of older persons to contribute are particular relevant when considering the importance of environmental or conservation-based volunteering in promoting a grass-roots approach to implementing climate-change adaption within our communities. The 2006 Census identified that the peak age bracket for volunteering in Australia was between the ages of 65-79 amongst which some 24% or almost a quarter of the cohort were regularly participating in some form of community volunteering (ABS 2006). As highlighted by Bernard Salt in a presentation to the Volunteering Australia’s National Conference in 2010, the influx of the Baby Boomer generation could potentially be a ‘golden age’ for volunteering if strategically managed. The Baby Boomers are, as he noted, “very different to other generations that have come before them – they are highly educated, articulate and opinionated but most importantly, accustomed to trading, not giving things away for nothing...in order to capture their potential as a volunteer workforce, it will be important to manage their [Baby Boomers] expectations and to engage with them in a way that recognises their skills” (ProBono Australia, 2010, p. 1).

3.9 Summary

Having an ageing society suggests that Australia, due to its higher percentage of 'older' people who are comparatively more sensitive to environmental exposures than younger cohorts, will be more vulnerable to the impacts of climate change. While this casts population ageing and 'old people' in a negative light, paradoxically an ageing society also means that more people are living longer and in better health than ever before in Australia's history.

This chapter highlights how and why people age differently, and the danger in stereotyping the geriatric condition, with more recent concepts of ageing benefiting by recognising the high degree of heterogeneity that exists within the 'senior' cohort. The reality is that there will be significant variation in the physical, cognitive, social and financial capacities of older persons and hence in their ability to maintain their independence and wellbeing.

However there is value in considering the range of non-pathological changes, physical as well as some cognitive and behavioural functions in the performance of older persons when compared to younger cohorts, as predictors of pathology resulting in morbidity but also resulting in increased sensitivity to environmental exposures. These factors point to the types of sensitivities that older people, as a cohort, will have to the impacts of climate change, but also their ability to cope and respond in the face of climate change. Based on this range of sensitivities of the senior cohort, the following chapter will explore the impacts of individual exposures predicted as a consequence of climate change within the Australian context as a starting point for discussion about how to address this group's potential vulnerability.

What this chapter also highlights is the benefits to be gained by ensuring the built environment is supportive of older people. Not only does this make fiscal sense, by helping older people to age in better health and to continue to contribute in a meaningful way to society, but the flow-on impacts are that it has the potential to increase the capacity of the community as a whole to cope with the direct and indirect impacts of climate change. In other words, there is a strong case for considering climate change adaptation in parallel with strategies needed to support the nation's ageing population.

CHAPTER 4: AGEING & VULNERABILITY TO CLIMATE CHANGE

While every member of society has the potential to suffer health and other impacts resulting from climate change, older persons will be more sensitive and likely to suffer a greater degree of impact than any other age group. While physiological decline and the progression of chronic disease associated with ageing are obvious causes of this increased sensitivity, there are other contributing factors that can be bundled under the headings of psycho-social and socio-economic risks due in part to the elderly stage in their lifecourse.

This chapter will explore a range of climatic ‘exposures’ predicted to impact upon communities as a result of climate change. This will allow the ‘sensitivities’ of Australian communities to these exposures to be identified, not only in terms of the potential risks to public health but also the social and economic impacts resulting from disruption to natural and social systems, and in particular any generic sensitivities of older persons that need to be considered.

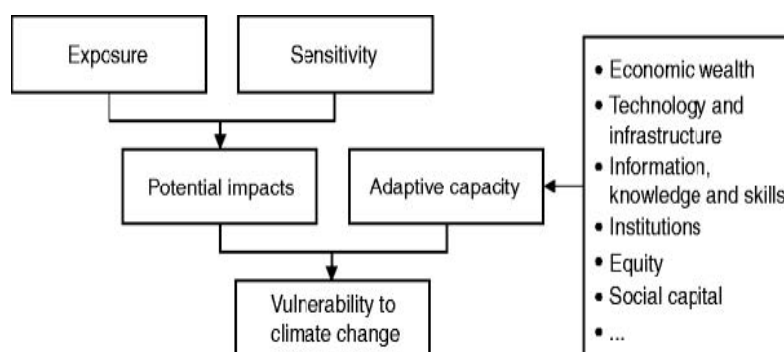
4.1 Conceptualising vulnerability to climate change

The IPCC Third Assessment Report defines vulnerability to climate change as “a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity” (IPCC 2001, p. 995). Lonescu et al (2006, p. 4) observe that there are three important caveats in attempting to predict vulnerability that also emphasises the complexity of the exercise:

- the direct effects of climate change will be different in different locations;
- there are differences between regions, groups and sectors in society which determine the relative importance of the direct effects of climate change; and
- there are differences in the extent to which regions, groups and sectors are able to prepare for, respond to or otherwise address the effects of climate change.

This is why varying groups and sectors within society or a particular locality will be affected differently.

Figure 13: Conceptualisation of vulnerability to climate change



Source: IPCC Third Assessment Report. p. 32

The IPCC’s conceptualisation of vulnerability illustrated above is particularly useful in visualising the role that adaptive strategies play in reducing vulnerability. Obviously, the aim of such a strategy is to increase or improve an older person’s capacity to reduce either their degree of exposure to harm or their degree of sensitivity to a harmful change caused by variations in climate or extreme weather events. This is useful in that it

introduces the underlying concept that some strategies aimed at developing adaptive capacity will be about controlling environmental conditions or limiting the level of exposure. It is here that the role of the built environment becomes evident, whereas others strategies are about maintaining the robustness of the individual to cope with changed conditions.

4.2 Exposures linked to climate change in Australia

Research conducted between 1998 and 2000 as part of the National Assessment of the Potential Consequences of Climate Variability and Change for the United States into the potential health impacts of climate variability and change, published in *Environmental Health Perspectives* in April 2000, proposed that the various exposures attributed to climate change with the potential to cause a health impact, could be categorised under five (5) broad themes (Bernard and Ebi 2001, p. 177). These included:

- temperature-related morbidity and mortality;
- impacts from extreme weather events;
- impacts on air quality;
- water and food-borne diseases; and
- vector-borne diseases.

It is important to highlight that the definition provided by the World Health Organisation (WHO) for 'health' is being applied in this context, inferring "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity" (WHO, 2011).

This provides a useful framework to examine the potential impacts as well as factors which may amplify or compound the level of exposure and/or sensitivity to it. Several of these exposures fall under the heading of 'natural disasters', including bushfires, cyclones, severe storms and flooding. These are especially significant due to their potential to disrupt social and ecological systems. In addition to the direct loss of life and injury caused during the event, these disasters also present a range of public health risks and social and economic impacts during the recovery period.

A detailed examination of the research findings of each category of climatic-related exposure was undertaken for this study. The results are summarised in the following section allowing several important patterns to be observed.

4.3 Temperature-related exposures

It is expected that average seasonal temperatures will increase with global warming. In Australia the major risk of exposure will come from heatwaves, bushfire and the effect of drought and/or changes in seasonal rainfall patterns. Not only do these events pose a risk of increased morbidity and mortality, but cause widespread disruption to social and ecological systems, inflicting a high social and economic cost to the nation.

4.3.1 Heatwaves

Heatwaves presents as the immediate and most serious threat public health and ageing, heat-sensitive infrastructures in Australia. Heatwaves have been responsible for the death of more Australians than any other form of natural disaster, recording mortality rates double that attributed to tropical cyclones or floods and significantly higher than for bushfires (Coates 1996). More alarming is that recorded deaths are likely to be significantly underestimated given that exposure exacerbates a range of pre-existing conditions leading to heart attack or stroke; and associated morbid conditions typically resulting in death within 12-months of the exposure (McGeehin & Mirabelli 2001).

The elderly are at considerable risk during heatwave events given the high probability of

suffering from a chronic health condition making them more susceptible to heat stress (Andrews, 1994; Deo and McAlpine, et al 2007). In the 2009 Victorian heatwave, almost 80% of the 374 fatalities were people aged 65, with 84% of this group being aged 75 years of older, demonstrating that vulnerability to this exposure increases with age (Cooper, 2009). The ability for older persons to cope however is also linked to their level of preparedness for extreme heat including having sufficient warning to seek necessary assistance or relocate to more appropriate accommodation. What is apparent is that both adaptive behaviour as well as the conditions presented in the home environment play a critical role in either limiting or amplifying the exposure.

In terms of adaptive behaviours, remaining hydrated, staying in-doors and avoiding strenuous activity is important, but also in the case where older persons may be bedridden or restricted in their mobility, it is important that assistance is given to ensure conditions are appropriate to avoid inducing overheating and problems of dehydration. Similarly the degree to which the environment can reduce exposure to excessive heat is important. Unfortunately, a compounding problem experienced in Australia during heatwaves is the high probability of the electricity supply failing. Obviously if the home environment is also reliant on mechanical systems such as ceiling fans or air-conditioning for cooling, the risks to older persons can escalate during periods of power outage. Notably older persons with limited financial means are likely to be most vulnerable, being unable to afford to install or operate air-conditioning (or evaporative cooling) and their housing may be inferior in terms of its design for passive cooling - in other words being well insulated with good cross-ventilation or being appropriately orientated and incorporating sun shading devices to minimise heat loading, etc. Table 6 below summarises the range of generic sensitivities of older persons to heat wave events separated into risks induced by physiological, social or economic conditions.

Table 6: Generic sensitivities of older persons to heatwave events

Physiological Induced	Socially Induced	Economically Induced
Heat stress due to reduced ability to regulate body temperature either as a result of normal ageing and/or as a side effect of some medications or dehydration.	If living alone, seniors may have a reduced capacity to retreat/relocate to a more suitable location or to seek assistance i.e. no longer driving or as a result of physical disability.	Reduced financial capacity/resources to retrofit housing to reduce exposure – installing insulation or mechanical systems or to pay the ongoing operational costs for these systems.
Higher probability of having a pre-existing condition such as chronic pulmonary or cardiac disease increasing sensitivity/risk of mortality induced by heat stress.	If social contact is reduced – older persons may not be pre-alerted to heat condition or be adequately prepared during the course of the event.	Living in inferior accommodation as a result of financial situation that may amplify exposures due to poor design and/or location.
Physical risks can be exacerbated/amplified by power outages impacting the home environment – loss of environmental cooling, lighting etc.	Lack of prevention awareness or recognition of the danger of heatwave conditions.	

4.3.2 Bushfire

The immediate risk for the elderly during bushfires is their capacity to evacuate or if choosing to stay, to effectively protect both property and themselves from harm. Difficulties arise not only from physical or cognitive impairment, but may be linked to other factors such as an inability to drive or not having access to a private vehicle, but also not having the physical strength, agility and stamina for the task. The other major

concern, particularly when older persons are living alone or as a couple are relatively isolated, is being accidentally forgotten or left behind, quite simply because no one else is looking out for them or aware of their circumstances.

Early warning plays a critical role in assisting older persons to cope with the risks presented. In looking at this aspect, it is particularly important to recognise that older persons will be likely to use traditional modes of communications including landlines, radio or television. While significant effort is currently being made by Governments to improve the speed and rapid delivery of alerts employing SMS and the internet, this may not be effective for the older population unless they have kept pace with technology and have access to it in their homes. In addition to the immediate risk, pre-existing health conditions may put older persons at risk from toxics in bushfire smoke. Other issues exposed during the recovery period are discussed in 2.4.6.

Table 7: Generic sensitivities of older persons to bushfire events

Physiological Induced	Socially Induced	Economically Induced
<p>Physical and/or cognitive impairment hindering evacuation or capacity to defend property.</p> <p>Higher probability of having a pre-existing condition such as chronic pulmonary or cardiac disease increasing sensitivity/risk of morbidity and mortality induced by toxics in bushfire smoke.</p> <p>Chronic health conditions can be aggravated or contribute to increased health risks as a result of disruption to normal routines including eating habits, medication or hygiene as well as the added psychological trauma of the event itself.</p>	<p>If social contact is reduced – an older person’s level of preparedness for evacuation or defense of property may be lacking. Risk of being left behind or without adequate level of assistance.</p> <p>Reliance on more traditional methods of communication – landlines, radio and television for early warning. Recent focus on new technologies will require older persons to have access to newer technologies in their homes and to have kept pace with the use of these technologies.</p>	<p>Reduced financial capacity/resources to defend property.</p> <p>Often lacking confidence or have difficulties in obtaining disaster relief and available resources – recovery tends to be slower for older persons.</p> <p>Risk of scams/being taken advantage off in the re-building phases of recovery.</p>

4.3.3 Disruption to local food supply

Disruption to local food production as a result of drought or other climate-induced causes impacts on the cost of food and the availability of fresh supplies. The major concern for older persons living on limited income is their ability to maintain an adequate diet in the face of escalating food supply induced by supply shortages.

Physiological changes brought about by ageing impact upon the ability of older persons to metabolise and absorb certain nutrients, making them more vulnerable to malnutrition and illness if their dietary intake is inadequate.

Sensitivities specific to age and dietary intake include:

- loss of lean muscle mass through age reduces an older person’s ability to burn calories. This can result in appetite suppression (weight loss and malnutrition, but also put them at risk of obesity if the diet is high in fat and sugars;

- inactivity through loss of mobility can result in several problems including constipation and bowel problems due to reduced gut motility but also if fibre intake is low, equally older persons may be suffer from Vitamin D deficiency from lack of exposure to sunlight which in turn reduces their ability to absorb calcium essential for bones;
- older persons can suffer from anaemia due to poor absorption of iron due to changes in the gastrointestinal tract, blood loss and through use of some medications.

Table 8: Generic sensitivities of older persons to food security

Physiological Induced	Socially Induced	Economically Induced
<p>Higher risk of malnutrition as a result of reduced ability to metabolise and absorb nutrients if dietary intake is inadequate or inappropriate to compensate for these problems.</p> <p>Physical impairment reducing mobility may result in vitamin D deficiencies due to lack of exposure to sunlight as well as gastrointestinal disorders due to inactivity.</p> <p>Appetite suppression and/or risk of weight gain as a result of loss of lean muscle mass.</p>	<p>Education about nutrient and risk associated with ageing is vital to ensure dietary intake is adequate and supports healthy ageing.</p> <p>Encouraging older persons to get outdoors into the sunshine to ensure adequate levels of Vitamin D.</p> <p>Inability to access fresh and appropriate food within their locality. This may be compromised by an inability to access shops/supplies due to a lack of private or public transport or being unable to walk to shops.</p> <p>Supervision of dietary intake and food presentation is important to ensure older persons particularly if suffering physical or cognitive impair.</p>	<p>Reduced financial capacity/resources to maintain health and appropriate dietary intake.</p>

4.4 Extreme weather events

Climate change will likely affect the frequency, severity and duration of extreme weather events, as well as alter the geographic regions affected by them. Extreme weather has been defined as “meteorological events that have a significant impact upon a local community or ecosystem” but which are also “a departure from what is considered the norm” (Greenough, McGeehin et al. 2001, p 191). While there is overlap between temperature-related and air quality exposures such as heatwaves, dust storms and bushfires, in the Australian context the term ‘extreme weather events’ will be used to refer to:

- tropical cyclones including storm surge;
- flooding; and
- severe storms.

Extreme weather events have particular relevance to the discussion about adaption of the built environment for climate change given their potential to destroy and damage buildings and infrastructure. These events also pose significant public health risks, not only through traumatic death or injury during the event, but indirectly as a result of the

disruption to social and ecological systems, which will occur during the post-disaster recovery phase. These indirect impacts include risks associated with shortages of safe drinking water and food supplies, acute illness caused through infectious and vector borne disease, as well as psychological trauma. There are also other indirect links that need to be considered including financial hardship and the risk of criminal activities such as looting and civil disobedience or violence.

Community preparedness for extreme events is a key determinant of a disaster’s impact (Greenough, McGeehin et al. 2001, p 192). Thankfully in Australia, disaster planning at all levels of government provides timely and coordinated emergency responses, backed by robust public health infrastructure, and when required, military support to coordinate delivery of emergency shelter, supplies and ‘re-building’.

Early warning systems are also comparatively sophisticated and linked into national broadcasting and telecommunication networks. This has been demonstrated to effectively reduce the loss of life and personal injury during these extreme events, but also in containing the potential public health risks in the recovery period. However if climate change, as predicted, increases the frequency and/or severity of extreme weather events, it will have a flow-on affect impacting both the individual’s as well as the nation’s capacity to respond and to fund recovery, particularly when coupled with disruption to economic production and loss of trade. This is especially the case for industries sensitive to the impacts of natural disasters such as agriculture, mining and in particularly tourism.

The study undertaken by McAneney et al (McAneney, Crompton et al. 2007, p 19-20) on insurance losses in Australia between 1966/7 and 2005/6 by frequency and natural hazard category (excluding earthquakes), provides some surprising results in relation to what leads to adjusted insurance claims. Compared to cyclones, severe hailstorms, which occur relatively less frequently, resulted in a higher accumulated cost in terms of claims for property damage. If combined with thunderstorms, these events, which are considered to be minor in terms of severity relative to cyclones, constituted a higher economic risk for the community, and while these generally impact a smaller geographic location, they occur within a much wider distribution pattern across the continent, particularly in coastal regions that are heavily populated and urbanised.

Figure 14: Assessment of insurance claims across Australia by hazard types

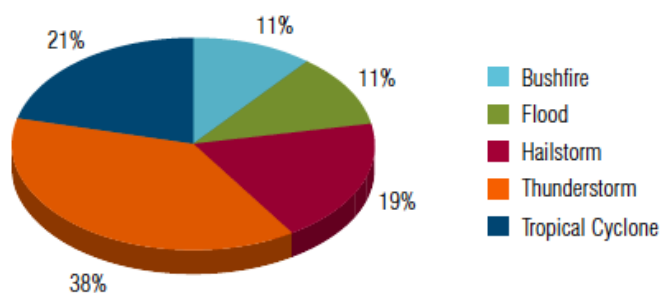


Figure 7a: Percentage of the number of weather-related events classified by hazard type in the ICA Disaster List. Here event losses from hailstorms have been separated from other forms of severe storms – tornados and high winds.

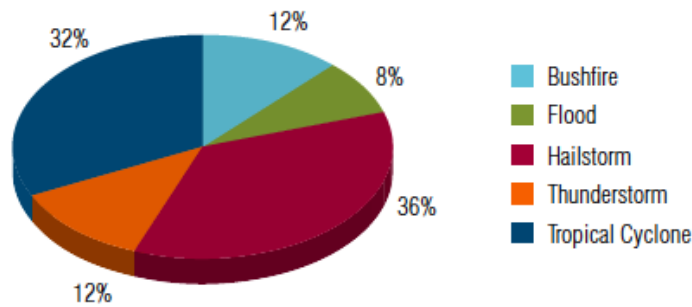


Figure 7b: Percentage of the total accumulated current losses as at 2006 (AUD\$M) of weather-related events in the Disaster List classified by hazard type.

Source: McAneney, Crompton et al. 2007

Note: Figures 7a and 7b show the breakdown of insured losses by frequency and meteorological hazard category. 21% of loss events (ignoring earthquakes) are tropical cyclones that have been responsible for 32% of losses. Hailstorms comprise 19% of loss events and have been responsible for 36% of losses. Floods are less prominent but are probably under-represented because this peril has not been uniformly insured.

4.4.1 Tropical cyclones

The immediate risk for the elderly during a cyclone, as with bushfires, is their capacity to evacuate or if choosing to stay, to effectively protect both themselves and their property from harm during the storm and subsequent inundation by floodwaters. Again early warning plays a critical role and past experience has demonstrated that as the cyclone approaches, it is likely that lifelines including communications, roads and other transport will be cut and remain severed for some considerable time following the event (ABCB 2010; Boughton, Henderson et al. 2011). This places even greater emphasis on evacuation particularly if older persons have dependency needs, including the need for medication, regular health care or supervision.

