

## Climate change adaptation in South East Queensland human settlements: Issues and context



*A report for the South East Queensland Climate Adaptation Research Initiative*

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This report, *Climate change adaptation in South East Queensland human settlements: Issues and context*, is part of the South East Queensland Climate Adaptation Research Initiative (SEQ-CARI), a partnership between the Queensland and Australian Governments, the CSIRO Climate Adaptation National Research Flagship, Griffith University, University of the Sunshine Coast and The University of Queensland.

South East Queensland (SEQ) is particularly vulnerable to climate change because of its growing population and coastal location. Human settlements, infrastructure, unique ecosystems, and primary industries all face threats from more extreme weather events, increased temperatures and altered rainfall patterns as a result of increased greenhouse gas emissions. Despite these risks and challenges, climate change may also bring some economic and social opportunities.

SEQ-CARI aims to provide research knowledge to enable the region to adapt and prepare for the impacts of climate change. It will develop practical and cost-effective adaptation strategies to assist decision-makers in government, industry and the community. The initiative is the first comprehensive regional study on climate change adaptation undertaken in Australia and one of only a few worldwide. It is exploring both vulnerabilities and adaptation options in response to climate change so that our prosperous regional economy, environment and lifestyles can be maintained into the future.

For more information about this and other projects in the South East Queensland Climate Adaptation Research Initiative (SEQ-CARI) visit: [www.csiro.au/partnerships/seqcari.html](http://www.csiro.au/partnerships/seqcari.html)

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## EXECUTIVE SUMMARY

Climate change will lead to significant impacts on our environment, society and economy. Australia has already observed significant warming over the past fifty years, and is expected to face more severe extreme events, and increased frequency of heatwaves, droughts, floods and storm surges in the decades ahead. The South East Queensland region has been identified as one of six climate change 'vulnerability hotspots' in Australia (Hennessy et al 2007). The region is particularly vulnerable because of its coastal location and the distribution and location of its growing population. The nature and scale of climate change impacts, however, will depend on a wide range of physical, social and economic variables and will not be equally distributed across the landscape.

The South East Queensland Climate Adaptation Research Initiative (SEQCARI) was established to examine the region's vulnerability to climate change and to develop practical and cost-effective adaptation strategies to assist decision-makers in government, industry and the community. It is a 3-year collaborative project between the CSIRO, Department of Climate Change, Queensland State Government, Griffith University, University of Queensland, and the University of the Sunshine Coast. It is the first comprehensive, regional study of climate change adaptation in Australia, and one of just a few worldwide (CSIRO 2009).

SEQ's sensitivity to projected climate impacts will be affected by the patterns of land use, development and population growth across the region. The design, construction and functioning of the urban landscape will affect the impact of climatic events, such as heatwaves, bushfires and severe storms, on human life and health. Population growth and development in areas of high exposure, such as flood plains and along the coastline, may in turn have implications for emergency management systems during extreme weather events.

Individuals, households, communities, private enterprise, and local and state governments must all learn to adapt to these projected changes. This will involve a mix of technological, institutional, and behavioural changes. Current thinking on adaptation recognises the need for hybrid approaches that contain a mix of risk-specific measures and those that focus on eliminating barriers to adaptation and enhancing adaptive capacity.

The Human Settlements component of the SEQ-CARI, being undertaken by Griffith University, is an integrated, multi-sectoral study of climate change adaptation options across three interrelated sectors: urban planning and management, including coastal management, emergency management and human health. The project will explore a range of appropriate adaptation strategies, policies and practices in each sector and across sectors, for better governance and management in response to the impacts of climate change.

This Report lays the foundations for the Human Settlements component of the SEQ-CARI by identifying the key issues, research questions, and policy context(s) for the project. The institutional and policy landscape within which adaptation decisions for the region must be made is complex and fragmented. There are multiple agencies, from the national to the local level and across sectors, whose activities and decisions will affect the way in which adaptation can occur at the local level. These agencies and organizations are discussed in Section 5 of this Report. There is also a plethora of legislative instruments, policies, plans and strategies, some of which address climate change issues directly, others whose impact on regional adaptation efforts is more oblique. These are set out in Section 6.

Having reviewed the institutional and policy context, the climate projections and the demographic and development trends for the region, the over-arching goals of the project are to explore the following issues:

1. What adaptation actions (including human, institutional and organisational capacity) are currently employed to reduce the effects of climate change on human health, urban form and infrastructure, environmental and urban amenity and public safety?