Excluding problems associated with older persons having pre-existing physical or cognitive impairment, much of the preparation for an approaching cyclone involves removing or securing objects around the home, boarding or taping windows and sandbagging, all of which require physical strength, agility and stamina. Older persons, particularly if living alone may find this difficult without assistance. The other major concern for older persons who are socially isolated or living in remote locations, is being accidentally forgotten or left behind simply because no one is looking for out for them or aware of their circumstances.

During the recovery period, older persons have a higher risk of infection from contaminated floodwater and debris during clean-up operations. With age, a person's skin becomes increasing fragile and susceptible to abrasions and cuts, therefore the likelihood of infection is not only heightened, but given that their immune system is more likely to be depressed due to pre-existing medical conditions or prescription medications, their ability to fight the infection is often compromised. Similarly the risks presented by a common bout of gastroenteritis, colds and flu induced by inferior sanitary conditions or increased exposure due to crowded conditions in an evacuation centre, can have more serious consequences for older persons, particularly if access to medical treatment is delayed.

Vector-borne disease is the most significant risk after a cyclone and its clean-up period, as flooding associated with the cyclone offers an abundance of breeding sites particularly for mosquitoes, with the risks of being bitten heightened given physical damage to housing or conditions within evacuation centres. Added to the problem is

that many of the more serious vector-borne diseases including Dengue and Ross River Fever, have a relatively long incubation period and will not present until sometime after the initial disaster and even well after the recovery period. Initial symptoms mimic those of the common colds or flu, meaning that often these more serious diseases go undiagnosed and untreated with potentially serious consequences. For older persons again the added risk is associated with pre-existing health conditions and/or a compromised immune system.

In addition to the health-related risks, older persons are likely to shoulder a higher social cost and take longer to financially recover from the disaster. Given the likelihood of being on a fixed or limited income (pension support), the cost of repairs to housing and the replacement of personal and household goods will be proportionally higher when compared to income or available savings, but also the level of insurance may be less given the ongoing financial burden of maintaining a policy in high-risk locations. There is some evidence based on post-disaster investigations (Gibson and Hayunga 2006) that older persons find the process of seeking government assistance more difficult and while often not persistent in gaining financial help during the recovery period, are also more vulnerable to unscrupulous scams for building repairs and welfare fraud.

Table 9: Generic sensitivities of older persons to cyclones

Physiological Induced	Socially Induced	Economically Induced
<p>Physical and/or cognitive impairment hindering evacuation or capacity to remain safe if remaining with the property.</p> <p>Higher risk of infection of wounds during clean-up due to increased risk of exposure to be sensitive of skin to breaking and impaired immune system.</p> <p>Chronic health conditions can be aggravated or contribute to increased health risks as a result of disruption to normal routines including eating habits, medication or hygiene as well as the added psychological trauma of the event itself.</p>	<p>If social contact is reduced – older persons level of preparedness for evacuation or defense of property/personal safety may be lacking. Risk of being left behind or without adequate level of assistance.</p> <p>Reliance on more traditional methods of communication – landlines, radio and television for early warning. Recent focus on alternative or newer technologies will require older persons to have access to these alternative technologies in their homes and to have kept pace with the use of these technologies.</p>	<p>Reduced financial capacity/resources available to maintain adequate level of preparedness.</p> <p>Often lacking confidence or have difficulties in obtaining disaster relief and available resources – recovery tends to be slower for older persons.</p> <p>Risk of scams/being taken advantage off in the re-building phases of recovery.</p>

4.4.2 Flood

The generic sensitivities, particularly in terms of health risks, are similar to those for cyclones, primarily because most cyclone events are accompanied by flooding. It is perhaps the community’s tendency to perceive flooding as a lesser threat to human life and property than cyclones. In reality however, for older persons living in vulnerable or flood prone areas, the frequency of flooding is a major issue from the perspective of psychological and financial stress, and they may not have the financial means to relocate themselves to a less vulnerable location or housing type.

Table 10: Generic sensitivities of older persons to flooding

Physiological Induced	Socially Induced	Economically Induced
<p>If older persons get caught in floodwater, the risk of hypothermia is greater due to reduced body mass and capacity to regulate body temperature. This combined with reduced physical strength and stamina can result in downing or permanent injury.</p> <p>Physical and/or cognitive impairment hindering evacuation or capacity to remain safe if remaining with the property.</p> <p>Higher risk of infection of wounds during clean-up due to increased risk of exposure and sensitivity of skin to breaking and impaired immune system.</p> <p>Chronic health conditions can be aggravated or contribute to increased health risks as a result of disruption to normal routines including eating habits, medication or hygiene as well as the added psychological trauma of the event itself.</p>	<p>If social contact is reduced – older persons' level of preparedness for evacuation or defense of the property may be lacking. Risk of being left behind or without adequate level of assistance to ensure their personal safety.</p> <p>Reliance on more traditional methods of communication – landlines, radio and television for early warning. Recent focus on alternative or newer technologies will require older persons to have access to these alternative technologies in their homes and to have kept pace with the use of these technologies.</p>	<p>Reduced financial capacity/resources available to maintain adequate level of preparedness.</p> <p>Often lacking confidence or have difficulties in obtaining disaster relief and available resources – recovery tends to be slower for older persons.</p> <p>Risk of scams/being taken advantage off in the re-building phases of recovery.</p>

4.4.3 Severe thunder storms

The major risk from severe storms for older persons is injury from property damage or inappropriate sheltering or use of phone lines during the storm. Unfortunately early warning coupled with general complacency about the potential severity of storms often means that the public are not adequately prepared and in the case of older persons, their ability to react quickly in the face on an approaching storm may be limited if suffering from a physical impairment. With increasing frequency and severity of storms, particularly in areas outside high wind regions (and therefore adapted for cyclonic weather), maintaining adequate levels of insurance is a financial burden that many older persons, particularly those dependent on social security may find increasingly hard to bear.

Table 11: Generic sensitivities of older persons to severe storms

Physiological Induced	Socially Induced	Economically Induced
<p>Physical and/or cognitive impairment hindering capacity to prepare for and remain safe during the storm.</p> <p>Chronic health conditions can be aggravated or contribute to increased risk of asthma attack following the storm due to elevated levels of pollens or dust in the atmosphere.</p>	<p>If social contact is reduced, an older person's level of preparedness for the storm event or able to cope may be compromised.</p> <p>Education to ensure appropriate and risk adverse behaviours including sheltering in-doors, avoiding using landlines, unplugging electrical and computer equipment, etc.</p>	<p>Reduced financial capacity/ resources available to maintain adequate level of preparedness/ maintenance of the property.</p>

4.5 Air quality impacts

Air pollution, by definition, is when gases or particulates are introduced into the atmosphere either via natural or anthropogenic sources. There is little dispute that air pollution can cause adverse health impacts to humans, plants and animals, with most nations, including Australia, now having legislated to put air quality and/or emission controls in place to mitigate this risk. Given that climatic conditions play an important role in the distribution as well as concentration of air-borne pollutants, exposure to air pollution will be affected by climate change. Equally, weather in particular seasonal temperature variations directly influences fossil-fuel consumption and indirectly, the production of air pollutants, which leads to other impacts induced by climate change.

In 1998, working through the National Environment Protection Council, the Federal, State and Territory Governments within Australia agreed to the National Environment and Protection Measure for Ambient Air Quality, which set maximum safe concentrations for six common air-borne pollutants determined on the basis of the Nation's geographic, climatic and demographic conditions (Australian Government 2011). In addition, in 2002 Australia was successful in phasing out the use of leaded petrol and introduced vehicle emission standards, as well as National Fuel Quality Standards. In 2004, Australia also introduced the National Environmental Protection Measure for Air Toxics. Air Toxics, often described as hazardous air pollutants (as opposed to common air pollutants), by definition are "a range of air-borne pollutants usually present in ambient air in relatively low concentrations but which have characteristics such as toxicity or persistence that make them a hazard to human, plant or animal health" (Australian Government 2005), including volatile and semi-volatile organic compounds and heavy metals.

The major risk for older persons presented by the various types of air pollution comes from their likelihood of suffering from some degree of chronic obstructive pulmonary disease or having other pre-existing medical conditions leading to more serious complications if the respiratory function is compromised. Therefore avoiding conditions where air quality may be compromised will reduce vulnerability, which may include avoiding high risk environments including parking basements or living within close proximity of pollution sources (industry or concentration of vehicle emissions), but also avoiding smoking and ensuring gas appliances within the home environment are appropriately located and functioning properly.

Warning about adverse conditions and/or high pollution counts can be helpful in ensuring that older persons at higher risk due to pre-existing medical conditions can plan to remain in-doors and avoid physical excursion or limit exposure by switching air-conditioning to internal circulation and ensuring windows are closed. Regular

maintenance, particularly for those living within close proximity to pollution sources is important. Preventing dust from accumulating and taking precautions when working in gardens or disturbing soil can help to avoid exposures especially to heavy metal fallout.

Table 12: Generic sensitivities of older persons to air pollutants

Physiological Induced	Socially Induced	Economically Induced
<p>Pre-existing health conditions or age-related chronic obstructive pulmonary disease presents increased risk of complications induced by exposure to air pollution.</p> <p>Accumulation of persistence toxics within the body due to age and exposure particularly to lead prior to changes in air-quality controls (lead in petrol or exposure to asbestosis).</p>	<p>Exposures linked to living within close proximity of pollutant sources or in settings where exposures many have accumulated.</p> <p>Continuing to smoke or living with a smoker.</p> <p>Being unprepared or adding to the risk by being outdoors and participating in physical activity when the pollution threat is present. Either absence of warning or failure to heed the warning/not taking the threat to health seriously.</p>	<p>Reduced financial capacity/resources available to relocate away from pollution sources or to undertake the level of routine maintenance needed to avoid the risk of exposure.</p> <p>Unable to replace or pay for the inspection/repair of faulty appliances or gas leaks.</p>

4.6 Water & food-borne diseases

These two risks of exposure of disease are closely related. Water-borne diseases are caused by pathogens spread through contaminated water used for drinking, recreational or other purposes such as irrigation, or coming in contact with contaminated surface water as a result of localised flooding. In such cases pathogens are either ingested, inhaled or absorbed through the skin or into the bloodstream via cuts and abrasions (Rose, Epstein et al. 2001, p. 211). While food-borne diseases are ingested, the accumulation of pathogens on or within plant and animal tissues is generally linked to contaminated water supply. Although improved sanitation and water treatment processes have significantly reduced the public health risk associated with these exposure, there is growing concern around the emergence of antibiotic-resistant strains and/or the re-emergence of pathogens such as cholera (Rose, Epstein et al. 2001).

The complex relationships between pathogen transmission and transportation, anthropogenic factors and the possible impact of climate change are only beginning to be appreciated. While climatic events and longer-term change in weather patterns will not directly cause the disease threat, it has the potential to amplify the risk of exposure.

Older persons are more at risk of severe and even fatal illnesses as a result of water and food-borne disease due primarily to a compromised immune system as a result of pre-existing medical conditions and treatments or medication use, but also in failing to seek prompt medical attention when poisoning does occur and succumbing to the effects of dehydration. The NSW Food Authority reported that between 1995 and 2008, 65 food-borne illness outbreaks were reported in vulnerable care facilities in Australia including age-care and nursing homes, childcare centres and hospitals, with 758 illnesses and 75 fatalities. The Authority also highlighted that the elderly living in nursing homes were at far greater risk than the baseline level of illness in the general population (NSW Food Authority 2009, p 11).

Most states have now implemented Food Standard Codes requiring catering for vulnerable persons. This has involved the implementation of food safety programs within aged care and nursing home facilities, which has seen the substitution of high risk foods with safer alternatives; effective cleaning and sanitation of fresh or raw foods, limiting storage times and stringent temperature controls as well as proper food handling and preparation and sanitation of equipment. Unfortunately such preventative measures are more difficult to implement for the majority of the elderly population ageing in place. This suggests that education and promotion of food safety directed to the older population is extremely important in combating this public health risk.

Table 13: Generic sensitivities of older persons to water and food-borne diseases

Physiological Induced	Socially Induced	Economically Induced
Pre-existing health conditions and/or a compromised immune system as a result of medication or treatment can result in complications resulting from even mild cases of food poisoning.	Lack of education and poorer food storage, handling and preparation practices can increase the risk of exposure to food poisonings.	Inability to repair or replace appliances, in particular fridge or freezers allowing for appropriate storage of food. Purchase of discounted/cheap food that might be close to expiry dates or eating food that has past expiry rather than seeing it go to waste.

4.7 Vector and rodent-borne diseases

Gubler et al (2001) describe how vector-borne diseases result from “infections transmitted to humans and other animals by blood-feeding arthropods including mosquitoes, ticks and fleas” while vector-borne pathogens causes these diseases, “which include viruses, rickettsiae, bacteria, protozoa and worm parasites are transmitted because they spend part of their lifecycle in a cold-blooded arthropod vector” (p. 223). In terms of the climate change debate, it is the influence of climate on the prevalence and distribution patterns of the arthropod hosts that is critical. In saying this however, not all rodent-borne disease relies on an arthropod host, which means the link with climatic conditions is more tenuous. Reiter (2001) however argues that “some models suggest that higher global temperatures will enhance their transmission rates and extend their geographic ranges. However, the histories of three mosquito-borne diseases - malaria, yellow fever, and dengue - revealed that climate had rarely been the principal determinant of their prevalence or range but rather human activities and their impact on local ecology have generally been much more significant” (p. 141).

Fortunately, Australia’s isolation allowed the continent to remain free of some major vector and rodent borne diseases, however international travel and trade has increased the opportunity for both exposure and breaches in quarantine. The most significant risk in the Australian context to vector borne disease comes from exposure to mosquitoes particularly in the northern and more tropical parts of the continent. Concern about the potential for exotic diseases, in particular malaria and yellow fever entering the country, has led the Australian Quarantine and Inspection Service AQIS to monitor for mosquitoes a minimum 400m around the perimeters of all Australian ports of entry for international vessels and at Australian international airports. Australia is also one of the few countries that requires the fumigation of international aircraft cabins and holds to kill insects (AQIS 2007).

Older persons are not necessarily more or less sensitive to this exposure however pre-existing medical conditions and/or a compromised immune system may make them more

susceptible to complications should they become infected. Living conditions if general housekeeping and maintenance is below standard due to physical or cognitive disability may encourage vectors into the living environment (mice and rats), however the more likely risk of exposure is following extreme weather events or other form of natural disaster.

4.8 Natural disasters – exposures during evacuation & recovery

The loss of life and injury from natural disasters has been significantly reduced by evacuation responses and evacuation planning in Australia, however there are a number of indirect threats that pose a threat or risk to communities after the event during the recovery period to which older persons are particularly vulnerable. While the nature of the natural disaster may vary, many of the issues presented during the evacuation and recovery period are common to most events.

There is no doubt that early warning can significantly reduce the impact of natural disasters not only in terms of the community's risk of injury and loss of life, but also in reducing property damage and the impact on livestock and family pets etc. However community preparedness relies on good education about the most appropriate course of action and preventative measures, as well as an understanding of evacuation procedures.

Effective communication by issuing warnings and ensuring adequate time for effective evaluation is critical. Similarly, offering help to those, including older persons, who may require assistance in both preparing their properties but also preparing themselves for timely evacuation is essential. Some members of the community will require access to transport and assistance to physically access designated shelters or evacuation centres.

The design of shelters and evacuation centres is also a critical factor particularly in assisting with the health and comfort of people impacted during the recovery period. Factors such as disability access and provision of adequate sanitation are a priority, but also the ability to feed and house those evacuated potentially for several weeks needs to be considered.

In the Australian context, the most significant public health risk comes from the potential spread of infectious and vector-borne disease. While thankfully Australia's emergency response has been extremely successful in containing outbreaks through implementing appropriate recovery responses, quarantine measures and vaccinations, the risk is very real. As reported in the local media in February 2011, following CT Yasi, 29 cases of type 2 and 9 cases of Type 4 Dengue Fever were confirmed in Innisfail attributed to conditions caused in the wake of flooding brought by the cyclone (Dixon Feb 19th 2011).

Smith (1999) makes the point that natural disasters do not generate 'new' diseases, but as a result of the disruption to social and natural systems, they increase the potential for the transmission of diseases that are already present a region. This occurs as a result of several mechanisms including:

- altering the numbers or distribution of vector and disease host species;
- providing new breeding sites or food sources (animal carcasses & food waste);
- direct effect of the physical event itself, such as faecal contamination or flooding;
- disrupting routine vector control programs; indirect effects which may result from such conditions as exposure or overcrowding and poor sanitation at evacuation or community shelters; and
- promoting or causing the movement of large numbers of people.

(Smith 1999, p. 28 - 29)

While physical and cognitive impairment present the most obvious difficulties in helping older persons to cope with an evacuation and recovery period, there are other general sensitivities that need to be highlighted.

In terms of the evacuation itself, there are several key issues to consider, including ensuring:

- that older persons are being alerted to and kept apprised of their situation, but also but also have the ability to prepare themselves for evacuation. A major consideration often overlooked is having sufficient supplies of medication to support them through the evacuation and recovery period but also knowing what their medications and dosages are should replacements be required. Not having access to medications can pose a significant threat to their health during evacuation and recovery, particularly as getting access to medical supplies will be compromised, particularly in the short term;
- that older persons are capable of evacuating or escaping the danger and have a means of travel to safely access a designated shelter or evacuation centre. This can be problematic for those with a physical/cognitive impairment but also those who may not drive or own a vehicle and will require assistance to reach a safe haven. In these cases there is a very real risk, particularly if they live alone or have no family, of being accidentally forgotten or left behind;
- if evacuation is unplanned or needs to be executed quickly, often items such as walking aids and other assisted living devices may be left behind. This poses an issue following evacuation;
- ensuring shelters or evacuation centres are accessible and safe for people with physical or cognitive impairment, but also can support their needs in terms of personal hygiene and comfort;
- older persons may be at risk, due to their inability to thermo regulate their body temperature from hypothermia or heat stress while in temporary shelters and should be monitored if alone and without family; and
- older persons are often more reluctant to seek assistance and if immobile or experiencing difficulties due to a physical or cognitive impairment may not be capable of voluntarily seeing help. Again identification of possible needs and monitoring is important to ensure any problems or needs are addressed as soon as possible.

Table 14: Generic sensitivities of older persons during evacuation & recovery periods

Physiological Induced	Socially Induced	Economically Induced
<p>Ensuring adequate supply and knowledge of all medications required for chronic or pre-existing medical conditions.</p> <p>Physical and/or cognitive impairment may impair an older person's capacity to prepare their property for the pending disaster and to evacuate. Assistance in these cases will be required.</p> <p>The speed or ability to respond/react quickly to changing conditions may be hampered by a physical and/or cognitive impairment.</p> <p>Higher risk of hyperthermia and/or heat stress due to impaired ability to regulate body temperature.</p> <p>A compromised immune system due to chronic illness or medication will make older persons more susceptible to infection during the recovery period. Similarly the risk of open wounds due to increased facility of the skin will also make older persons more susceptible to water and soil-borne infections.</p>	<p>If social contact is reduced an older persons level of preparedness for evacuation or defense of the property may be lacking. Risk of being left behind or without adequate level of assistance to ensure their personal safety.</p> <p>Reliance on more traditional methods of communication – landlines, radio and television for early warning. Recent focus on alternative or newer technologies will require older persons to have access to these alternative technologies in their homes and to have kept pace with the use of these technologies.</p> <p>May lose their independence if walking aids and other assisted living devices are not available/left behind during the evacuation or not made available during the recovery period.</p>	<p>Reduced financial capacity/resources available to maintain adequate level of preparedness.</p> <p>Often lacking confidence or have difficulties in obtaining disaster relief and available resources – recovery tends to be slower for older persons.</p> <p>Risk of scams/being taken advantage off in the re-building phases of recovery.</p>

4.9 How adaptive capacity influences vulnerability

As demonstrated in the earlier discussion in this chapter, the impact caused to an individual or community will depend of the nature of the climate-induced exposure and their sensitivity to it. However the extent to which an impact will cause injury or loss is also dependent on the 'adaptive capacity' of individuals or the community in managing their risk.

DARA (2010) defines 'adaptive capacity' as the range of actions taken by individuals, a community or government to reduce adverse effects or future risks, which in the context of this discussion are climate-induced impacts. Similarly the IPCC/UNFCCC defines adaptation as "the adjustments in natural or human systems in response to actual or expected climate stimuli or their effects which moderates harm or exploits beneficial opportunities" (DARA 2010, p.254). Importantly, the ability of individuals, a community or government to take effective action, in other words their adaptive capacity, is dependent on their access to resources or capital, be it economic wealth, knowledge and skills, technology or supporting infrastructure and institutions, social networks and the like. This helps to explain why the level of injury or loss to individuals and/or communities varies in the face of climate-induced impacts, but also how vulnerability can be reduced through building adaptive capacity.

Adaptive measures essentially work in one of two ways to moderate impact, which in this context the extent of injury or loss caused as a result of a climate-induced exposure. Firstly, those measures or actions which aim to reduce or intensify the level and duration of the exposure depending on whether it is harmful or beneficial. The second being designed to reduce the individual's or a community's sensitivity or the risk of injury or loss; or conversely to benefit or gain from the exposure. In both cases buildings and other infrastructure have the potential to be barrier deflecting, absorbing or re-channelling of the effects of the exposure to modify its impacts. Similarly there are opportunities for people to modify their behaviours in response to a pending threat which might include avoiding or escaping the risk of exposure. Used in combination, both approaches have the potential to significantly reduce the vulnerability of individuals and communities to the impacts induced by climate change.

The following tables present an analysis of how the adaptive actions could be used to reduce the vulnerability of older persons to loss and injury as a result of climate change impact, and the types of strategies recommended in developing a greater level of adaptive capacity at a community level to the impacts of climate change. This has been done for each type of exposure predicted. Looking collectively across all possible exposure risks, this analysis allows actions that might be common across several exposure types to be identified. Given the potential for these 'shared' actions to deliver "more-bang-for-the-buck" in terms of reducing vulnerability of older persons to several exposure types, helps in ranking actions suggesting which should be given a higher priority in terms of implementation and/or funding support.

4.9 1 Exposure to Heatwaves

POTENTIAL IMPACTS		ADAPTIVE MEASURES OR ACTION		DEVELOPING ADAPTIVE CAPACITY AT A COMMUNITY LEVEL		
Older Persons	Amplifying Factors	Reducing the Exposure	Reducing Sensitivity	Strategies Recommended	Opportunities	Constraints
Increased risk of heat stress or stroke – potentially life threatening.	<p>Level of acclimatisation to heat and typical temperature ranges to which the built environment has been designed to accommodate.</p> <p>Urban Heat Island effect extending duration of event.</p> <p>Urban infrastructures being sensitive to temperature – high probability of power supply and transport failures.</p>	<p>Urban Context</p> <p>Reducing urban heat absorption through increasing vegetation coverage/open space provisions.</p> <p>New Housing/Building Stock</p> <p>Design for passive cooling and low carbon footprints.</p> <p>Existing housing/building stock</p> <p>Retrofitting opportunities including:</p> <ul style="list-style-type: none"> planting trees & incorporating shade structures within private and public open space. installing thermal insulation and reflective/shading devices to minimise heat build-up within interior living spaces. changing roof/wall colour and/or materials to reduce radiation absorption. increase opportunities for cross ventilation and/or air movement including installation of ceiling or mobile fans to induce evaporative cooling. reducing interior humidity. Installation of air conditioning and/or interior dehumidifiers. 	<p>Urban infrastructures</p> <p>Increase the reliance/robustness of urban infrastructures to temperature variations.</p> <p>Behaviour Modifications</p> <p>Dressing appropriately, avoiding dehydration and physical excursion during the event.</p> <p>Temporarily relocating/evacuating at risk persons to more appropriate environment for the duration of the event.</p> <p>Surveillance to ensure older persons are coping/assistance at first signs of heat stress.</p>	<p>COMMUNITY PREPAREDNESS/INCREASED RESILIENCE</p> <p>Investment to adapt/retrofit urban infrastructures to reduce the risk of failure during heatwaves.</p> <p>Acclimatising the community to temperature increases.</p> <p>COMMUNITY WARNING</p> <p>Implementing early warning of potential heat event to increase the level of community and individual preparedness.</p> <p>RESPONSE & DISASTER RECOVERY PLANNING</p> <p>Need for coordinated inter-agency planning and response specifically for heatwave events.</p>	<p>Recognising heatwaves as a natural disaster at a federal level to allow state/local governments to access funding for recovery.</p> <p>Reducing reliance of artificial climate control including modifying temperature controls and dress standards to better reflect outside temperatures/seasonal changes.</p> <p>Providing incentive/support allowing high-risk groups to retrofit or occupy more suitable housing in order to cope with heatwave events.</p> <p>Expanding the role of the Australian Bureau of Meteorology to issue Heat Warning Alerts.</p> <p>Education programs targeting high-risk groups to ensure individuals both acknowledge the risks and adopt appropriate behaviours to reduce their sensitivity to the exposure.</p> <p>Identifying at risk groups & implementing strategies to reduce the impacts of the event including contracting and monitoring older persons living alone or without family support.</p>	<p>Cost to retrofit existing infrastructures and continued reliance on system that are temperature-sensitive.</p> <p>Adjustment of cultural norms/community expectations of thermal comfort.</p> <p>Logistics and cost to implement schemes need to re-build community confidence in the value of such schemes including the longer-term cost and social benefits to be gained.</p> <p>Need to develop appropriate 'heat index' for major population centres on which warnings can be based.</p> <p>Overcoming the community's complacency about the public health risk of heatwaves.</p> <p>Developing and maintaining local registers of at-risk persons including older persons living alone or without family assistance.</p>

4.9.2 Exposure to Bushfire

POTENTIAL IMPACTS		ADAPTIVE MEASURES OR ACTION		DEVELOPING ADAPTIVE CAPACITY AT A COMMUNITY LEVEL		
Older Persons	Amplifying Factors	Reducing the Exposure	Reducing Sensitivity	Strategies Recommended	Opportunities	Constraints
<p>Higher risk of injury/drowning if suffering from physical or cognitive impairment hampering ability to assess the risk and/or protect themselves from harm.</p> <p>Loss of Property – reduced capacity to appropriately prepare the home/property for the approaching event.</p>	<p>Building in high-risk locations.</p> <p>Buildings constructed prior to or not confirming to BCA requirements for bushfire areas.</p> <p>Physical or cognitive impairment may restrict ability to maintain the property to resist ignition and/or defend the site should property face a bushfire treat.</p>	<p>Urban/Regional Context</p> <p>Avoiding residential development in high risk/high bushfire prone areas.</p> <p>New Housing/Building Stock</p> <p>Requiring new buildings and property to be designed for maximum fire risk/robustness against ignition in bushfire events.</p> <p>Existing Building Stock & Property</p> <p>Retrofitting buildings and modifying grounds to reduce risk of ignition including:</p> <ul style="list-style-type: none"> • general debris remove and fuel reduction around the property; • routine maintenance beyond debris removal includes repairing building surfaces & openings to maintain bushfire resistant performance; • replacing combustible materials at high risks including installing aluminium, steel or bronze mesh flyscreens covering doors and windows & fibrous cement sheeting under eaves or retrofitting fire shutters on doors & windows; • installing sprinkler systems and non-combustible leaf-guards to protect the roof of the primary structure; • structurally separate adjacent structures, such as pergolas and decks that may be combustible elements or ember traps for primary building and seal/ protect any penetration for the building's exterior. Treat exposed timbers with paintable fire retardant. • seal common construction junctions against ember entry & flame access to the structure including roof ridge and flashings, end flutes of roof sheets at the gutter line, eaves junctions to fascia and wall and openings to cavities in walls and under suspended floor voids; and • provide a physical firebreak & fire fighting capacity within grounds. <p>(Victorian Building Commission 2003).</p>	<p>Urban/Regional Context</p> <p>Fire Reduction strategies to reduce combustible load.</p> <p>Behaviour modifications</p> <p>Route maintenance & being appropriately prepared to be able to defend property in the event of a bushfire event.</p> <p>if property is unable to be defended, being resolved to evacuate and to safe life and valuables in the face of a bushfire threat.</p> <p>Surveillance to ensure older persons are coping/assistance to prepare and defend their property against bushfire threat.</p>	<p>COMMUNITY PREPAREDNESS/INCREASED RESILIENCE</p> <p>Investment to adapt/retrofit urban infrastructures to reduce the risk of igniting or become ignited during bushfire events.</p> <p>COMMUNITY WARNING</p> <p>Implementing early warning of potential bushfire risk and potential threat to property.</p> <p>RESPONSE & DISASTER RECOVERY PLANNING</p> <p>Need for coordinated inter-agency planning and response during bushfire events.</p>	<p>Current consideration of BCA requirements for private bushfire shelters/mandatory compliance requirements.</p> <p>Education program targeting high-risk groups to ensure individuals both acknowledge the risks and adopt appropriate behaviours to reduce the potential for loss of property.</p> <p>Given the speed and unpredictability of bushfire threats – employing technology to keep the community aware of the threat and to warn of the appropriate response (text messaging, mobile phones, web-based tools etc).</p> <p>Maintain a register of at risk older persons within bushfire prone areas to ensure assistance can be offered to assist with site preparation and to defend property.</p>	<p>Risk that property owners will become reliant of private shelters as their preferred option and remain with property in preference to evaluating in the event of an extreme event.</p> <p>Cost to retrofit/modify existing properties and building stock to increase robustness during bushfire events.</p> <p>Delivery of education programs to older persons via more traditional communication methods/media platforms.</p> <p>Ensure that older cohort has access to and is conversant in the use of new technology and acknowledge that many older persons will continue to remain reliant on traditional modes of communication – landline, radio/TV.</p> <p>Maintaining the currency of registers and overcoming any social stigma attached to being nominated or included on them.</p>

4.9.2 Exposure to Bushfire (continued)

POTENTIAL IMPACTS		ADAPTIVE MEASURES OR ACTION		DEVELOPING ADAPTIVE CAPACITY AT A COMMUNITY LEVEL		
Older Persons	Amplifying Factors	Reducing the Exposure	Reducing Sensitivity	Strategies Recommended	Opportunities	Constraints
Increased health risk particularly due to air-borne particulates from bushfire smoke and during clean up.	Use of building materials and or storage of chemicals that if burnt will release toxic or hazardous gases or particulates i.e.	<p>New Housing/Building Stock</p> <p>Avoid use of building materials or storage of chemicals that may become toxic if exposed to bushfire threat.</p> <p>Existing Housing/Building Stock</p> <p>Being aware (test for) and keep a record of known hazardous building materials used in or likely to be present in older building stock.</p>	<p>Behaviour modifications</p> <p>Wearing appropriate clothing including footwear to avoid injury during the event and post-recovery period.</p> <p>Use of P1/P2 dust mask to protect against particulates if participating in site clean-up or at high risk due to pre-existing health during period of adverse conditions during and post the event.</p> <p>Avoiding physical excursion and if possible remaining in doors if smoke haze is present.</p> <p>Avoid drinking from water supplies that may have become contaminated by ash including from domestic water tanks.</p> <p>Seek immediate medical attention as the first signs of distress or breathing difficulties.</p>	<p>COMMUNITY PREPAREDNESS/INCREASED RESILIENCE</p> <p>Acknowledge and plan for the indirect threats to public health that can be presented by bushfires – in particular by the smoke/ash plumes.</p> <p>COMMUNITY WARNING</p> <p>Implementing early warning of bushfire smoke/ash plumes.</p>	<p>Pre-warning/preparing supporting & public health services to ensure additional resources are available to respond adequately to the potential threat.</p> <p>In addition to ongoing campaigns encouraging bushfire preparation, evacuation planning and procedures during the recovery period/clean up phases - expanding programs to also include warnings about the health risks associated with bushfire smoke/ash even in metropolitan areas physically removed from direct fire threat.</p> <p>Respond to assist with widespread contamination of water sources and food sourcing replacement supplies.</p> <p>Expanding the role of the Australian Bureau of Meteorology to issue warnings about smoke/ash plumes as part of their current bushfire warning system coordinated with media weather broadcasts.</p>	Complacency about the potential risk of smoke/ash haze and the public health risk it can pose.

4.9.3 Disruption to local food supplies

POTENTIAL IMPACTS		ADAPTIVE MEASURES OR ACTION		DEVELOPING ADAPTIVE CAPACITY AT A COMMUNITY LEVEL		
Older Persons	Amplifying Factors	Reducing the Exposure	Reducing Sensitivity	Strategies Recommended	Opportunities	Constraints
<p>Increased risk of malnutrition/vitamin deficiency leading to chronic conditions such as osteoporosis due to age-related impairment of the digestive system and general metabolism.</p>	<p>Reduction in local production resulting in price escalation due to supply/demand making fresh food unaffordable to persons on limited income.</p> <p>Lack of opportunity or choice in terms of food retail providing the opportunity for substitution when local supplies of a particular food item might be scarce or cost prohibitive.</p>	<p>Farming Practices Modifying existing practices/industries (crop or species selection) to offer greater resilience/sustainable production in the face of anticipated changes to growing season, temperature or drought conditions.</p> <p>Households Opportunities for individuals to develop their own or shared communal gardens to assist in supplementing food supply.</p> <p>Providing seniors at risk, due to physical or cognitive impairment or under financial hardship, with access to quality food/meal service (meals on wheels, food stamps or vouchers).</p>	<p>Regional/Community Safeguarding prime agricultural and pastoral lands (lower risk of disruption due to climate change – incidence of drought/natural disasters) is protected for local food security.</p> <p>Providing access to a wide variety of food and sourcing food from a variety of regions to ensure supply in the event that one regions or source is impacted by drought or natural disaster.</p> <p>Behaviour modifications Ensuring seniors are being supervised or assisted in their shopping and/or meal preparation to ensure the quality of their dietary intake is adequate.</p> <p>Having knowledge and ability to access substitutions (i.e. frozen or canned alternatives) if local supplies are scarce or become unaffordable.</p> <p>Access to affordable supplements to ensure dietary intake of essential vitamins and minerals/fiber is adequate to maintain good health.</p> <p>Participating in outdoor exercise/exposure to sunshine to avoid Vitamin D deficiency.</p>	<p>COMMUNITY PREPAREDNESS/INCREASED RESILIENCE</p> <p>Investment to support primary industry adapt/modify local production in response to predicted climatic changes.</p> <p>Planning to protect land most suitable for agricultural production (reduced risk of disruption due to climate change).</p> <p>Encouraging/supporting communities to implement community or local gardening as a methods of helping to educate the community about food production but also to supplement food supplies – added food security.</p> <p>Ensuring compliance/surveillance of food safety and dietary requirements for high risk environments providing meals for seniors – aged care and nursing homes, hospitals etc.</p> <p>Continued/increased funding for senior’s meal programmes (meals on wheels, etc) to offer seniors at risk access to a quality diet.</p> <p>COMMUNITY WARNING</p> <p>Using the media effectively to alert the public to status of local food production.</p>	<p>Tapping into local knowledge of Farming communities to implementing change and retain future generations “on the land”.</p> <p>Adjustment/modification of traditional practices or types of production (crops or species) to offer a more sustainable and viable industry in the face of climate change.</p> <p>Providing access to public land, expertise and resources in suitable locations to facilitate/encourage community gardening or local food production.</p> <p>Identifying and maintaining register of seniors at risk within the local community.</p> <p>Education program alerting seniors, care givers etc about nutrition and dietary requirements of older persons to help combat risks including options for substitution when access to local supplies is disrupted.</p>	<p>Conflict between urban expansion and agricultural production – opportunity for off-set schemes and other strategies to protect farmland from development but also the viability of investment by the Farming community.</p> <p>Support for ongoing research and training to assist Farming communities to adopt more sustainable practices in the face of climate change and to assist with the adaptation or conversion process.</p> <p>Overcoming cultural resistance to changing traditional farming practices.</p> <p>Reluctance on the part of older persons to seek assistance or who may because of physical or cognitive impairment that may have difficulty in accessing Government/charitable assistance or supportive services.</p>

4.9.4 Tropical cyclones

POTENTIAL IMPACTS		ADAPTIVE MEASURES OR ACTION		DEVELOPING ADAPTIVE CAPACITY AT A COMMUNITY LEVEL		
Older Persons	Amplifying Factors	Reducing the Exposure	Reducing Sensitivity	Strategies Recommended	Opportunities	Constraints
<p>Higher risk of injury/drowning if suffering from physical or cognitive impairment hampering ability to assess the risk and/or protect themselves from harm.</p> <p>Increased risk of hypothermia due to impairment of thermo-regulatory mechanism.</p> <p>Loss of Property – reduced capacity to appropriately prepare the home/property for the approaching event.</p>	<p>Predicted pole-ward tracking of cyclones meaning southern areas bounding existing cyclone zones may increasingly be subject to more intense wind and potentially tidal surge impacts.</p> <p>Buildings constructed prior to or not confirming to BCA requirements for the location's cyclone rating.</p> <p>Physical or cognitive impairment may restrict ability to maintain the structure and/or surrounding property appropriately for the cyclone and/or flood threat.</p>	<p>Urban/Regional Context:</p> <p>Avoiding residential development in high risk locations for wind gusts and/or tidal surges</p> <p>New Housing/Building Stock:</p> <p>Building to achieve requirements for predicted Cyclone Zone Rating.</p> <p>Existing Housing/Building Stock:</p> <p>Retrofitting existing building stock to achieve compliance to relevant Cyclone Rating.</p>	<p>Urban/Regional Context:</p> <p>Ensuring public infrastructures are designed to relevant cyclone zone rating.</p> <p>Developing/establishing community evacuation centres capable of safely and comfortably accommodating displaced persons during the event and post recovery period.</p> <p>Behaviour modifications</p> <p>Routine maintenance & being appropriately prepared in the face of an approaching cyclone/likely flooding.</p> <p>if property is vulnerable, being resolved to evacuate and to save life and valuables in the face of an approaching cyclone.</p> <p>Surveillance to ensure older persons are coping/assistance to prepare their property to withstand the approach cyclone and offering assistance to evaluate.</p>	<p>COMMUNITY PREPAREDNESS/INCREASED RESILIENCE</p> <p>Continuing to undertake post-storm reviews to identify opportunities for continual improvement of BCA design standards/codes to increase resilience.</p> <p>COMMUNITY WARNING</p> <p>Implementing early warning of an approaching cyclone and likely predictions of tidal surge.</p> <p>RESPONSE & DISASTER RECOVERY PLANNING</p> <p>Need for coordinated inter-agency planning and response to both the cyclone and potential storm surge/flooding event.</p>	<p>Extending Cyclone Zones southwards to increase reliance of building stock in the face of the pole-ward migration of cyclones and predicted increased intensity of storm system.</p> <p>Community education reminding people within high risk areas to be prepared prior to the cyclone season and to undertake regular maintenance of all structures and around their properties.</p> <p>Continually improving prediction/simulation models and communication of warnings.</p> <p>Delivery government support/contact into affected areas to assist with assessment and delivery of financial and other forms of community assistance to hasten the recovery period.</p> <p>Providing additional services to guard against looting and other criminal behaviours such building scams targeting vulnerable members of society needing repair work.</p>	<p>Cost and investigating the feasibility of upgrading existing building stock and infrastructure to comply to requirements of a higher wind load design standard if zones are expanded.</p> <p>Complacency about the potential risk given reductions in physical damage as the % of code compliant building stock increases but also due to variability cyclone tracking promoting cautious warnings about the anticipated threat that do not eventuate.</p> <p>Acknowledging that older persons may continue to rely on traditional modes of communication.</p> <p>Reluctance on the part of older persons to seek assistance or who may because of physical or cognitive impairment who may have difficulty assessing Government assistance or supportive services.</p>