2. What are major obstacles/barriers to effective adaptation in human settlements, encompassing urban planning, coastal management, emergency management and human health sectors, and how can these be overcome?
3. What are the current institutional, policy and regulatory arrangements and responsibilities for the management of human settlements in SEQ, and are they able to deal with increasing demands imposed by a changing climate?
4. What links between sectors must be understood in order to develop integrated and holistic cross-sectoral adaptation strategies for human settlements in SEQ? Are current arrangements for the coordination of adaptation decision-making across sectors best designed to support successful collective action?
5. What initiatives can enhance communities' ability to deal with climate change and expanding and changing risks in the future?
6. How can the role of the private sector be enhanced to promote adaptation?
7. Which tools, strategies, models and mechanisms should each sector utilise to adapt to climate change in urban landscapes?
8. How can lessons learned about effective climate change adaptation at the local level be transferred to other locations and contexts?

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## ACRONYMS

ACEM – Australasian College of Emergency Medicine	DRO - Desired Regional Outcome
ACEN – Australian College of Emergency Nursing	DTMR – Department of Transport and Main Roads
AEMC – Australian Emergency Management Committee	EMA – Emergency Management Australia
AGDRC – Australian Government Disaster Recovery Committee	EMQ - Emergency Management Queensland
AHDMPC – Australian Health Disaster Management Policy Committee	ENSO – El Nino Southern Oscillation
AHMAC – Australian Health Ministers’ Advisory Council	ETEK – Emergency Triage Education Kit
AHPC – Australian Health Protection Committee	FaHCSIA – Commonwealth Department of Families, Housing, Community Services and Indigenous Affairs
AILA - Australian Institute of Landscape Architects	GCCC - Gold Coast City Council
ALGA – Australian Local Government Association	GHG - Greenhouse Gases
AMA-Australian Medical Association	ICLEI – International Council for Local Environmental Initiatives
ARC- Adaptive and Resilient Communities	IDAS - Integrated Development Assessment System
ARI- Average Recurrence Interval	IPA - <i>Integrated Planning Act 1997</i>
ATS – Australasian Triage Scale	IPCC – Intergovernmental Panel on Climate Change
BCC - Brisbane City Council	IPO – Interdecadal Pacific Oscillation
BMP – Bushfire Mitigation Program	LAPP - Local Adaptation Pathways Program
BoM – Bureau of Meteorology	LGAQ - Local Government Association of Queensland
CAWCR – Centre for Australian Weather and Climate Research	MCPEM – Ministerial Council for Police and Emergency Management
CCP - Cities for Climate Protection	NCCARF - National Climate Change Adaptation Research Facility
CDSMAC – Community and Disability Services Ministers’ Advisory Council	NDMP – Natural Disaster Mitigation Program
CENA – College of Emergency Nursing Australasia	NDRP – Natural Disaster Resilience Program
COAG - Council of Australian Governments	NDRRA – Natural Disaster Relief and Recovery Arrangements
CRANA – Council of Remote Area Nurses Australia	NEVSF – National Emergency Volunteer Support Fund
CSIRO - Commonwealth Scientific and Industrial Research Organisation	NFRAG – National Flood Risk Advisory Group
DACC – Defence Assistance to the Civil Community	NHMRC-National Health and Medical Research Council
DCC – Department of Climate Change	NRAAG – National Risk Assessment Advisory Group
DCS – Department of Community Safety	NSIM - National Spatial and Information Management Working Group
DEO - Desired Environmental Outcome	NTWP – National Triage Working Party
DERM – Department of Environment and Resource Management	OCC – Office of Climate Change
DIP – Department of Infrastructure and Planning	PHIL – Public Health Information Line
DMA – Disaster Management Act	PIA - Planning Institute of Australia
DPI&F – Department of Primary Industries and Fisheries	PPRR- Prevention, Preparedness, Response and Recovery
	QCCCE - Queensland Climate Change Centre of Excellence
	QEMSAC – Queensland Emergency Medical System Advisory Committee
	QH-Queensland Department of Health

QRRRA – Queensland Rural Adjustment Authority  
SEQ - South East Queensland  
SEQCARI – South East Queensland Climate Adaptation Research Initiative  
SEQIPP - South East Queensland Infrastructure Plan and Program  
SES – State Emergency Service  
SMP- Shoreline Management Plan  
SPA – Sustainable Planning Act  
SPP - State Planning Policy  
TRAAC – Technical Risk Assessment Advisory Committee  
UDIA - Urban Development Institute of Australia  
UNFCCC – United Nations Framework Convention on Climate Change

## 1. INTRODUCTION

### 1.1 Background and Context

It is now widely recognised that human activities are contributing to climate change and that this change will lead to significant impacts on our environment, society and economy. Australia is already experiencing the impacts of a changing climate and is expected to face more severe extreme events, with a projected increase in heatwaves, droughts, floods and storm surges. South East Queensland has been identified as one of six 'vulnerability hotspots' in Australia (Hennessy et al 2007). The SEQ region (see Map 1) is particularly vulnerable because of its coastal location and growing population. The nature and scale of climate change impacts, however, will depend on a wide range of physical, social and economic variables and will not be equally distributed across the landscape.