4.9.4 Tropical cyclones (Continued)

POTENTIAL IMPACTS		ADAPTIVE MEASURES OR ACTION		DEVELOPING ADAPTIVE CAPACITY AT A COMMUNITY LEVEL		
Older Persons	Amplifying Factors	Reducing the Exposure	Reducing Sensitivity	Strategies Recommended	Opportunities	Constraints
Higher risk of contracting an infection or illness during the post recovery period.	<p>Post- traumatic stress resulting from experiencing the event combined with being displaced from their home or normal environment during the post recovery period.</p> <p>Creation of breeding sites/conditions for vector and/or water-borne diseases to increase in prevalence or providing opportunities for exposure.</p>	<p>Building Stock</p> <p>Ensuring homes are fitted with insect scenes and/or use of devices to deter or kill vector species to prevent exposure within the home.</p> <p>Avoid providing breeding site or food sources to encourage vector species around the home i.e. locations where water can accumulate (pot plants, water tanks and guttering, water features, etc).</p>	<p>Behaviour Modifications</p> <p>Ensuring vaccination boosters are up to date to protect against preventable diseases i.e. tetanus</p> <p>Avoiding coming in contact with vector species and wearing suitable protective clothing/avoiding strong perfumes that may attract insect vectors and using suitable strength insect repellants to avoid being bitten.</p> <p>If at high risk of infection due to pre-existing medical condition or on medication, avoid being involved in clean-up operations particular involving contact with contaminated soil, water or in high exposure risk locations.</p> <p>If involved in clean-up, taking all necessary precautions in terms of suitable clothing, gloves and foot ware to avoid cuts and abrasions.</p>	<p>COMMUNITY PREPAREDNESS/INCREASED RESILIENCE</p> <p>Implementing vector control programmes both pre and post event to reduce breeding numbers and opportunities for populations to multiple.</p> <p>Community being prepared and vigilant for disease & infection post the event.</p> <p>COMMUNITY WARNING</p> <p>Implementing education programs targeting senior nutrition in particular to assist older persons and their supporting networks to ensure diets are adequate to allow proper substitutions to be made when necessary due to supply or cost making some foods unavailable.</p>	Community education alerting the community about the risk of disease and infection and encouraging seniors in particular to seek medical attention at the first signs of any symptoms.	Complacency about the potential risk given reductions in physical damage as the % of code compliant building

4.9.5 Floods (including storm surge)

POTENTIAL IMPACTS		ADAPTIVE MEASURES OR ACTION		DEVELOPING ADAPTIVE CAPACITY AT A COMMUNITY LEVEL		
Older Persons	Amplifying Factors	Reducing the Exposure	Reducing Sensitivity	Strategies Recommended	Opportunities	Constraints
<p>Higher risk of injury/drowning if suffering from physical or cognitive impairment hampering ability to assess the risk and/or protect themselves from harm.</p> <p>Increased risk of hypothermia due to impairment of thermo-regulatory mechanism.</p> <p>Loss of Property – reduced capacity to appropriately prepare the home/property for the approaching event.</p>	<p>Development occurring within flood prone areas.</p> <p>Modification of natural drainage system and urbanisation (increase in hard surface run-off) resulting in increased velocity/volume of floodwater.</p>	<p>Urban Context</p> <p>Increasing the capacity of catchment to absorb/contain and manage stormwater run-off to reduce flooding impact.</p> <p>New development/Housing Stock</p> <p>Prohibition of developing within flood prone areas.</p> <p>Design structures to minimum the risk of water intrusion/sit above the design flood level however ensure compliance for disability access.</p> <p>Provision of temporary storage of valuable items and/or living space above anticipate flood level that can moved into in the case of a flooding event to reduce losses.</p> <p>Existing Building Stock</p> <p>Where feasible and practical, construction of permanent barrier or levy system around sites to minimum floodwater intrusion.</p> <p>Adding provision for /building extension allow for the temporary storage for valuable items and/or living space above anticipate flood level that can moved into in the case of a flooding event to reduce losses.</p> <p>Replacing internal fixtures and finishes to be more resistance/resilient to flood water intrusion to reduce cost and loss during flood event.</p>	<p>Urban/Regional Context:</p> <p>Ensuring public infrastructures are located outside flood prone areas or alternatively designed to cope with the frequency of flooding anticipated either through elevating above flood level or being capable of resisting impacts if inundated with floodwater.</p> <p>Developing/establishing community evacuation centres capable of safely and comfortably accommodating displaced persons during the event and post recovery period.</p> <p>Behaviour modifications</p> <p>Routine maintenance & being appropriately prepared in the event of a flooding including opportunity storage and/or temporary living space available above flood level for use</p> <p>if property is vulnerable, being resolved to evacuate and to save life and valuables in the face of an approaching flood waters.</p> <p>Surveillance to ensure older persons are coping/assistance to prepare their property in the event of anticipated flooding or approaching flood waters.</p> <p>Avoid travelling/driving during flooding events. Avoid attempting to cross roads or paths if subject to flooding – always assuming the depth and velocity of the flood water and/or integrity of the pavement surface is unknown and therefore presents a credible danger or risk of personal injury.</p>	<p>COMMUNITY PREPAREDNESS/INCREASED RESILIENCE</p> <p>Design buildings and their curtilages in high risk and/or increasingly flood prone areas (including those subject to storm surge inundation) to be more robust or resilient in the face of flooding events.</p> <p>COMMUNITY WARNING</p> <p>Implementing early warning of risk of flooding as a result of severe weather conditions.</p> <p>RESPONSE & DISASTER RECOVERY PLANNING</p> <p>Need for coordinated inter-agency planning and response to both the cyclone and potential storm surge/flooding event.</p>	<p>Encourage/funding to implement uniform assessment and identification of flood prone land taking into account predictions of sea level rise and increased flood risk to assist with disaster planning and to ensure residents/community is informed about future risks.</p> <p>Incorporate new design standards for construction within flood prone areas as part of the BCA coupled with adoption nation-wide by Local Government to be applied to all new development.</p> <p>Uniform definitions of ‘flooding’ for insurance to give consumers clear understanding of policy coverage and/or their assumed risk.</p> <p>Community education program aimed at avoiding risk taking during flood events including attempting to cross or swim in flood-affected areas.</p> <p>Improved communication about impacts such as roadway flooding to discourage the public from attempting to enter affected areas or find themselves in potentially dangerous situations.</p> <p>Delivery government support/contact into affected areas to assist with assessment and delivery of financial and other forms of community assistance to hasten the recovery period.</p> <p>Providing additional services to guard against looting and other criminal behaviours such building scams targeting vulnerable members of society needing repair work.</p>	<p>Risk of devaluing property and/or financially impacting existing properties at risk in using future predictions. Similar impact on the cost and availability of flood insurance.</p> <p>Continued research and review post flood disasters to provide input & continual improvement of design standards for housing and properties to increase resilience/reduce damage costs in the event of flood exposure.</p> <p>Potential to add to the cost of building/impact affordability of housing.</p> <p>Complacency about warnings and the potential risks presented by flood water.</p>
<p>Higher risk of contracting an infection or illness during the post recovery period.</p>	<p><i>SIMILAR RISKS/OPPORTUNITIES DISCUSSED FOR CYCLONES</i></p>					

4.9.6 Severe storms & hail

POTENTIAL IMPACTS		ADAPTIVE MEASURES OR ACTION		DEVELOPMENT ADAPTIVE CAPACITY AT A COMMUNITY LEVEL		
Older Persons	Amplifying Factors	Reducing the Exposure	Reducing Sensitivity	Strategies Recommended	Opportunities	Constraints
<p>Higher risk of injury if suffering from physical or cognitive impairment hampering ability to assess the risk and/or protect themselves from harm.</p> <p>Loss of Property – reduced capacity to appropriately prepare the home/property for the approaching event.</p>	<p>Rapid formation and unpredictable nature of storm formation makes prediction and early warning problematic – often the community will have little to no warning of the pending threat and will require a rapid response/action to seek safe shelter or prepare their homes and property.</p> <p>Increasing frequency and/or intensity of storms as a result of climate change particularly in regions outside of high wind zones where building standards anticipate impacts from cyclonic weather.</p>	<p>New Housing/Building Stock</p> <p>Consider upgrading design standards particularly in 'hot zones' for severe storms to achieve higher wind gusts but also to cope with impacts from large hail.</p> <p>Appropriate design of gardens, particularly in the planting of trees within residential gardens and/or streetscape planting to minimise rise of limbs or trees falling on homes and damaging infrastructure in the event of strong winds during severe storms.</p> <p>Existing Housing/Building Stock:</p> <p>Retrofitting existing building stock to reduce exposure particularly from hail damage including strengthening roofing materials (in particular skylights and/or outdoor coverings).</p> <p>Provide suitable shelter for cars to reduce risk of hail damage where possible.</p> <p>Removal or appropriate maintenance to avoid limbs or falling trees damaging homes or other property. Replace planning with suitable species that are of a more suitable scale and/or more robust (less likely to drop limbs) in high wind condition.</p>	<p>Urban/Regional Context</p> <p>Ensuring public infrastructures are designed to cope with severe storms and in particular hail damage in hot zone.</p> <p>Behaviour modifications</p> <p>Routine maintenance & being appropriately prepared in the event of a severe storm – securing loose items around the home, ensuring external structures are robust. Ensure trees are healthy and not overhanging or if falling will not cause severe damage to property or threaten life.</p> <p>Surveillance to ensure older persons are warned/required any assistance to prepare for an approaching storm. Ideally offering help to ensure properties are being appropriately maintained.</p> <p>Seeking shelter indoors and avoiding using landlines during the storm event. If outdoors avoid trees and metal items that may attract lightning strikes.</p> <p>Ensuring public facilities i.e. golf courses, schools etc, have procedures in place to warn patrons/visitors or users of an approaching storm and that people are aware of appropriate behaviours if the warning is sounded.</p> <p>if vulnerable due to respiratory disease or asthma, avoid going outside immediately after a storm due to risk of air-borne irritates in the air that can trigger respiratory problems.</p>	<p>COMMUNITY PREPAREDNESS/INCREASED RESILIENCE</p> <p>Continuing to undertake post-storm reviews to identify opportunities for continual improvement of BCA design standards/codes to increase resilience.</p> <p>COMMUNITY WARNING</p> <p>Implementing early warning of an approaching cyclone and likely predictions of tidal surge.</p> <p>RESPONSE & DISASTER RECOVERY PLANNING</p> <p>Need for coordinated inter-agency planning and response to severe weather and/or damage from hail/fallen trees and damage to public utilities.</p>	<p>Extending Cyclone Zones southwards to increase reliance of building stock would also offer added resilience against severe storms.</p> <p>Community education reminding people about how to prepare their property and to take safe shelter in the event of a severe storm warning and event occurring.</p> <p>Continually improving prediction/simulation models and communication of warnings.</p> <p>Delivery government support/contact into affected areas to assist with assessment and delivery of financial and other forms of community assistance to hasten the recovery period.</p> <p>Providing additional services to guard against looting and other criminal behaviours such building scams targeting vulnerable members of society needing repair work.</p>	<p>Cost and investigating the feasibility of upgrading existing building stock and infrastructure to comply to requirements of a higher wind load design standard if zones are expanded.</p> <p>The speed at which storms develop and travel present a major problem for public warnings. In particular older persons may have difficulties in responding quickly encourage or may have difficulties seeking shelter.</p> <p>Acknowledging that older persons may continue to rely on traditional modes of communication.</p> <p>Reluctance on the part of older persons to seek assistance or who may because of physical or cognitive impairment have difficulty assessing Government assistance or supportive services.</p>

9.6.7 Air Pollution

POTENTIAL IMPACTS		ADAPTIVE MEASURES OR ACTION		DEVELOPING ADAPTIVE CAPACITY AT A COMMUNITY LEVEL		
Older Persons	Amplifying Factors	Reducing the Exposure	Reducing Sensitivity	Strategies Recommended	Opportunities	Constraints
Higher risk of serious health complications due to pre-existing medical conditions or chronic respiratory/pulmonary disease.	<p>Physical proximity to the polluting source.</p> <p>Climatic conditions such as prevailing winds or thermal inversion impacting the transport or trapping of air-borne pollutants.</p> <p>Smoking – both in terms of the pre-existing health conditions but also as the major source of toxins within interior environments.</p> <p>Physical excursion during periods of high exposure.</p> <p>Persistence/accumulation of toxins within the body overtime with prolonged exposure.</p>	<p>Urban Context</p> <p>Reducing reliance on polluting sources i.e. motor vehicles and manufacturing processes that add to the pollution sources.</p> <p>Establishing exclusion zones/restricting residential development within close proximity to polluting sources (industry or infrastructure).</p> <p>Understanding local as well as regional weather/wind patterns to avoid locating pollutant sources where climatic conditions may amplify or distribute pollutants to populated areas.</p> <p>New Housing/Building Stock</p> <p>Designing for good ventilation/air circulation to maintain quality internal air quality. Conversely in high-risk areas, the ability to seal interior space and avoid or limit exposure. Introduce interior and exterior planting or vegetation to assist in filtering but also improving air quality.</p> <p>Ensuring surfaces/interiors are easy to clean to avoid accumulation of contaminated particulate fallout.</p> <p>Fitting CO₂ and other gas monitors within interior spaces and in particular enclosed parking or driveway areas linked to warning alarms and/or designing mechanical ventilation systems to increase air flushing/circulation when levels of toxics are detected.</p> <p>Avoid locating openings (windows, air intake points etc) near polluting sources i.e. entries to enclosed parking areas or heavily trafficked roadways, etc</p> <p>Existing housing/building stock</p> <p>Ensuring/upgrade ventilation and exhaust systems to dispel toxics generated within the household or interior spaces in particular enclosed parking</p> <p>Introducing planting/vegetation both within interior and exterior spaces to assist with filtering of dust and improve air-quality.</p> <p>Installation of air conditioning and/or interior dehumidifiers with air filters.</p>	<p>Behaviour Modifications</p> <p>Remaining indoors and avoiding physical activity/excursion during high-risk period i.e. smog alerts/dust storms etc. If available, setting air conditioning to internal circulation to avoid contamination from outside.</p> <p>Routine cleaning/maintenance to ensure that contaminated dust fallout is removed and not allowed to accumulate and pose an on-going health threat.</p> <p>Appropriate siting and regular inspection of gas appliances to ensure these do not pose a health risks. Gas heating is to be avoided in bedrooms or in locations where older persons may fall asleep and accidentally circum to gas poisoning.</p> <p>If at high risk from exposure, avoiding spending extended periods/waiting in vehicles in enclosed parking stations or other similar situations that might trigger breathing difficulties.</p> <p>Wearing face or dust masks to minimise exposure – however dust marks need to be of an appropriate standard to filter the type and level of particulates causing health problems.</p> <p>Surveillance of older persons during periods of high risk (smog or dust storms alerts). If the home environment is vulnerable, temporarily relocating to a more appropriate setting for the duration of the exposure. Seeking assistance/medical attention immediately at the first signs of respiratory distress or breathing difficulties.</p>	<p>COMMUNITY PREPAREDNESS/INCREASED RESILIENCE</p> <p>Strategies to remove vehicles and other pollutant sources by converting to 'cleaner' alternatives – particular for energy generation and manufacturing processes.</p> <p>Monitoring air quality and in particular impacts on populated areas from dust storm and bushfire events.</p> <p>Tighter planning controls to impose appropriate environmental controls/exclusion or buffer zones on potentially polluting sources and ensuring regular monitoring.</p> <p>Continued monitoring and implementation of safe work practices/construction and use of building materials to avoid accidental or likely public health risks i.e. disposal and maintenance of asbestos, dust or particulate generation, etc.</p> <p>COMMUNITY WARNING</p> <p>Implementing early warning of potential heat event to increase the level of community and individual preparedness.</p> <p>RESPONSE & RECOVERY PLANNING</p> <p>Need for coordinated inter-agency planning and response specifically for high pollution events – trigger putting healthcare and emergency services on alert to cope with spikes in respiratory/asthma cases.</p>	<p>Providing incentive /support to convert to cleaner sources and promotion of use of public transport or other efficiency measures.</p> <p>Providing incentive/support allowing high-risk groups to retrofit or occupy more suitable housing or to compensation to relocate away from pollution sources.</p> <p>Expanding the role of the Australian Bureau of Meteorology to issue Air Pollution Warning Alerts including smoke and dust storm plumes.</p> <p>Education programs targeting high-risk groups to ensure individuals both acknowledge the risks and adopt appropriate behaviours to reduce their sensitivity to the exposure.</p> <p>Identifying at risk groups & implementing strategies to reduce the impacts of the event including contracting and monitoring older persons living alone or without family support.</p>	<p>Need for better and more localised research to understand the complex causes and distribution mechanism for air-borne pollutants to feed into planning and monitoring systems.</p> <p>Cost to retrofit/relate to reduce exposure and/or commercial impacts of imposing and implementing stricter controls.</p> <p>Need to develop appropriate 'pollution index' for major population centres on which warnings can be based, including understanding natural sources of air toxics i.e. vegetation and bushfire/dust storm sources.</p> <p>Overcoming the community's complacency about the public health risk of air-borne pollutants/smog, dust and smoke haze alerts.</p> <p>Developing and maintaining local registers of at-risk persons including older persons living alone or without family assistance.</p>

4.9.8 Water & soil-borne diseases

POTENTIAL IMPACTS		ADAPTIVE MEASURES OR ACTION		DEVELOPING ADAPTIVE CAPACITY AT A COMMUNITY LEVEL		
Older Persons	Amplifying Factors	Reducing the Exposure	Reducing Sensitivity	Strategies Recommended	Opportunities	Constraints
Higher risk of serious health complications due to compromised immune systems due to pre-existing medical conditions or chronic disease.	<p>Increased density of development/population increases the risk of anthropogenic sources of human diseases entering into the food chain/water supply.</p> <p>Disturbance of natural ecosystems either through development or natural disaster increases risk of exposure.</p>	<p>Regional Level</p> <p>Preventing potential anthropogenic sources of contamination such as Urban development/run-off from animal-based production within water catchments.</p> <p>Implement adequate levels of treatment for water supply and in food processing to eliminate/destroy harmful pathogens prior to ingestion, coupled with regular monitoring and maintenance of infrastructure to ensure safety standards and reduce risk of exposure.</p> <p>Ensuring property testing and treatment of public pools and other recreational water sources to limit the potential exposure to pathogens.</p> <p>Enforcement of routine maintenance and testing of air-conditioning systems/water towers to avoid risk of Legionaries Disease.</p> <p>Individual Households</p> <p>Ensure proper treatment of backyard swimming pools and other recreational or ornamental water sources to reduce risk of pathogen contamination.</p> <p>Requirement appropriate treatment of potting/mulch and garden soil mixes to avoid Legionaries Disease and other potential pathogen sources.</p>	<p>Behaviour Modification</p> <p>Drinking water only from known potable/treated supplies or pre-treating water taking from natural or unknown sources to minimize risk of exposure to pathogens.</p> <p>Maintaining booster inoculation for tetanus and other pathogens.</p> <p>Wearing appropriate protective clothing and footwear when working in gardens/areas presenting risk of exposure to water or soil borne pathogens.</p> <p>Ensuring fruit and vegetables are washed prior to being prepared and/or consumed.</p>	<p>COMMUNITY PREPAREDNESS/INCREASED RESILIENCE</p> <p>Maintaining infrastructure, treatment regimes and pathogen screening to ensure potable water supplies and other sources of soil or water-borne pathogens present a minimum public health risk.</p> <p>Planning and other pollution controls to avoid or reduce the risk of contamination via anthropogenic sources particularly within water catchments.</p> <p>Strategies implemented to effectively de-contaminate vehicles/machinery to avoid the spread or disbursement of soil and/or water-borne pathogens.</p> <p>COMMUNITY WARNING</p> <p>Implementing early warning of outbreaks of disease with advise to the community of strategies to limit exposure and/or to see immediate medical attention at the first signs of symptoms.</p> <p>RESPONSE & DISASTER RECOVERY PLANNING</p> <p>Need for coordinated inter-agency planning and response to warning or evidence of disease outbreak to identify the source and control/limit the threat of exposure.</p>	<p>Upgrading technology to improve the level of screening and/or elimination of pathogens.</p> <p>Community-based education program to alert high risk groups about the potential sources of infection and strategies to limit exposure.</p> <p>Campaign encouraging and offering assist to older adults in maintaining booster immunisation to known diseases such as tetanus.</p> <p>Health sector being vigilant and reporting cases of disease to assist in the containment of outbreaks as quickly as possible.</p>	<p>Increasing problem of new resistant strains of pathogens entering the ecosystem which are more difficult to eliminate and for which treatment if infected is more problematic particularly for those with compromised immune systems due to pre-existing medical conditions.</p> <p>Cost of maintaining and replacing ageing infrastructure or upgrading to new treatment technologies.</p> <p>Added cost of pollution/de-contamination measures on production.</p> <p>Complacency about the risks of infection particularly from diseases previously considered to have been eliminated but which as a result of the community failing to become immunised or emergence of new resistance strains within the ecosystem.</p> <p>Risk of litigation making public authorities cautious in warning of potential threats.</p> <p>Difficulty in identifying cases of infection and/or many cases where symptoms in healthy persons will go unreported. This makes containment and/or identification of outbreaks more difficult.</p>

4.9.9 Food-borne diseases & toxins

POTENTIAL IMPACTS		ADAPTIVE MEASURES OR ACTION		DEVELOPING ADAPTIVE CAPACITY AT A COMMUNITY LEVEL		
Older Persons	Amplifying Factors	Reducing the Exposure	Reducing Sensitivity	Strategies Recommended	Opportunities	Constraints
Higher risk of serious health complications due to compromised immune systems due to pre-existing medical conditions or chronic disease.	<p>Some sources of contamination, particularly in seafood, are undetectable by consumers during preparation and pathogens in some cases will not be eliminated as a result of the cooking process.</p> <p>Commercial food production has the potential to expose higher numbers of consumers to a contamination risk if source product is infected and/or food handling and preparation is inappropriate.</p> <p>Failing eyesight and/or cognitive impairment may result in difficulties in food preparation and heighten the risk of cross contamination due to poor hygiene/ability to see what needs to be cleaned.</p> <p>Older persons may not want to see food going to waste and consume items may have exceeded their recommended expiry date or been left in the fridge/storage at home for too long.</p>	<p>Regional Level</p> <p>Preventing potential anthropogenic sources of contamination of ecosystem supporting food production through controlling location of development/industries in relation to key resources.</p> <p>Monitoring/protecting the health of the ecosystem supporting food production as well as stages of processing/delivery of products from farm to the table.</p> <p>Individual Households</p> <p>Being aware of where food supplies come from and the potential risks certain foods/locations present in terms of diseases or toxins.</p> <p>Ensuring food storage, particular refrigeration is adequate to prevent disease or food spoilage resulting in risks of infection.</p>	<p>Community Level</p> <p>Implementing safe food handling regulations and food labeling to minimize the risk of exposure but also ensuring the public are aware of the source of the food, its age and other factors impacting its quality.</p> <p>Modifications to behaviour</p> <p>Avoid or limit the intake of foods which may represent a risk of toxin/disease.</p> <p>Surveillance of older persons to ensure that food supply, storage and meal preparation is safe and appropriate to reduce the risk of infection or contamination.</p>	<p>COMMUNITY PREPAREDNESS/INCREASED RESILIENCE</p> <p>Monitoring of food supply, handling and preparation to ensure health standards are maintained to avoid risks.</p> <p>COMMUNITY WARNING</p> <p>Implementing early warning of outbreaks of disease with advise to the community of strategies to limit exposure and/or to see immediate medical attention at the first signs of symptoms.</p> <p>RESPONSE & DISASTER RECOVERY PLANNING</p> <p>Need for coordinated inter-agency planning and response to warning or evidence of disease outbreak to identify the source and control/limit the threat of exposure.</p>	<p>Focus attention and effort on ensuring the safety of food/meals supplied to consumers at high risk of complications within facilities such as hospitals, aged care facilities.</p> <p>Community education about the risk of food-borne disease and toxins as well as strategies in food storage, handling and preparation known to eliminate or reduce the risk of infection or exposure.</p> <p>Campaigned to ensure that the community reports and seeks immediate medical attention when food poisoning occurs.</p>	<p>Resistance/cost of introducing and enforcing labelling standards particularly if setting restrictions or warnings about food quality, age or source of origin.</p> <p>Ongoing research into the likely impact of climate change/impacts on temperature and other mechanisms within the ecosystem resulting in toxic accumulation or persistence/presence of pathogens.</p> <p>Complacency about the potential risk given improvements in food health and safety standards. Being ignorant of the potential risks.</p> <p>Reluctance on the part of older persons to seek assistance or who may because of physical or cognitive impairment has difficulty assessing Government assistance or supportive services.</p> <p>The rapid onset of food poisoning can often result in older persons being unable without assistance to seek help. Equally even mild symptoms can result in serious health risks if left unattended – surveillance and encouragement is often required to get older persons to seek medical attention immediately.</p>

4.9.10 Vector-borne diseases

POTENTIAL IMPACTS		ADAPTIVE MEASURES OR ACTION		DEVELOPING ADAPTIVE CAPACITY AT A COMMUNITY LEVEL		
Older Persons	Amplifying Factors	Reducing the Exposure	Reducing Sensitivity	Strategies Recommended	Opportunities	Constraints
<p>Higher risk of complications due to compromised immune system and/or pre-existing medical conditions or chronic disease.</p> <p>Reduced ability to limit exposure as a result of physical or cognitive impairment or prohibitive cost to relocate or install protective fixtures.</p>	<p>Creation of breeding sites/conditions for vector.</p> <p>Good season condition providing an abundance of food may result in plague conditions for vector species. Alternatively conditions left by natural disasters – flooding in particular can result in ideal breeding conditions and sites boosting vector numbers and the risk of exposure.</p> <p>Climate change may result in new distribution patterns for disease-carrying vectors – migration induced by variations/changes in seasonal temperatures and rainfall patterns.</p>	<p>Regional/community level</p> <p>Avoid creating breeding sites for vectors or where this risk is presented, implementing vector controls to reduce numbers/public health risk.</p> <p>New and Existing Building Stock/individual households</p> <p>Ensuring homes are fitted with insect screens and/or use of devices to deter or kill vector species to prevent exposure within the home.</p> <p>Avoid providing breeding sites or food sources to encourage vector species around the home i.e. locations where water can accumulate (pot plants, water tanks and guttering, water features, etc).</p>	<p>Behaviour Modifications</p> <p>Avoiding coming in contact with vector species and wearing suitable protective clothing/avoiding strong perfumes that may attract insect vectors and using usable strength insect repellants to avoid being bitten.</p>	<p>COMMUNITY PREPAREDNESS/INCREASED RESILIENCE</p> <p>Implementing vector control programmes to reduce exposure.</p> <p>Strict quarantine and boarder surveillance to avoid accidental migration of disease-infected vectors or humans into Australia.</p> <p>COMMUNITY WARNING</p> <p>Reporting/monitoring all cases of disease presented, and alerting the community when conditions may be ideal for breeding and/or cases of disease have been reported.</p> <p>RESPONSE & RECOVERY PLANNING</p> <p>Need for co-ordinated inter-agency planning and response specifically for disease outbreaks to contain the event as quickly as possible but also to ensure healthcare system is appropriately resourced to treat cases.</p>	<p>Community education alerting the community about the risk of disease and infection and encouraging seniors in particularly to seek medical attention at the first signs of any symptoms.</p> <p>Training for health professionals in high-risk locations about the presentation of vector-borne diseases to ensure early detection and treatment.</p>	<p>Complacency about the potential risk from vectors particular given the likely risk of re-distribution of vector breeding due to climate change introducing risks into areas previously free of the potential disease threat.</p> <p>Resident population/tourists or importing activities not complying with quarantine laws and introducing exotic vectors and diseases into Australia.</p> <p>Vector controls (chemical spraying etc) may also impact other species and disrupt ecosystems. Research into methods of control not requiring chemical treatments is required to avoid risking ecosystem health and/or causing other health risks due to toxic accumulation.</p> <p>Symptoms often mimic other conditions making diagnosis difficult/those at risk may not seek early medical intervention thinking they have the flue or other common complaints not realising the risk of the diseases progression.</p>

4.9.11 Natural Disasters– evacuation & recovery

POTENTIAL IMPACTS		ADAPTIVE MEASURES OR ACTION		DEVELOPING ADAPTIVE CAPACITY AT A COMMUNITY LEVEL		
Older Persons	Amplifying Factors	Reducing the Exposure	Reducing Sensitivity	Strategies Recommended	Opportunities	Constraints
Higher risk of physical and/or cognitive impairment resulting in an inability to access or remain mobile/independence during the evacuation and recovery periods.	Walking aids, wheelchairs and supportive medications being left behind, particularly if rapid evacuation is necessary to protect life and reduce risk of personal injury. Similarly if subject to event conditions – other aids such as spectacles, hearing aids, dentures/false teeth may also become lost or damaged rendering a person more impaired than would normally be the case.	<p>Community Level</p> <p>Selecting evacuation sites or shelters that shelters are disability accessible and offer suitable bathroom and other facilities to cater for the needs of seniors and others with physical or cognitive impairment.</p> <p>Individuals/Households</p> <p>Being prepared for evacuation if in a high-risk location – with all necessary aids/supplies supporting health or mobility are gathered to reduce the risk of being without these items during the recovery period.</p>	<p>Community Level</p> <p>Identifying and screening persons arriving or occupying the shelter to identify any needs quickly and ensuring assistance is offered to support those at risk during the course of the recovery period.</p> <p>Have a supply of replacement aids and general medications in the event of seniors or persons with a disability presenting without the necessary support.</p> <p>Behaviour Modification</p> <p>Encouraging those at risk to be prepared or willing to evacuate early when there is sufficient time to bring all necessary support and supplied with them to the evacuation shelter but also for screening/assistance to be arranged for them during the recovery period.</p>	<p>COMMUNITY PREPAREDNESS/INCREASED RESILIENCE</p> <p>Selecting and/or making necessary modification to site selected as community evaluation shelters in high-risk areas to ensure facilities are suitable and capability of supporting those seeking shelter during the recovery period.</p> <p>Developing community or regional evacuation plans and ensure appropriate training/resourcing to allow sites to operate effectively.</p>	<p>Review the performance of shelter post events to provide continual improvement of procedures and to the design/modification of site selected as evacuation shelters.</p> <p>Set the requirement for regulate drills/evacuation exercises to ensure procedures are known and well practiced for evacuation of high risk facilities such as schools, aged care & nursing homes etc.</p> <p>Priority to be given to early evacuation of high-risk groups/facilities. Maintaining a current register of seniors/those at risk to avoid those who may be socially isolated or requiring assistance from being accidentally forgotten or left behind.</p>	<p>Cost to provide/upgrade facilities selected as community evacuation shelters especially if private sites such as shopping centres are being used.</p> <p>Difficult logistic exercise, which may cause stress to those at high risk.</p> <p>Maintain accurate records/registration.</p>
<p>Higher risk of complications from general illness and infection contracted during the recovery period due to compromised immune systems and predisposition due to pre-existing medical conditions or chronic disease.</p> <p>Higher risk of Hypothermia due to impairment of thermoregulatory system.</p>	<p>Stress induced by the experience of the event/loss of property and concern about the threat to friends and family.</p> <p>Crowded conditions and being in close contact with people resulting in more rapid spread/risk of infection or contraction of communicable diseases (common flu etc).</p>	<p>Community Level</p> <p>Avoiding overcrowding if possible within the evacuation shelters and providing adequate capacity in terms of access to bathroom facilities, food preparation etc.</p> <p>Screening persons entering the shelter for illness and if possible isolating persons to avoid infection of the general population. Similarly isolating or locating those at risk in conditions supporting health, good ventilation, etc.</p> <p>Providing access to a supply of dry clothes/blankets within the shelter to combat risk of hypothermia. Conversely during recovery period or in bushfire event, access to clean water and fans to reduce heat stress.</p> <p>Individuals/households</p> <p>Wearing and packing suitable clothing to offer protection against wet/ cold conditions but also physical injury (cuts and abrasions) during the evacuation.</p>	<p>Community Level</p> <p>Providing access to grief counseling and pastoral care support to assist in reducing stress and to deal with the emotional losses.</p> <p>Surveillance particular of older persons to ensure that they are coping and getting necessary assistance. Treat all minor injuries and symptoms of illness immediately.</p> <p>Good and continuous communication/updates about the event and conditions as well as about any known causalities or losses to avoid panic/reduce anxiety.</p> <p>Getting public sanitation and safe drinking water re-established as a priority to avoid adding to the public health risk post the event.</p> <p>Behaviour Modification</p> <p>Acknowledging stress and loss – being prepared to seek assistance.</p> <p>Having information about family or other contacts available so that support can be found during the recovery period.</p>	<p>RESPONSE & RECOVERY PLANNING</p> <p>Need for co-ordinated inter-agency planning and response specifically for disease outbreaks to contain the event as quickly as possible but also to ensure healthcare system is appropriately resourced to treat the affected population.</p>	<p>Ensuring the general community is educated about evacuation procedures, what to have prepared to bring with them to assist with the evacuation and during the post recovery period, as well as the location of designated shelters.</p> <p>Providing access to/bringing in Government agencies to coordinate the delivery and provision of financial and other support as quickly as possible. Targeting seniors as a priority accepting that many may have difficulties seeking help or completing the necessary paperwork to gain help.</p>	<p>Seeking cooperation of people and in particular those at most risk to evacuate early and to be adequately prepared in the event of needing to be evacuated. Knowledge or having records of medications, supplied of medications to cope during anticipated recovery as well as being able to articulate or inform authorities of about their particularly needs or level of impairment.</p>

4.10 Summary

This chapter has outlined the generic sensitivities of older persons to the range of climate-related impacts likely to be experienced within the Australian context in order to understand the impacts of climate change on this cohort. The analysis reveals, not surprisingly, that an older persons' sensitivity or risk of injury or loss increases in proportion to their level of physical and/or cognitive impairment, social isolation, reliance on traditional methods of communication and level of financial dependency. The analysis also demonstrates that the vulnerabilities of older persons to the impacts of climate change can be reduced through taking adaptive actions and developing a greater level of adaptive capacity at a community level.

In term of exposure, the most immediate threat to public health and infrastructure in Australia, and to which older persons have particular sensitivity, will be heatwave events. In terms of economic risk, severe thunderstorms and hail surprisingly represent a more significant risk, particular given the wide distribution pattern across the entire continent but particularly in coastal regions that are most heavily populated and urbanised (McAneney, Crompton et al, 2007). Combined with their destructive capability, storm activity is less predictable and the relatively rapid formation generally limits early warning and therefore the level of preparedness to minimise property loss. Longer term, flooding and in particularly storm surge are likely to be an increasing threat to Australia's heavily populated coastal regions given the amplifying effects of sea level rise.

The literature reviewed highlights the importance of environmental and/or climatic condition monitoring coupled with early warning mechanisms. This has been demonstrated to be effective in increasing the level of community preparedness but also allowing people to evacuate to more suitable or lower risk locations in the face of an extreme climatic event. Similarly designing resilience into our built environments, and in particularly housing, to cope with extreme weather, be it the structural design for strong wind load, or passive solar design or passive thermal design to reduce temperature, can significantly reduce the vulnerability of the community as a whole to the impacts of climate change.

The following chapter will look at the current response in Australia to combating climate change (mitigation) on one hand, while also attempting to reduce the nation's vulnerability to the impacts of climate-induced exposures through developing adaptive capacity. It will examine in greater detail the benefits of not only adapting the built environment to support older persons age positively but how in doing so, many of this group's sensitivities to climate-induced exposures can also be reduced.

CHAPTER 5: CLIMATE CHANGE IN THE CONTEXT OF AN AGEING SOCIETY

This chapter will review Australia's policy response to climate change and population ageing and examine the role that the various levels of government are playing as part of this response. Specifically it will explore how policies targeting the adaption of the built environment are operating; and the impact the design and/or modification of buildings and the community setting are having in reducing the nation's vulnerability to climate change while also in addressing the needs of a rapidly ageing society.

5.1 Mitigation verses adaptation

Before discussing the current trends in climate change policy within Australia, it is important to clarify the difference between mitigation and adaptation. In the context of climate change, mitigation refers specifically to efforts to reduce or stabilise greenhouse gas emissions (UNDP et al 2010) through investment and development of more sustainable infrastructure and/or prohibition of less sustainable practices. Haines et al (2006) observe that while mitigation can produce effects in the near term, such as improvements to health by reducing exposure to air pollution, the process of restructuring towards a more sustainable future will require time as well as sustained and widespread co-operation to be effective. In other words future generations will reap the benefits of actions taken now. This introduces issues of intergenerational equity and highlights why mitigation is taking central stage within political arenas around the world.

Adaptation on the other hand, refers to coping strategies in response to the consequences of climate change (UNDP et al 2010). Adaptation generally responds to a specific environmental risk which has been predicted for a particular place, allowing actions to be tailored to increase the resilience of a place in a relatively short timeframe. Such 'coping' strategies may involve physical adaption of buildings or landscape, but also involve educational programmes or communication systems designed to modify community and/or individual behaviours in response to particular risks.

Although when dealing with adaptation the cause or risk and the benefits of actions are generally able to be easily appreciated, the difficulty in formulating effective adaptive strategies is due to the fact that the action is 'anticipatory' or needing to predict the magnitude of the risks into the future. Given the current uncertainty surrounding climate change predictions, action is often hindered by debate over what intensity or frequency of climatic event to plan for (Mendelsohn 2000, cited Williams et al 2010, p. 112).

The other fact to be considered when discussing adaptive strategies is the distinction between what the CSIRO (2011) calls 'incremental' verses 'transformational' adaptation. Incremental adaptation can be defined as the discretionary changes individuals can make in response to altering circumstances, i.e. investing in home insulation in response to rising temperatures and increasing power bills. In contrast, transformational adaptation refers to more profound changes that need to be implemented with community co-operation, such as relocation of industry or settlements to avoid the environmental impacts such as sea level rise.