The South East Queensland Climate Adaptation Research Initiative (SEQCARI) was established to examine South East Queensland's vulnerability to climate change and develop practical and cost-effective adaptation strategies to assist decision-makers in government, industry and the community. It is a 3-year collaborative project between the CSIRO, Department of Climate Change, Queensland State Government, University of Queensland, University of the Sunshine Coast and Griffith University. It is the first comprehensive, regional study of climate change adaptation in Australia, and one of just a few worldwide (CSIRO 2009).

### 1.2 Purpose and structure of this paper

This paper reviews the major issues arising for climate change adaptation decision making in South East Queensland settlements, with a specific focus on urban planning and management, coastal management, human health, and emergency management. It also surveys the policy context in which climate change adaptation options will have to be developed and tested in South East Queensland, including identifying major policies and legislative instruments,

stakeholders, and institutional arrangements. In so doing, it provides a foundation for the work of the human settlements component of the broader SEQ Climate Adaptation Research Initiative.

The human settlements component within SEQCARI is briefly described in the following section. Section 2 then provides an overview of the theory of adaptation to climate change and explains the approach adopted in this research. Section 3 reviews the climate projections and impacts for South East Queensland. Section 4 examines some of the key adaptation issues for human settlements in SEQ. The final two sections, sections 5 and 6, examine the key institutions and relevant regulatory and policy arrangements for urban planning, coastal management, emergency management and human health at the national, state and local levels.

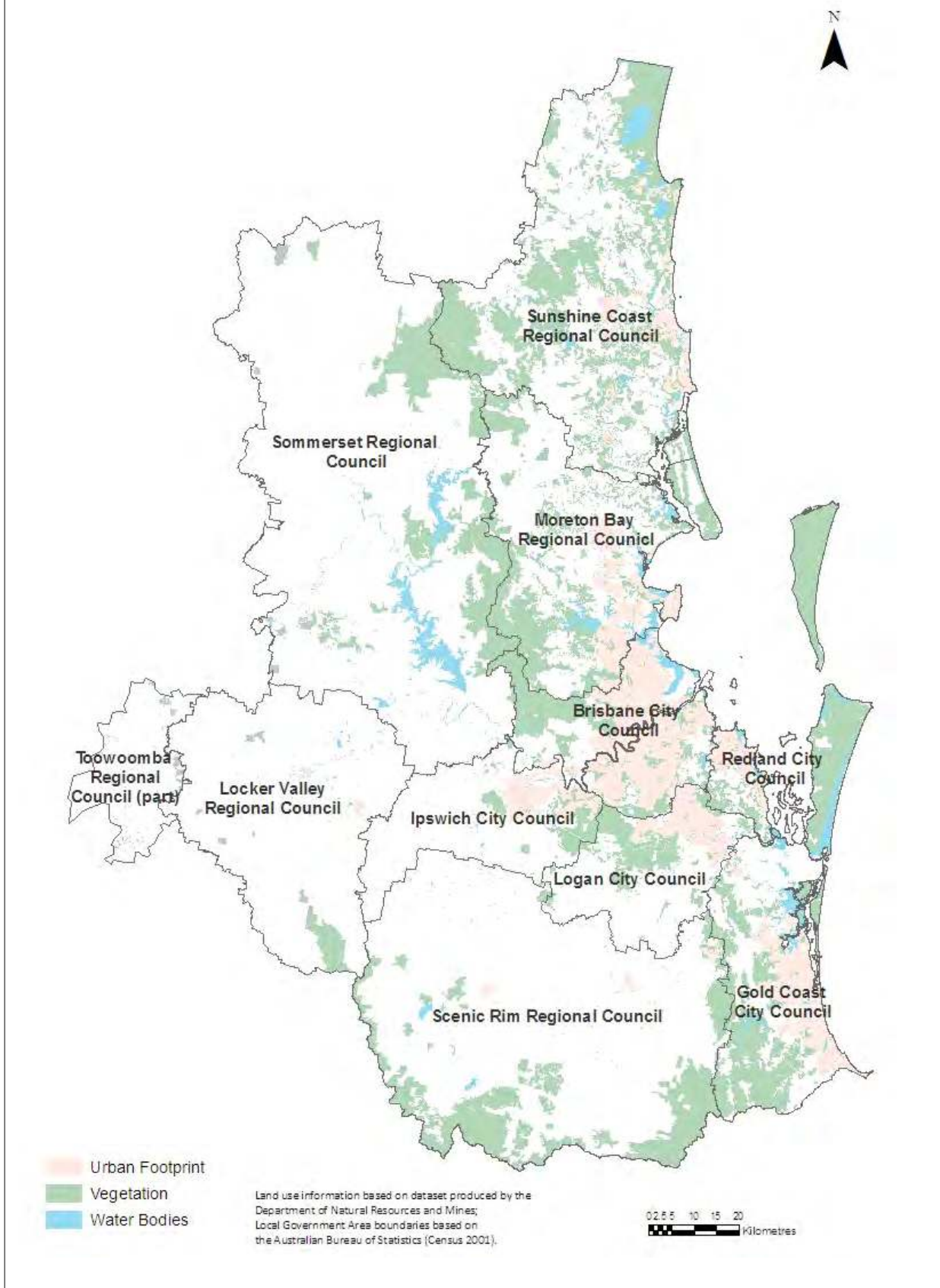
### 1.3 SEQ-CARI Human Settlements Project