While different in aim, mitigation and adaptive strategies are inextricably linked and both are crucial in response to climate change. The stronger or more successful mitigation strategies are in stabilising or slowing climate change, and therefore the magnitude of the change in climate, the less reliant the community will need to be on adaptive measures allowing them to cope with climate-induced exposures. Equally there is overlap in the benefits delivered by both types of strategies. Some measures to militate against climate change will have an adaptive function. A good example would be requiring new housing construction to incorporate passive solar design features i.e. good insulation, preferred building orientation, provision for cross ventilation and the like. Not only will such features reduce the building's overall energy consumption in maintaining thermal comfort

(mitigation), but it will also deliver adaptive benefits allowing the occupants to cope more successfully with hotter seasonal temperatures and during heatwave events. But both strategies also have the potential for conflict and contradiction in outcome due often to the differences in the time-scales in delivering the benefit. Again by way of an example, while increasing urban densities from a urban planning perspective may be an appropriate long-term strategy intended to make a city more energy efficient and therefore more sustainable (mitigation), it may also exacerbate the urban heat island effect unless appropriate adaptive strategies are implemented in the short-term to counteract the impact caused by this longer term strategy.

5.2 The Australian Response to climate change

5.2.1 National mitigation strategy – A tax on carbon pollution

In July 2011 the Australian Federal Government announced its intentions to introduce a carbon tax as an initial phase of a longer term mitigation strategy aimed at encouraging consumer driven restructuring towards more efficient and sustainable infrastructures; coupled with planned investment in renewable energy and other innovations. This responds to the target set by the nation to reduce Australia's net expected greenhouse emissions by at least 23% by 2020 (Prime Minister's Office, 2011).

Commencing in July 2012, a price on carbon of \$23 for every tonne has been set with the price to rise by 2.5% per annum in real terms during a three-year fixed price period until 1 July 2015. The carbon price mechanism will then transition to an emissions trading scheme where the price will be determined by the market (Prime Minister's Office 2011).

5.2.2. National adaptive strategy – vision and setting the role of government

In February 2010, the Australian Federal Government also released "Adapting to Climate Change in Australia – An Australian Government Position Paper" outlining its vision for adapting the nation to cope with the impacts of climate change and the role of Government in facilitating the process. In it the Commonwealth acknowledges that adaptation is a shared responsibility, seeing the role of government being to "create the right conditions and incentives for businesses and the community to make efficient investment decisions and manage risks from climate change impacts" (Commonwealth of Australia, 2010). It also established three (3) primary objectives for government as well as identifying initial priorities for adaptive action at a national level.

Objective 1: providing information for business and communities to adapt.

The position of government is that it acknowledges that business has little incentive in investing in basic knowledge that has a broader public benefit that may be of limited benefit to it, and sees it has a important role to play in funding research to fill the current gap in knowledge, including providing public information to build understanding about climate change adaptation in the Australian context, and to support better decision-making across both the public and private sectors.

Objective 2: setting the right conditions supporting climate change adaptation.

The underlying objective is to ensure that regulator or legislative systems facilitate but also do not distort market signals encouraging business and the community to adapt for climate change; and the risks presented by climate-induced impacts to be not only recognised but appropriately apportioned. Governments acknowledge that policy instruments such as land-use planning, codes and standards as well as environmental or public health legislation play a complimentary role to market-driven mechanisms in encouraging or delivering adaptive change.

The Commonwealth assumes stewardship of the national economy and is seen to play a leadership role in positioning Australia to adapt to climate change impacts. State and Territory Governments given their responsibility to in delivering more services and in managing a greater proportion of publically-owned assets, demands this level of government assume a bigger role in direct adaptation for climate change, particularly in relation to urban land release. It is this level of government that is responsible for regulation that bears the most of the nation's ability to adapt the urban environment including implementation of building codes and land use planning regulations.

Significantly, the position paper also establishes the view that climate change adaption is most effectively managed at a single State or Territory level and through the mechanism of delegated authority to local government, that local councils are critical stakeholders, having major responsibility for identifying and implementing adaptive measures addressing localised climate-induced impacts.

Objective 3: demonstration of 'best practice' through control of Government-owned assets and infrastructures and incentives offers via Government programmes and funding.

In addition to demonstrating 'best practice' in the management of national and state-owned assets or resources and infrastructure including implementation of adaptive strategies to protect these assets, the position paper identifies the role of government in continuing to provision services for the 'public good', acknowledging that in some cases the market will be unable to deliver the required benefit or desired level of public good services – examples being flood and coastal protection, emergency management, access to health services and so forth. As such governments have the opportunity and responsibility to leverage publically owned assets and funding to ensure climate change adaptation is progressed in order to benefit the community as a whole.

(Australian Government, 2010a, p 8 - 10).

It should be noted that work on formulating a national response to climate change adaptation began almost a decade earlier, sponsored through the efforts of the Council of Australian Government or COAG, which culminated in the 2007 National Climate Change Adaptation Framework (COAG 2007a) and supportive National Climate Change Adaptation Program (COAG 2007b). This framework effectively co-ordinated a range of co-operative action undertaken across all three levels of government within Australia, and in particular to address a growing demand for targeted information on climate change impacts and adaptation options.

The framework sponsored a National Climate Change Adaptation Program which provided funding over a five-year period to establish:

- the National Climate Change Adaptation Research Facility, supported by \$20M of funding over 4 years, to help bridge the gap in current scientific knowledge and assessment of national climate change vulnerability;
- five (5) significant vulnerability assessments including the risk to the Australian coastline, biodiversity, world heritage properties, national reserve system, as well as the interactions between climate change, national fire regimes and biodiversity in Australia;
- a grants program supporting local councils in the development of local climate change adaptive strategies, including the Local Adaptation Pathways Program (\$2M) as well as five (5) specific projects under the Integrated Assessment of Human Settlements sub-program; and
- development of a Climate Change Adaptation Skills program for professionals

and offering accreditation for architects, planners, engineers and national resource managers intended to build professional capacity supporting climate change adaptation.

SOURCE: Department of Climate Change & Energy Efficiency website:
http://www.climatechange.gov.au/government/initiatives/climate_change_adaptation-program.aspx

In addition to defining the role of each level of government in relation to climate change adaptation and setting in place the three key objectives, the 2010 Positioning Paper also established six (6) initial national priorities for adaptation action. Again reflecting the earlier work of COAG. These priorities include:

- coastal management;
- water;
- infrastructure;
- national system of national significance;
- prevention, preparedness, response and recovery with regard to natural disasters; and
- agriculture.

(Australian Government, 2010a, p 11).

Focusing specifically on the built environment, it can be observed that adaptation for climate change is being encouraged through two primary mechanisms: the Building Code of Australia (BCA) and via urban planning systems. Both are enforced through legislation enacted by individual State or Territory Governments and implemented under delegated authority by Local Government within each State or Territory.

5.2.3. The role of the Building Code of Australia

The Building Code of Australia (BCA) essentially sets the societal risk for the performance of built structures within Australia; acting like a national building regulation given that it has been referenced within all State and Territory Building Acts and Regulations. While the intention of the BCA is to regulate building performance rather than climate change adaptation per se, it has proven effective in ensuring that new construction and major alterations are increasingly being designed to cope with extreme climatic and/or weather events including tropical cyclones and bushfires, with design for flood prone areas currently under development.

Since 2003 the BCA has incorporated requirements for buildings to be designed for energy efficiency with amendments in 2006 and most recently in 2010 having steadily increased performance targets for all classes of buildings, including housing. Such measures demand assessment of aspects such as thermal performance and passive solar design helping to combat the impact of predicted temperature increases and increased frequency of heat wave events. It has established a unified 'climate' map dividing the Australian continent into eight (8) climatic zones and setting requirements for thermal design and energy efficiency for all building types based on geographic location within the continent. In the case of Class 1 buildings (various types of single dwellings) where, in addition to conforming to the requirements under Part 3.12 of the BCA, alternative solutions can be assessed to 'deem to apply' following the testing methodology outlines in Section J of the BCA. With the exception of New South Wales which has developed its own performance modelling (BASIX), all states and territories have adopted this method of testing for thermal design and energy efficiency. BASIX, introduced by the NSW Government in 2004 is an online building assessment and certification tool for building designers and the construction industry to enable

comparison of a building design with water consumption, thermal comfort and energy reduction targets (BASIX, 2006). It has been progressively applied to all new residential development as well as alterations and additions.

As mentioned, the BCA also sets a range of other performance criteria that directly support thermal comfort and energy efficiency including setting minimum requirements for building/room ventilation, building insulation, glazing or window performance and the like. There are also numerous workplace standards regarding air-quality and operational temperature ranges.

The Australian Commonwealth Department of Climate Change and Energy Efficiency in support of these inclusions within the BCA, jointly developed with the broader construction industry and published a detailed series of technical manuals providing guidelines for building and renovating for energy efficiency, but which also includes aspects of passive solar design, as well as adaptive construction or universal design principles. This includes the “Your Home Technical Manual”, “Your House Renovations Guide” and “Home Buyers Guide” which recognise both the needs and difficulties faced by the community in retrofitting existing housing stock in support of achieving a greater level of sustainability and robustness against the impacts of climate change (Commonwealth of Australia, 2010).

In addition the BCA has incorporated building design standards designed to improve the performance of buildings in the face of extreme weather events, in particular cyclonic conditions (and by default severe storms) and bushfires. This has been in response to the aftermath of national disasters which resulted in major loss of life and property damage. In part, support for adoption of such codes has been demonstrated through the adaptive capacity it has delivered to communities living within regions prone to both cyclones and bushfires, in significantly reducing loss of life, property and economic production. As a result, and in response to recent losses experienced in Eastern and Southern States due to flooding, work is currently underway developing design standards for buildings in flood affected regions. Similarly in response to losses in Victoria due to bushfire, standards for private bushfire shelters also underway. Appendix 2 provides a summary of the various codes within the BCA developing adaptive capacity within the built environment to climate-induced impacts.

A significant issue for legislators resulting from climate change is the predicted change in weather patterns affecting the distribution and intensity of extreme weather events, in particular the forecasted pole-ward migration of tropical cyclones and seasonal variations affecting bushfire regions, as well as flood zoning. While adjustment of existing ‘regions’ or zone boundaries in response to predicted changes in the distribution and frequency of events would undoubtedly improve adaptive capacity of communities and properties likely to come under increasing threat as a result of climate change, adjustments of boundaries also has significant economic implications. These include escalating the cost of new construction in areas affected by any adjustment, but also in the investment needed by property owners to upgrade the performance of existing building stock. Not investing to upgrade homes and other dwellings not only suggests property will be more vulnerable in the future but also brings into question the cost and ability to gain insurance cover on property which retrospectively becomes non-compliant. Such factors make adjustment of the BCA a complex and often highly political issue, with short term economic impacts needing to be weighed up against building longer term adaptive capacity.

While there is little doubt that the BCA is an effective tool in literally ‘building’ adaptive capacity within the community to the impacts of climate change, the fact is that these requirements only apply to new construction or when substantial renovation or additions are being made to existing dwelling and are not therefore enforceable on owners of existing building stock.

Adaption of existing building stock therefore presents as the more significant issue within the Australian context in terms of adaption to climate-induced impacts. Similarly as in the case of cyclone design codes, modification or adjustment to standards in response to climate change predictions, such as the pole-ward tracking of cyclones, would require individual property-owners to fund works to upgrade buildings to the prescribed standards. While some will see the value in doing so, the vast majority may not, or may find such an investment unaffordable.

5.2.4. Land use planning – current trends

State and/or Territory Governments are responsible for land use planning in Australia, with each state or territory having established its own legislation and development regulations. In all cases, implementation of this legislation is undertaken by Local Government under delegated authority from the State or Territory Government. While the level of regional or state-wide planning varies across and between states or territories, for the most part, land use and urban development is regulated using local planning instruments (town plans) and specific development controls developed in response to local conditions and issues. In terms of addressing climate-induced impacts, this localised focus is advantageous given the variation in climatic conditions across the continent and also variation in local demographics, economic activities and so forth.

While it is not feasible to discuss in detail the approach taken within all local government areas across Australia, there are some important trends in terms of urban design and sustainable land use that are important to identify as part of this discussion. Significant attention is now being given to the design of urban environments and how aspects of density and movement not only of people but also goods and services impact sustainability.

As discussed in Chapter 2, there is mounting evidence of the relationship between climate change and development. Bizikova et al (2007, cited in Robinson et al 2008, p. 5) states, “climate change vulnerability and impacts influence prospects for development, and in turn, the development path not only determines greenhouse gas emissions affecting future climate change, but also influences capacities to adapt to and to mitigate climate change”. In recent decades a number of models have developed which seek to reduce carbon footprints and improve the health of the population. Most, not surprisingly have focused on issues of urban density and spatial arrangement, which in turn influence transport systems (movement of people as well as goods and services).

Appendix 3 summarises a number of urban design approaches or models which aim to improve the level of sustainability as well as the health of the resident population. Certainly Australia, like most other developed economies around the globe, is pursuing a strategy of urban consolidation, increased urban densities and transit oriented development in an attempt to make urban environments more sustainable (clearly mitigation strategies). Increasing densities of existing cities and development of new greenfield sites will be necessary to accommodate Australia’s projected population of 35.9 million people by 2050. Wilbanks and Sathaye (2007) stated that “regardless of size, the sustainable community is generally characterized by densification, mixed land use, sustainable water and transportation systems, a net-zero energy system, and a diverse local economy” (cited Robinson et al 2008, p. 6).

In terms of adaptive strategies, there is no universal solution. Rather there is a need to respond to local conditions as well as to the specific types of climate-induced impacts. What is evident is that the approach needs to consider all aspects of the urban fabric including housing, transport, commercial/retail as well as industrial activities and public space. Geis (2000, p. 154) draws attention to the fact that built environments will be less vulnerable and therefore more resilient when they are sensitive and considerate of the natural conditions in terms of siting and function, design and construction. Pizarro et al 2006 emphasise that planning policy needs to be better informed by engineering and

related scientific knowledge about likely climate change scenarios so that specific and effective adaptive strategies are implemented, rather than just broad 'feel good' sustainable principles.

Adaptive capacity of the built environment to climate change will depend on the specific climate events, government policy, settlement patterns, adaptive and emergency measures, as well as social, psychological and economic factors (Stanley et al 2010, p. 5). Individuals must also take responsibility for private property and sustainable living. Woodward et al., 1998 (cited Haq et al 2008, p. 9) found that an individual's sensitivity to the effects of climate change will be determined by genetic disposition, pre-existing burden of disease or ill health, income, geographic location, family support systems, quality of public health infrastructure and access to relevant local information. Gill et al 2007 also highlight the importance of new considerations and the emergence of what is generally termed 'green infrastructure' or more specifically attempts to balance the ratio of built versus natural or open vegetated space within urban environments to improve micro-climate and combat amplifying factors such as urban heat island effect, pollution etc. This means local councils will need to consider a wider range of components being retrofitted within the urban landscape i.e. green roofs, solar panels, grey water reuse systems, water tanks, flood retention basins, and so forth.

5.3 Australia's response to population ageing

5.3.1 National Strategy for an Ageing Australia

In 2002 the National Strategy for an Ageing Australia: An Older Australia, Challenges and Opportunities for All, was announced by the Commonwealth Government. This has continued to shape public policy at all levels of government over the following decade.

It is important to recognise that the policy focus in Australia surrounding population ageing has been fuelled by pessimistic forecasts on the fiscal impact on the national economy, and more recently by concerns over future labour shortages with the aged-care sector. Underscoring this pessimism is the legitimate concern that the number of 'working' to 'non-working' persons will decrease at the same time as demand for age-related services, pension entitlement and healthcare will rise. The significance of this was brought to the public's attention in the first Intergenerational Report prepared by the Commonwealth Treasury in 2002, and been a headline feature of the subsequent 2007 and 2010 reports. In 2010 Treasury predicted that the dependency ratio in Australia, based on recent population growth projects, would fall to 2.7 working-age persons (15 to 64 years) supporting each senior aged 65 years or older by 2056, which compares to a ratio of 5 in 2010 and 7.5 back in 1970 (Australian Government 2010, p. 9).

While acknowledging the considerable debate over the magnitude of the fiscal impact of population ageing on Australia's economy and the nation's ability to pay for it (Badham 1998; Cooper & Hagan 1999; Coory 2004; Healy 2004; Richardson & Roberson 1999), there is no doubt the cost to support an increasing number of older persons will escalate, and so there is continuing need for public policy aimed at cost cutting, be it through curbing demand, increasing the efficiency of service delivery within the aged care and health sectors, or expecting/enabling older people to be more self-reliant in funding their aged care needs.

Healy highlights how Australia has been successful in reducing costs through "effectively transferring the long-term care of dependent older people out of the hospital system and into less costly residential care and nursing homes", and through this shifting of the cost of aged care away from the health budget, it has allowed the burden to be 'increasingly and controversially moved from the public to private purse" (Healy 2004, p. Vii; Zelenev 2008). Yet despite the gains made, such policy does little to curb longer-term demand for health and aged care services and therefore cost. A problem exacerbated by population ageing.

Recognition of this issue led to the formulation of the 2002 National Strategy for an Ageing Australia. This strategy reflected the significant change in policy direction for the nation in its approach to dealing with an ageing society. The obvious shift towards 'positive' or 'healthy' ageing is not unique to Australia, but rather is reflective of a global trend, as evident in the endorsement of the 2002 Madrid International Plan of Actions on Aging (Madrid Plan), to which at the time Australia became a signatory (UN 2002).

Since its adoption of the 2002 strategy, Australia has progressively moved from a 'welfare' approach to one that aims to "harness the capacity of older persons to contribute and participate in society" (Zelenvev 2008, p. 1). While maintaining the overarching economic objective of cost cutting through curbing demand for health services and aged care, policy effort and funding have been re-directed into supporting older persons to maintain their health and capacity to continue to live independently within the community setting. To achieve this, the 2002 strategy set in place a series of goals focused on four key areas of public policy. These included:

- *maintaining a secure and sustaining retirement income scheme that also encouraged individual contributions to retirement saving;*
- *removing the barriers to continued participation of mature aged workers in the work and encouraging the recognition of the value and importance of retaining mature-aged workers within the labour market;*
- *promoting positive images of older Australians and their potential to contribute positively to society; and to develop public, private and community infrastructure allowing older Australian's to continue to participate in society; and*
- *to continue to provide access to a choice of affordable, high quality health care servicing a diversity of care needs; acknowledging that in order for the system to be sustainable, balance needs to be struck between public and private funding.*

(Australian Government 2002, p.15 – 62)

Interestingly the strategy was silent on the longer term implications of climate change on the health and wellbeing of older persons and failed to include any specific recommendations about increasing the adaptive capacity of the senior cohort in the face of climate change impact.

The strategy did however recognise that the various levels of government within the Australian context, with each playing a distinct role in delivering supporting infrastructures and services. Again these roles were largely dictated by the responsibilities delegated under the Australian Constitution. The split in responsibility impacting aged care, health and welfare is complex and demands a high level of cooperation between all levels of government. While the Commonwealth has direct responsibility for social security and health systems, administration of the hospitals remains vested with the State despite recent attempts to transfer this responsibility to the Commonwealth. State and local government play a critical role given their responsibility for land use planning and development control, but also in the provision of many local support and aged care services.

5.3.2 Home and Community Care

The centrepiece of the Commonwealth's program of service-based support to frail older persons and those with a disability including caregivers is the Home and Community Care Program (HACC). The HACC was established in 1985 and in many ways helped to cement the concept of home-based delivery of care services to support ageing in place long before the 2002 National Strategy was drafted.

Since its inception, the intent of HACC has been to provide a basic set of support services allowing frail seniors and those with a physical disability to remain within their

homes and local communities in preference to having to enter into institutional care. The program has been progressively expanded to offer a three tiered hierarchy of support depending on the level of need, and offering access to a wide range of support services. Eligibility for assistance under the HACC program is determined by locally based aged care assessment teams (ACAT), and offers a wide range of supportive services including:

- *home-based nursing and other allied health;*
- *meals and other food services;*
- *domestic assistance;*
- *personal care;*
- *home modification and maintenance;*
- *transport;*
- *respite care;*
- *counselling, support, information and advocacy;*
- *assessment.*

The HACC has been operating under a joint funding arrangement with the Commonwealth, and is currently administered by the State and Territory Governments, however under the recent National Health and Hospitals Network Agreement, it is proposed to split the responsibility for aged care and disability services, with the Commonwealth to assume full responsibility for delivery of services under the HACC program to those 65 or older (or 50 and over for Indigenous Australians), in other words the aged care component, from the 1st of July, 2012.

Operating in parallel, and offering a similar range of services to those provided through HACC, is the Commonwealth administered program of Community Aged Care Packages (CACP). This program was introduced in 1992 by the Commonwealth as a way of encouraging residential care agencies and others to offer home-based support to people otherwise eligible for admission to commonwealth funding hostels (Victorian Government, 2003, p. 4). Again like the HACC program, CACP has also been expanded to include Extended Aged Care at Home (EACH) and Extended Aged Care to Home with Dementia (EACH-D).

As these programs have been progressively been extended to older people with higher support needs, this means that in addition to an ageing population there is a growing percentage of older people living in the general community with functional limitations that increase their vulnerability to impacts of climate change. However, it is also important to recognise the mechanisms set in place to provide assistance in adapting the family home to support ageing, and assist with routine maintenance of the home. Not only does this reduce the vulnerability of older persons ageing in place to injury and social isolation, but is likely also to provide resilience to impacts from climate change. A significant advantage is the opportunity for increased surveillance and/or monitoring by care workers which could also be utilised to assist in early warning and preparedness (including education for behaviour modification) in the event of extreme weather events.

A second important feature of these programmes was the release in 2009 of Commonwealth Charter of Rights and Responsibilities for Community Care. In many ways this can be seen as an important first step towards development of 'elder' laws helping to protect the rights and reduce the risks of abuse of older persons.

5.3.3 Building regulation for accessibility

As in the case of adaption for climate change, the BCA through its reference in individual State and Territory legislation, acts as a national code ensuring access and mobility for people with various physical impairments or disabilities, including older persons, and is being applied within the built environment. In May 2011 disability access codes were strengthened with the introduction of the 'Access to Premises Standards' within the BCA, and is now being applied to any new or affected part of a Class 1b, 2, 3, 5, 6, 7, 8, 9 or 10 building. A summary of the provisions assisting with the adaption of the physical environment for physical impairment is provided as part of Appendix 2.

Unfortunately the standard does not apply to Class 1a buildings (single detached or attached dwellings), or the internal configuration of Class 2 buildings (residential apartments), in other words to mainstream housing. Similarly these standards only apply to new construction or where substantial renovation or addition is being made an existing building.

Exclusion of mainstream housing from the need to comply with disability access or mobility standards is as a significant problem, and comes into direct conflict with a policies aimed at supporting positive ageing. As discussed earlier, while on one hand government policy is actively encouraging 'ageing in place', supported by programmes delivering aged care services within the home, the reality is that the bulk of new as well as existing housing stock will not be adequately accessible, and will require modification or alteration in order to support the needs of older persons as they experience progressive physical or cognitive impairment. Ironically since 1995 the BCA has contained the 'Australian Standard for Adaptable Housing AS4299' which sets out the objectives and principles of adaptable housing and provides guidelines for the planning and design of housing offering three categories (A, B and C) allowing adaption accommodating an increasing level of physical disability. Compliance to this standard has not however been made mandatory for mainstream housing.

5.3.4 Age-friendly housing

While the HACC program had been assisting older people to age in place since the mid 1980s, it was not until the early 1990s that the broader housing needs of an ageing population began to be seriously addressed. As part of the National Housing Strategy and the Aged Care Reform Strategy a background paper was prepared on Housing for Older Australians (Howe, 1992a) which provided a profile of older people and their housing, explored the housing options available to older people, emphasised the importance of housing to the social and psychological wellbeing of older people, and identified problems of affordability particularly in the private rental sector. This was followed in 1994 by the New Homes for Old Strategy (AURDR, 1994) which emphasised the importance of providing public, private and community infrastructure to support the participation of older people in society through ageing in place or moving to more appropriate accommodation, and by encouraging innovation in improving housing design for older people. In 2003 the Prime Ministers' Science, Engineering and Innovation Council produced a report on Promoting Healthy Ageing in Australia (PMSEIC, 2003) which covered a wide array of ageing related policy issues including linking the healthy ageing debate to the need for technological innovation in land use planning, housing design and transport infrastructure to enable a more age-friendly built environment. However none of these initiatives specifically considered the importance of climate change to age friendly housing and neighbourhoods.

More recently, in 2005 the Office for an Ageing Australia of the Commonwealth Department of Health and Ageing instituted a National Speakers Series "to raise awareness of the need to plan and build better communities to meet the long-term needs of a future Australian population which will have a higher proportion of older people." It aimed to "challenge traditional models of housing and community design...and move our thinking from our current car-oriented suburbs to 'walkable communities' where older

people can remain in their own homes and communities.” (DoHA, 2006 p.8)) Amongst the “lesson’s learned” from this Series was: the need for a whole of government approach; the need to increase housing choice for consumers, to promote sustainable design and planning; training guidelines and best practice models for the housing industry; and for infrastructure and urban design to support healthy and active ageing (DoHA, 2006 p. 9,10). The report also recommended a number of actions to bring together the various stakeholders around adaptable and universal design to improve the design of housing for an ageing population.

Following this initiative, in late 2009, the Federal Parliamentary Secretary for Disabilities and Children Services (Hon. Bill Shorten) convened the ‘National Dialogue on Universal Housing Design’ which brought together representatives from all levels of government, key stakeholder groups from ageing, disability and community support sectors as well the property and building industries across Australia. The stated intent of this forum was to increase awareness of; and to promote the social and economic benefits of adopting Universal Housing Design - defined as “designing Australian homes to meet the changing needs of home occupants across their lifetime” (NDUHD 2010, p1).

The output of this forum was a 10-year strategic plan and the setting of an ‘inspirational’ target of having all new homes being constructed to an agreed universal housing design standard by 2020. The first major milestone was the release in 2010 of the Livable Housing Design Guidelines. The voluntary guidelines are based on universal design principles and include six core elements as outlined below.

1. A safe and continuous path of travel from the street entrance and/or parking area to a dwelling entrance that is level.
2. At least one level (step free) entrance into the dwelling.
3. Internal doors and corridors that facilitate comfortable and unimpeded movement between spaces.
4. A toilet on the ground (or entry) level that provides easy access.
5. A bathroom that contains a hobless (step free) shower recess.
6. Reinforced walls around the toilet, shower and bath to support the safe installation of grabrails at a later date.

(NDUHD, 2011 p. 6)

The guidelines include three levels of performance for each of the elements: Silver (provision of core liveable housing requirements only), Gold (enhanced core plus additional elements) and Platinum (core plus all remaining elements)

A 2007 cost study of the 12 universal design features outlined in the NSW Landcom, ‘Universal Design Guidelines’ calculated additional costs to be between 1-2% of the original construction cost. The study also indicated that when these features are designed up front, universal housing could be achieved with almost no additional cost (Landcom 2008). The Victorian Regulatory Impact Statement conducted in 2010 for visitable and adaptable features in housing, found that the additional cost of the four elements; accessible path of travel to entrances; increasing the width to doorways, passage, and common corridors for improved access as well as more accessible bathroom design (toilet access and reinforced bathroom walls for hand railing) was between 0.1-0.3% of the total dwelling cost if designed into the project from the start (Regulatory Impact Solutions 2010).

The literature also points to the fact that while some additional cost is incurred in the initial construction, the inclusion of these types of universal design features has been found to be substantially more cost effective than the costs and disruption involved in making alterations and additions later on (Malloy 2008; Johnson & Chen 2009, Judd et

al, 2010). Yet despite the apparent economic and social benefit in encouraging this adaptive capacity, a recent report by the Productivity Commission (2011 p. 281) recommended that “mandatory application of universal design standards for all new housing is not warranted given the community-wide costs. Nevertheless, voluntary adoption should continue to be encouraged”. This proposition is questioned by many advocates of universal design, who strongly support it being mandated as part of the BCA. Time will tell whether voluntary adoption will be sufficient to provide an adequate supply of housing suitable for an ageing population.

Finally, as valuable as universal design is for an ageing society, at present there is little integration between such guidelines and strategies required for climate change mitigation or adaptation.

5.3.5 Age-friendly cities and neighbourhoods

In 2005 the World Health Organisation (WHO) instituted a Global Age Friendly Cities Program (later renamed the Global Age Friendly Environments Program) to “address the environmental and social factors that contribute to active and healthy ageing in societies” (WHO, 2011). This saw the establishment of the WHO Global Network of Age-Friendly Cities in which two Australian cities participated – Melbourne, Victoria and Melville, Western Australia. It outlined the following guiding principles for planning and design:

- *pleasant environments: a clean and naturally beautiful place of residence is appreciated by older people;*
- *green spaces: ensuring safe and usable green space with adequate seating for passive recreation, ablutions facilities and lighting;*
- *places to rest: street furniture is important for people of all ages, but particularly older people who may not have the stamina for long excursions without rest breaks;*
- *age friendly pavements: ensuring that pavements are even, sufficiently wide, include dropped curbs that taper off to be level with the road, and have clearance from congestion and obstructions will reduce hazards for older people;*
- *safe pedestrian crossings: ensuring that pedestrian crossing lights provide sufficient time to cross the road will improve safety of crossings. Traffic islands and non-slip surfaces may also improve safety;*
- *accessibility: ‘barriers’ in the built environments are caused by a lack of understanding by architects and planners as to the variation in human form and abilities. Built environments need to be designed in an accessible to provide opportunities for inclusion and participation of all people;*
- *a secure environment: feeling safe in the built environment is particularly important for older people, many of whom identify as not willing to go out at night (refer to Banister & Bowling 2004). Features such as street lighting, CCTV, and appropriate landscaping will increase the safety of an area;*
- *walkways and cycle paths: the separation of pedestrian and cycle paths will reduce the risk of accidents;*
- *age-friendly buildings: features such as ramps, elevators, non-slip floors, ablutions facilities, signage and rest areas are important in creating more accessible buildings;*
- *adequate public toilets: the availability of clean, conveniently located, well-signed, handicap-accessible toilets is generally regarded as an important age friendly feature; and*

- *privileges for older customers: one of the barriers identified in a number of cities is the long queues or waiting times older people face to be served. It is suggested that special service arrangements be made for older people, such as separate queues or service counters.*

(WHO 2007, p. 12 – 17)

Just as local government has a key role to play in climate change adaptation, so it does in addressing issues associated with ageing, ***especially as it applies to providing an appropriate urban infrastructure for an ageing population.*** Building on the 2002 National Strategy for an Ageing Australia, the World Health Organisation's Age Friendly Cities (later Environments) Program and the DoHA National Speakers Series, the Australian Local Government Association developed the Australian Local Government Population Ageing Plan 2004-2008 (ALGA, 2004). Initiatives arising from this plan included the development of the Planning for an Ageing Community website, an occasional paper series, annual surveys of age friendly awareness in local government, an email discussion forum and a resource centre with examples of innovative practice. Their publication Age Friendly Built Environments: Opportunities for Local Government outlines the following key strategies for local governments to encourage age-friendly environments:

1. promote age-friendly built environments
2. create safe and secure pedestrian environments
3. foster age-friendly community planning and design
4. improve mobility options for seniors
5. support recreation facilities, parks and trails

(ALGA, 2006)

A recent study of dwelling, land and neighbourhood use by older home owners (Judd et al, 2010) found the design of neighbourhoods to be extremely varied in terms of their age-friendliness. Key neighbourhood design barriers to participation included inadequate provision, or poor quality of pedestrian pathways; vegetation obstructing footpaths; inadequate provision of safe street crossings; inadequate lighting at night; lack of seating and shelter in public streets and parks; poor access and maintenance of public parks, lack of provision, poor quality or closing hours of public toilets. Clearly, despite the initiatives of the ALGA, there remains much to be done to ensure that residential neighbourhoods are appropriately designed for an ageing population. While local government clearly has a leading role in the creation of age-friendly neighbourhoods, as well as responding to climate change, there is little evidence that these two challenges are being addressed in an integrated and coordinated way.

5.3.6 Transport infrastructure

The literature indicates high rates of car ownership and preferred modes of private transportation over public transport amongst older people (Gilhooly et al 2002; Alsnih and Hensher 2003; Banister and Bowling 2004, Judd et al, 2010). This can be attributed to a number of factors such as an increasing number of older people with drivers licences, cars which are easier to drive, a more active and healthier older population, a greater amount of disposable income, resistance to changing modal behaviour once retired, and the independence and freedom afforded by the private vehicle (Marotolli et al., 2000; Rosenbloom and Morris, 1998; Tacken, 1998, cited Alsnih & Hensher 2003, p. 906, Judd et al, 2010).

In a UK study Gilhooly et al (2002) found that car ownership and driving were linked to quality of life. Similarly Alsnih and Hensher (2003) found that driving cessation is perceived negatively because of dependence on cars in providing mobility and independence. In addition, older people who have never driven were more aware of their physical limitations and had adapted their lifestyles accordingly, however older ex-drivers were not as aware of their physical limitations, adding to the feeling of lost independence (Skinner and Stearns, 1999; Rosenbloom and Winsten-Bartlett, 2002, cited Alsnih and Hensher 2003). The Gilhooly et al (2002) study found that the idea of giving up driving was perceived by current drivers as entirely negative, however the responses of those who had already stopped driving were more positive. The study also showed variance in the third age and fourth age older people. Those of the fourth age indicated higher levels of satisfaction with public transport than 'baby boomers'. Barriers to the use of public transport included concerns about personal safety at night, difficulties carrying heavy loads, public transport running late, the behaviour of some passengers, poor cleanliness, and a lack of toilets. An Australian study of older home owners by Judd et al (2010) found barriers to public transport use to be distance and steep inclines to transport nodes, lack of available parking spaces at stations, poor public transport provision or irregularity of services particularly in outer suburban area and regional towns, queues and lack of seating at transport nodes, difficult access to busses and some railway stations, and concerns about personal safety on public transport or at transit nodes.

Alsnih and Hensher (2003) suggest that there will be great market opportunities in encouraging seniors away from private car use, for instance through a flexible but specialised door-to-door transport service. They also recommended that better education be provided to the middle aged population to make them aware of potential transportation needs in their retirement years and to factor that into retirement plans (Skinner and Stearns, 1999, cited Alsnih and Hensher 2003).

Cognitive barriers are becoming increasingly recognised as a significant factor in decision-making for older people and a cause of social isolation. A recent Swedish study examining the patronage of public transport by older people following a programme of infrastructure improvements, found that not only was declining health a barrier, but so too was the perception by older persons that the transit network was overly complex and difficult to negotiate, despite efforts to improve its physical accessibility (Wretstrand et al 2009). Similarly, an Australian study of Hervey Bay and Brisbane found that physical improvements to the accessibility of bus networks were not enough in themselves to vastly increase patronage (Broome et al 2010). 'Soft barriers' such as fear of travelling alone, difficulty boarding and alighting, perceived accessibility and distances, difficulty obtaining a seat, poor personal service and complex information and ticketing are factors which affect usability but are not necessarily rooted in the structural accessibility of public transport.

Metz (2003) further explains the factors which influence public transport usage for older people. The journey typically involves walking to the station, waiting for a service, embarking and disembarking from the transport vehicle, reaching the destination and

returning home. Sources of difficulty may include the gap between the train and the platform; the step up onto the bus; the absence of lifts on many rail and underground stations; local stations and bus stops that feel insecure and lack seating or shelter; timetables, signs and displays that are difficult to read; public address systems that generate inaudible announcements; buses that accelerate away from the stop before passengers are seated; and patronizing or unhelpful attitudes of staff.

5.4 Implications of the current policy response

This review of the current policy highlights several key issues that have direct bearing on the nation's vulnerability to climate change and ability to support an ageing population. These are:

- There is a distinct advantage in Local Government playing a key role in developing adaptive capacity to climate change impacts given at the risks and types of climate-induced exposures will be highly variable depending on the geographic location and the character of development as well as economic activity across the nation. This equally applies to adaptive strategies aimed at supporting the creation of age-friendly environments;
- Land use planning and development controls, working in concert with the BCA have proven successful in increasing community resilience to climate change impacts through improving the structural performance of buildings, landscapes and other public infrastructure in the face of predicted environmental exposures (cyclones, severe storms, floods and storm surge, bushfire, heatwaves, etc);
- Adaption of existing building stock presents as a more significant issue within the Australian context rather than new development given the performance standards set by the BCA in addressing issues for extreme weather events, thermal comfort and energy efficiency as well as disability access;
- The exclusion of mainstream housing from the requirements for disability access and/or incorporating adaptive capacity to be readily modified to support physical and cognitive impairment contradicts desires to encourage successful ageing-in-place;
- Creating 'age-friendly' environments, which promote positive ageing and encourages older persons to remain social active deliver the added benefit of also reducing the sensitivity of older persons to the impacts of climate change and hence the overall vulnerability of the community to climate change.

5.5 Summary

In reviewing Australia's policy response to climate change and population ageing, what is revealed is that these issues have tended to be addressed in isolation, with little attention paid to the compounding effect each has on the other. What has failed to be appreciated is the consequence of older persons being more vulnerable to the impacts of climate change in comparison to younger cohorts. Given that Australian society is rapidly ageing, the implication is that the vulnerability of the community to climate change will escalate unless action is taken to build the adaptive capacity of older persons in coping with the impacts of climate-induced exposures, simply due to the increasing percentage of older persons in the population. As observed by Hag (2008, p1) "there is an urgent need to exploit synergies between climate change policies and policies aimed at older people and to avoid overlaps and contradiction".

CHAPTER 6: CONCLUSION

While acknowledging that people are living longer and in better health, the reality is that ageing results in non-pathological decline in physical and cognitive abilities making older people not only more sensitive to environmental exposures compared to younger cohorts, but especially vulnerable to the impacts of climate change. Given that Australia's population is rapidly ageing, the nation's vulnerability as a whole will also increase unless action is taken to assist older person to cope with the impacts of climate change.

This chapter summarises the key findings from the review identifying the generic sensitivities of older persons to climate-induced exposures and the opportunities available to develop adaptive capacity to reduce this cohort's vulnerability to climate change, and as well Australia's current response in terms of public policy to both climate change and population ageing. It will focus specifically on the potential to modify or adapt the built environment, to deliver community settings that not only 'age friendly' but increase the community's resilience to climate change impacts.

6.1 Key findings

Australia's vulnerability to climate change

- Heatwaves pose the most immediate threat to public health and ageing, heat sensitive infrastructure. This is also an exposure to which older persons are particularly vulnerable.
- While tropical cyclones, floods and bushfires have the potential to cause significant damage to property and loss of economic production, severe thunderstorms and hail presents a more significant financial threat given the wider distribution across the continent.
- Longer term flooding and the threat of storm surge will pose an increasing risk due to sea level rise.

Generic vulnerabilities of older persons

- An older person's sensitivity and risk of injury or loss increases in proportion to their level of physical and/or cognitive impairment, level of social isolation and financial dependency.
- Pre-existing health and level of physical and/or cognitive impairment are major determinants of sensitivity to a range of environmental exposures, therefore supporting older persons to maintain their health and mobility is a key strategy in building resilience to and reducing vulnerability to climate change.
- The ability for older persons to obtain assistance and conversely community surveillance of older persons can improve their level of preparedness in response to an extreme weather event or environmental exposure, including modifying of behaviours reducing their sensitivity to the pending exposure. As such supporting older persons to remain socially engaged and active (avoiding becoming socially isolated) can significantly reduce vulnerability to climate change;
- Older cohorts are more reliant on traditional modes of communication (telephone, newspaper/print media, radio and television). While this reliance will likely change with the entry of the Baby Boomer cohort into retirement, this needs to be considered when formulating strategies for early warning and information about climatic-induced threats;

Australia's policy response

- There is a distinct advantage in local government playing a key role in developing adaptive capacity to climate change impacts given that the risks and types of climate-

induced exposures will be highly variable depending on the geographic location and settlement patterns across the nation, therefore demanding local responses. This equally applies to adaptive strategies aimed at supporting the creation of age-friendly environments; land use planning and development controls, working in concert with the BCA which have proven successful in increasing community resilience to climate change impacts through improving the structural performance of buildings, landscapes and other public infrastructure in the face of predicted environmental exposures (cyclones, severe storms, floods and storm surge, bushfire, heatwaves, etc).