#### *Project scope*

The human settlements component of the SEQCARI is led by Griffith University and consists of an integrated multi-sectoral study of climate change adaptation options for human settlements in SEQ. It will examine three interrelated sectors: urban planning and management, including coastal management, emergency management and human health. It will develop and improve the adaptation strategies, policies and practices in each sector and across sectors, for better governance and management in response to the impacts of climate change.

South East Queensland's sensitivity to projected climate impacts will be affected by the patterns of land use, development and population growth across the region. The design, construction and functioning of the urban landscape will affect the impact of climatic events, such as heatwaves, bushfires and severe storms, on human life and health. Population growth and development in areas of high exposure, such as flood plains and along the coastline, may in turn have

Map 1. SEQ region.



implications for emergency management systems during extreme weather events.

This study recognises the need for an integrated approach to the interplay between climatic forces, the physical form of the natural and built environment, and the social, economic and institutional factors that affect and are affected by that form. In addition to providing detailed sectoral insights, this study will also examine the interrelationships between the sectors of interest and the ways in which governance and institutional factors affecting one sector can facilitate or hinder adaptation across human settlements as a whole.

The human settlements component of the SEQ-CARI project therefore takes a two pronged approach, with over-arching research

questions that are either common to all sectors or which cut across sectoral domains and detailed analysis of sector-specific issues (sector-specific research questions are provided in Appendix 1). The over-arching objectives of the human settlements component are set out in Box 1.

### *Research approach*

This research takes a case study approach and will involve significant stakeholder engagement. The project is organised into five phases. The first phase involves a general assessment of the vulnerability of human settlements in South East Queensland, at both a sectoral and spatial level. Phases two, three and four consist of the case study analysis and elaboration, in order to develop and test adaptation options in consultation with

#### **Box 1. Human Settlements Component Research Questions**

1. What adaptation actions (including human, institutional and organisational capacity) are currently employed to reduce the effects of climate change on human health, urban form and infrastructure, environmental and urban amenity and public safety?
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6. How can the role of the private sector be enhanced to promote adaptation?
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stakeholders for each case study area. The final phase aims to develop adaptation plans and guidelines for each case study area and recommendations for the South East Queensland region as a whole.

This research will adopt a scenario planning methodology (Cork & Delaney 2007; Low Choy et al 2007), involving interviews and workshops with a broad variety of stakeholders, including state and local government representatives, industry bodies, non-governmental organisations and local community organisations. The scenario planning methodology will enable the refinement of the focal issues/questions for this research, development of scenarios for each case study area, exploration of factors driving climate change adaptation and the development of sectoral and cross-sectoral adaptation options. The cross-sectoral findings will contribute to a broader adaptation plan for human settlements in SEQ.

## 2. ADAPTATION TO CLIMATE CHANGE: A BRIEF OVERVIEW

Climate change adaptation refers to “the adjustment of natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC 2007a, p. 869). Adaptation, therefore, consists of actions undertaken to reduce the negative, and take advantage of the positive, impacts of climate change. Adapting to climate change is a complex and multi-faceted process that involves a mix of technological solutions and innovations, and changed attitudes, norms and behaviours at the levels of the individual, community, business and government (Adger et al 2005, IPCC 2007b). Some measures will be incremental, encouraging gradual on-going shifts, while others will involve transformation of a region, industry or community (Nelson et al 2007).