- Adaption of existing building stock for climate change and to supporting ageing-in-place presents as a more significant issue within the Australian context rather than new development given the requirement to comply with the performance standards set by the Building Code of Australia addressing issues for extreme weather events, thermal comfort and energy efficiency as well as disability access.
- Exclusion of mainstream housing from being required to be designed for disability access and/or incorporating adaptive capacity to be readily modified to support physical and cognitive impairment contradicts desires to encourage successful ageing-in-place.
- Creating 'age-friendly' environments, which promote positive ageing and encourage older persons to remain socially active has the potential to deliver the added benefit of also reducing the sensitivity of older persons to the impacts of climate change and thereby the overall vulnerability of the community to climate change.

6.2 Implications for future research

This study highlights the current understanding of how climate change, ageing and the built environment intersect and how integrated adaptive measures need to be mutually considered. It also reveals some of the gaps in knowledge that suggest a need for further research including in the following areas.

- The critical issue of how to retrofit or adapt existing building stock, not only to allow for ageing-in-place but to cope with the combined impact of climate change. In particular there is a need to develop methods to calculate the cost and benefits of adaptation, not only for individual households but at a community level to assist policy makers in supporting and providing incentives for retrofitting as a means of increasing community preparedness and resilience to climate change.
- Encouraging participation and action in individuals but also at a community level will be dependent on acceptance of climate change but also re-conceptualising of the social constructs of 'old age'. The attitudes of people towards climate change and their personal vulnerabilities will influence their behaviour in terms of both mitigative and adaptive action. Given that baby boomers are the first consumer generation to enter old age, but also the fact that this cohort will be the most prepared financially for retirement, is also the most educated and, through sheer numbers, politically influential, understanding their views and expectations is critical. Further research needs to be conducted into understanding the different attitudes of older Australians on the issue of climate change but also their expectations for ageing. This will also help to discern any complacency towards particular climatic exposures and willingness to adapt and seek assistance.
- Discussion about vulnerabilities of older persons to climate change appears to be inherently 'ageist' in its perspective. It is understandably easy to become fixated on issues of disability and cognitive impairment, which as a result, promotes a welfare mentality bias towards the need for government intervention and policy. As with many debates concerning ageing, while such decline is a reality for older persons, there is considerable benefit in also considering the capacity and willingness of older

persons to modify behaviours to seek more supportive environments to allow them to cope and continue to enjoy life. Research into the motivations encouraging older persons to remain socially engaged and to adapt their lifestyles or behaviours is required to encourage older persons to be part of the solution in addressing their vulnerabilities to climate change rather than just posing an increasing problem.

This literature review is therefore a useful starting point for ongoing research into the task of addressing the cumulative effects of an ageing society, climate change and the adaptive role of the built environment in the Australian context.

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APPENDIX 1:

IMPACTS OF CLIMATE CHANGE – RECENT EXAMPLES

Impact		Examples
Temperature-related impacts		
Heat waves	<p>High temperatures beyond averages will affect the health of those who are more vulnerable to heat stress. High temperatures will also affect infrastructure.</p> <p>A warmer and more variable climate leads to higher levels of some air pollutants and increased transmission of diseases through unclean water and contaminated food (Annan 2010).</p>	<p>The 2003 heat wave in Europe killed 35,000 people, of which the majority were aged 75 or older. There was also an upsurge of respiratory illness and high ozone levels. The heat wave strained water supplies, farmers, and energy suppliers. Livestock and crop losses alone amounted to over \$12 billion (Annan 2010).</p>
Cold waves	<p>Northern hemisphere countries are mostly at risk of excess mortalities in winter and extremes in cold weather. Although climate change data indicates rising temperatures, the impacts of cold waves are still a significant issue. Thresholds vary between regions as the population has acclimatized to regional temperatures. Major determinants of winter mortality include respiratory infections and housing quality.</p>	<p>Cold mortality is a problem in mid latitudes (IPCC 2007, ch 12) but is likely to decline with predicted milder winters due to global warming.</p> <p>Britain has a large burden of excess winter deaths, particularly for people aged over 75 (Wilkinson et al 2004).</p>
Bushfires	<p>Rising temperatures and changes in precipitation may increase the risk of bushfires.</p>	<p>There has recently been major fires in Australia, Greece, Spain and Russia.</p> <p>In Victoria, Australia, the 2009 bushfires destroyed 98,932ha of national park, more than 1 million animals, 2133 houses and killed 173 people (Victoria Bushfires Royal Commission 2009).</p>
Change in Seasonal Precipitation / Drought	<p>Changes in seasonal precipitation can cause drought or flooding and impact on food supply, disease and weather related mortality.</p>	<p>In Indonesia climate change is predicted to lead to a 2-3% increase in annual rainfall. However there are drier conditions and delayed monsoon rainfall for most of the year, followed by a condensed and even wetter three month rainy season in all of Indonesia. This causes changes reduced food supply and subsequent price increases, impacting on starvation and malnutrition. .</p> <p>In Morocco, drought is not unusual, averaging a one every 11 years. However, over the past 30 years, drought frequency, intensity and duration have increased. Overall annual water supply has decreased by 15% between 1971 and 2000, particularly in southern and south-eastern Morocco. By 2020, average annual rainfall is projected to decrease by 4% compared to 2000 levels, severely impacting on cereal yields.</p> <p>The region at most immediate risk of droughts and floods is sub-Saharan Africa (Annan et al 2010).</p>

Extreme weather events		
<p>Flooding</p>	<p>Increased risk of inland and coastal flooding may result from increasing rainfall, rising sea levels (including melting glaciers).</p> <p>Due to increasing rainfall in North and South America, northern Europe and Central Asia the risk of rapid flooding is predicted to increase. Flooding is attributed to both localized rainfall and glacial melts.</p>	<p>2010 Pakistan Flood - 20 million people affected, 2000 killed \$9.5 Billion in damages.</p> <p>2009 India Flood – 992 killed, 1.9 million affected and \$220 million in damages.</p> <p>2007 China Flood – 105 million affected, 535 killed and \$4.4 billion in damages.</p> <p>Bangladesh - Tropical cyclones, local storms, floods and droughts, have killed 9,000 people and caused damages of more than \$5 billion. One-fifth of the country is flooded every year, and in extreme years, two-thirds of the country has been inundated.</p> <p>Malawi, Mozambique, Nigeria, Somalia, Sudan and Tanzania are considered especially prone to floods. Flooding is also likely in Afghanistan, Bangladesh and Nepal.</p>
<p>Drought</p>	<p>Changes in local rainfall may bring about drought.</p>	<p>Droughts are most probable in Burkina Faso, Mozambique, Rwanda, Somalia and Tanzania,</p> <p>The semi-arid dry land belt countries because of overall vulnerability to droughts from the Sahara/Sahel to the Middle East and Central Asia. (The most affected countries include Niger, Sudan, Ethiopia, Somalia, Yemen, and Iran, all the way to Western/Northern China.)</p>
<p>Cyclones & Storm Surge</p>	<p>There are mixed predictions for how the frequency and intensity of cyclones will be impacted by climate change. One theory is that warming seas and air cause more water to evaporate, fueling strong rains and winds.</p>	<p>The North Atlantic is identified as an area that will experience increased tropical cyclones.</p> <p>The small islands of Tuvalu, Kiribati and the Maldives are particularly vulnerable to gradual sea level rise and storm surges. Tuvalu, in the South Pacific Ocean, is the lowest-elevated state, with a peak elevation of less than 4.5 meters above sea level. Key challenges include frequent saltwater flooding, accelerated coastal erosion and increasing difficulty growing vegetables and plants. Migration to New Zealand has begun (Annan 2010).</p>
<p>Severe Storms</p>	<p>Rising temperatures may increase the frequency and intensity of storms, cyclones and storm surges.</p>	<p>The most storm-prone areas are along the coasts of East Africa including Mozambique and Madagascar, and South Asia, including Bangladesh, as well as along the Southeastern and central areas of the US (Annan 2010).</p>
Sea level rise		
<p>Coastal impacts</p>	<p>Sea level rise may increase the intensity of storms, in land flooding and saltwater intrusion.</p>	<p>The large coastal populations of Bangladesh, China, Japan, Vietnam and Thailand are all at great risk of flooding. East Africa is also at great risk due to sea level rise and tropical storms.</p>

Source: Information collated from DARA 2010, Annan et al 2010 and IPCC 2007

APPENDIX 2

CONTRIBUTION OF THE BUILDING CODE OF AUSTRALIA (BCA) IN ADAPTING THE BUILT ENVIRONMENT FOR CLIMATE CHANGE & POPULATION AGEING

Code Ref & Title	Description	Contribution to climate change mitigation or adaption
THERMAL COMFORT & ENERGY EFFICIENCY		
AS/NZS 4859.1 2002/Amdt 1: 2006 Materials for the Thermal Insulation of Buildings	<i>Sets of the requirements and methods of test for materials that are added to, or incorporated in envelopes of buildings designed for human occupancy, to provide thermal insulation by moderating the flow of heat through these elements.</i>	<ul style="list-style-type: none"> • Reduced energy demand • Moderating impacts of seasonal temperature increases.
AS 3999 – 1992 Thermal Insulation of dwellings – Bulk Insulation & Insulation Requirements	<i>Deals with the installation of bulk thermal insulation in all classes of dwellings. It does not apply to the insulation of building services and equipment, or deal with foamed in-situ and reflective foil laminate thermal insulation materials.</i>	
AS/NZS: 4200.1 1994 Pliable Building Membranes and Underlay - Materials	<i>Specifies the requirements for materials suitable for use as a pliable building membrane (also known as underlay) when it is intended to act as a sarking membrane or thermal insulation, or a vapour barrier in a domestic, commercial or industrial building.</i>	
AS:1288 (set) 2006 Glass in Building including new supplement detailing glass specifically for different wind loadings.	Sets out procedures for the selection and installation of glass in buildings, subject to wind loading, human impact, and special applications such as overhead glazing, balustrades and glass assemblies. It also includes issues of thermal properties linked to assessment of building energy efficiencies in BCA 2010.	
BUSHFIRES		
AS/NZS: 1530.3: 1999 Methods for Fire Tests on Buildings, Materials, Components and Structures AS:1530.4: 2005 Methods for Fire Tests on Building Materials, Components and Structures – Fire resistance test of elements of construction.	<i>Simultaneous determination of ignitibility, flame propagation, heat release and smoke release of buildings and structures.</i>	<ul style="list-style-type: none"> • Reduces property loss/structures becoming ignited when fire in of approach and assisting occupants or owners to define the property. • Prevents development in high risk locations.
AS 2959-2009/Amdt 2-2011 Construction of Buildings in Bushfire Prone Areas HB 330-2009 Living in Bushfire Prone Areas	<i>Sets out the requirements for the construction of buildings in bushfire-prone areas in order to improve their performance when they are subjected to burning debris, radiant heat or flame contact generated from a bushfire. Also includes a methodology for assessing categories of bushfire attack in respect of a site situated in an area that has been designated by a relevant authority as bushfire-prone.</i>	
Under development by ABCB Private Fire Shelters	<i>Review of mandatory design requirements for private fire shelters.</i>	<ul style="list-style-type: none"> • Reduce the risk of injury or death to persons in the event of having to shelter during a fire.

CYCLONES, SEVERE STORMS & FLOODING		
<p>AS/NZS 1170: 2002/Amdt 4 - 2005</p> <p>General Principles</p> <p>AS/NZS 1170.2:2011</p> <p>Structural Design Actions – Wind Action</p>	<p><i>This Standard sets out procedures for determining wind speeds and resulting wind actions to be used in the structural design of structures subjected to wind actions other than those caused by tornadoes.</i></p>	<ul style="list-style-type: none"> Reduces property loss due to high winds and risk of injury or death of occupants if sheltering in the building during the storm event. Australia divided into zones reflecting the frequency and intensity of winds resulting from cyclones and be default also accommodating risks associated with severe storms.
<p>AS 4055 – 2006/ Amdt 1- 2008</p> <p>Wind Loads for Housing</p>	<p><i>Specifies site wind speed classifications for determining design wind speeds and wind loads for housing that is within specified geometric limits. Wind speeds are specified for the serviceability and ultimate strength/stability limit state.</i></p>	
<p>AS:1288 (set) 2006</p> <p>Glass in Building including new supplement detailing glass specifically for different wind loadings.</p>	<p><i>Sets out procedures for the selection and installation of glass in buildings, subject to wind loading, human impact, and special applications such as overhead glazing, balustrades and glass assemblies. It also includes issues of thermal properties linked to assessment of building energy efficiencies in BCA 2010.</i></p>	
<p>Under development by ABCB</p> <p>Buildings in Flood Prone Areas</p>	<p><i>The Board has included a project on the 2010-11 work program for the development of a technical standard for housing and other low rise residential buildings in flood prone areas as well as an accompanying non-regulatory handbook.</i></p>	<ul style="list-style-type: none"> Aim to reduce the losses incurred through properly damage caused by inundation and to hasten the repair time to get occupants back into their homes post event as quickly as possible.
INDOOR AIR QUALITY		
<p>AS/ NZS:1668 (Set) – 2005</p> <p>The use of ventilation and air-conditioning in buildings:</p> <p>1668.1 – Fire and Smoke Control</p> <p>1668.2 - Ventilation design for indoor air contaminant control,</p> <p>1668.2 – smoke control systems</p>	<p><i>Specifies design requirements for natural ventilation systems and mechanical air-handling systems that ventilate enclosures, and sets minimum requirements for the ventilation of enclosures.</i></p> <p><i>1668.2 also covers requirement for natural ventilation in car parks as well as sets minimum requirements for preventing excessive accumulation of air-borne contaminants and odours.</i></p>	
<p>AS/NZS: 3666 (Set) – 2006</p> <p>Air handling and Water Systems for Building – Microbial Control.</p> <p>3666.1 - Design, Installation and Commissioning</p> <p>3666.2 - Operation & Maintenance</p> <p>3666.3 - Performance-based maintenance.</p>	<p><i>Covers air-handling and water systems of buildings including various aspects of design, installation, cleaning, operation and maintenance of air conditioning systems. The entire series covers in-depth procedures to help efficiently prevent microbes developing, like the deadly Legionella bacteria, in air-handling systems.</i></p>	
<p>AS 1324.1 – 2001</p> <p>Air filters for use in general ventilation and Air-conditioning.</p>	<p><i>Classifies air filters on the basis of design, construction, performance and application, and establishes minimum criteria for acceptance of an air filter into a particular category.</i></p>	

ADAPTION FOR PHYSICAL IMPAIRMENT & ACCESS		
<p>AS: 4299-1995</p> <p>Adaptable Housing</p>	<p><i>Presents the objectives and principles of adaptable housing and provides guidelines on planning and design. Adaptable housing is the basis for the development of the accommodation needs of users of all ages and abilities by making provision for future building modifications at minimum cost and disruption to the inhabitants. Includes in Appendix A, which provides a checklist for certification of housing units as Adaptable House Class A, B or C.</i></p>	
<p>AS: 1428 (set) – 2010</p> <p>Design for Access and Mobility Set</p> <p>1428.1: General Requirements for Access (New Building works);</p> <p>1428.2: Enhanced and additional requirements – buildings and facilities</p> <p>1428.3: Children and adolescences with physical disabilities;</p> <p>1428.4: Means to assist the orientation of people with vision impairment's – tactile ground surface indicators</p> <p>1428.5: Communication for people who are deaf or hearing impaired.</p>	<p><i>General requirements for disability access and mobility, however excludes/not applicable to Class 1 or residential housing.</i></p>	

APPENDIX 3:

CURRENT MODELS/TRENDS INFLUENCING URBAN DESIGN AND PLANNING IN AUSTRALIA

DESIGN MODEL	CONCEPT
Transport Oriented Development	Compact, mixed use towns and neighbourhoods which are designed around existing or proposed transport networks to reduce reliance on private transport.
Aged friendly city	An age-friendly city encourages active ageing by maximising opportunities for health, community participation and security in order to enhance quality of life as people grow older (WHO 2007). Inclusive and accessible design principles must be integrated into all parts of the built environment including green open space, buildings, transport and housing.
Liveable cities	The term liveability has a broad and varying definition however generally refers to the design of a place which has affordable and appropriate housing, supportive community services and social infrastructure, and is accessible. A liveable community facilitates personal independence and encourages social interaction (refer to Oberlink 2008).
Walkable neighbourhoods	Walkable neighbourhoods encourage walking and public transport for the majority of trips. Housing, transport, services, employment and community nodes are located within a radius of between 400-800m, which is considered a comfortable walking distance of around 5 to 10 minutes (Halton Regional Council no date).
New Urbanism	<p>New Urbanist principles promote compact, walkable neighbourhoods with a mix of uses, housing densities and community facilities. The principles of New Urbanism include:</p> <ul style="list-style-type: none"> • <i>a built environment which is diverse in use and population, scaled for the pedestrian, and capable of accommodating the automobile and public transport;</i> • <i>structure based on walkable neighbourhoods, focused on fine-grained mixed-use town and neighbourhood centres with a variety of higher density housing in close proximity;</i> • <i>well-defined and high quality public realm which is responsive to site features and ecology, and supported by a distinctive architecture reflecting the climate and culture of the region; and</i> • <i>a highly-interconnected street network, with traffic management to support pedestrians, cyclists and transit-users (Kaufman 2006).</i>
Healthy cities	<p>Healthy cities is a broad term which looks at the overall structure of a city in improving physical and social structures to facilitate optimum liveability of a city. WHO's Healthy City Checklist suggests the following measures to create a health city:</p> <ul style="list-style-type: none"> • <i>a clean, safe physical environment of high quality (including housing quality);</i> • <i>an ecosystem that is stable now and sustainable in the long term;</i> • <i>a strong, mutually supportive and non-exploitative community;</i> • <i>a high degree of participation in and control by the citizens over the decisions affecting their lives, health and well-being;and</i> • <i>the meeting of basic needs (food, water, shelter, income, safety and work) for all the city's people;</i> • <i>access by the people to a wide variety of experiences and resources, with</i> • <i>the chance for a wide variety of contact, interaction and communication;</i> • <i>a diverse, vital and innovative economy;</i> • <i>a connectedness with the cultural and biological heritage of city dwellers and with other groups and individuals;</i>

DESIGN MODEL	CONCEPT
	<ul style="list-style-type: none"> • <i>a form that is compatible with and enhances the preceding characteristics;</i> • <i>an optimum level of appropriate public health and sickness care services, accessible to all; and</i> • <i>high health status (high levels of positive health and low levels of disease).</i>
Universal Design	<p>Universal design is an approach to the development of “products and environments that can be used effectively by all people, to the greatest extent possible, without the need for adaptation or specialized design” (North Carolina State University, 1997, cited City of New York 2001). It is an inclusive process aimed at enabling people to experience the full benefits of the products and environments regardless of age, size or ability.</p> <p>By designing for a diverse population, universal designers integrate usability for everyone into their work on a routine basis. This approach leads to greater inclusion for many groups often neglected in the design process (e.g., children, the elderly, people of small stature, frail people, etc).</p>