There are many different types or categories of adaptation measures. The most common distinctions between adaptation actions concern their timing (anticipatory vs. reactive), spatial and temporal scope (local vs. regional; short term vs. long term), purposefulness (autonomous vs. planned), and adapting agent (individual vs. collective; private vs. public) (Fankhauser et al 1999; Smit et al 1999; Smit & Pilifosova 2001). Anticipatory or proactive adaptation occurs before impacts are experienced and is preferable where the risks from impacts are potentially irreversible or catastrophic, and where the costs of prevention are lower than remediation or reactive adaptation (Easterling et al 2004). Planned adaptation is the result of a deliberate policy decision, whereas autonomous adaptation is an individual, rather than a policy-induced, response to climate impacts (Smit & Pilifosova 2001). Autonomous adaptation is triggered by ecological or environmental changes in natural systems or by market or welfare changes in human systems.

Adaptation, however, is not a new concept. It has its origins in natural sciences as a central concept in evolutionary biology but has been considered through a range of

disciplinary lenses and has a long history of being used in the social sciences, particularly in the fields of anthropology and cultural geography (Smit & Wandel 2006). Nevertheless, the application of adaptation theory to the climate change context is relatively recent and only really gained in importance under the United Nations Framework Convention on Climate Change (UNFCCC).

During the 1990s climate change adaptation theory and climate policy were mostly dominated by an impacts-approach to adaptation, which attempted to understand the extent to which adaptation could reduce the impacts of climate change (Burton et al 2002). The main aim of this approach was to compare the net impacts of climate change with the costs of mitigation. It required an identification and assessment of risk from a particular climate stimulus and the development of options to address the specific risk (Dessai & van der Sluijs, 2007). Burton’s (1996) typology of strategies, which remains a useful classification of adaptation options, illustrates this focus on impacts within the adaptation field:

- Share the loss – for example by purchasing insurance.
- Bear the loss – rebuild or abandon sites.
- Modify the events – for example preventing flooding by constructing levees, sea walls, stormwater drainage.
- Prevent the effects – improve the ability of structures to withstand high winds, intense heat, fire or flooding events, and implement systems of early warning and emergency management through a range of structural/technological, legislative, regulatory, financial, institutional, administrative, and market-based measures.
- Change use – convert the use of exposed sites from sensitive activities such as development to greenspace.
- Change location – relocate activities that are sensitive to climate impacts to less exposed locations.
- Research.
- Education and behavioural change

Since the turn of the century, there has, however, been a shift away from an emphasis on impacts research to understanding and developing adaptation policies and measures (Burton et al 2002). This shift has focused adaptation research on the vulnerability and adaptive capacity dimensions of adaptation (see Box 2 for definitions), and especially their social, institutional and economic determinants (e.g. Adger 1999; Adger & Kelly 1999; Adger 2000; Brooks et al 2005).

Adaptation research is increasingly incorporating insights from the field of vulnerability. Several disciplines have contributed to present understanding of vulnerability to environmental change, including natural hazards and risk research, human ecology, political economy, political ecology (Blaikie et al 1994), and entitlements theory, and are now informing the vulnerability-based adaptation research (Adger 2006; Fussel 2007). In addition, the

ecological resilience approach is receiving increasing attention within the climate change adaptation field, although Janssen et al (2006) show that the resilience and adaptation domains are still only weakly connected.

There is now a significant and growing literature with an increasing focus on the social dimensions of adaptation and concerned with definitions of, and interrelationships between, the concepts of adaptation, adaptive capacity, resilience and vulnerability of human and natural systems to climate change (Adger et al 2005; Brooks et al 2005; Lim et al 2004; Adger 2006; Fussel & Klein 2006; Gallopin 2006; Fussel 2007). This shift away from an impacts-based approach has been slower to occur at the policy level. However, the uncertainty that pervades modelling of specific climate risks, the recognition that the impacts of climate change will be a product of complex climatic, biological, social and economic interactions,

### **Box 2. Definitions of key terms within climate change adaptation research**

**Vulnerability** is defined as “the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity” (IPCC 2007a, p. 883).

**Exposure** refers to the expected changes to climatic stimuli in a given location. For example, coastal regions are more exposed to sea level rise than inland communities; and inland regions are more exposed to temperature increases than coastal communities.

**Sensitivity** is the degree to which a system may directly or indirectly be affected by climate variability or change (IPCC 2007a, p. 881). For example, the sensitivity of a large city to the impacts of a cyclone crossing over it is greater than an unpopulated region; and the sensitivity to higher temperatures of crops that require regular winter frosts is greater than tropical crops.

Together, exposure and sensitivity produce the *potential* impacts of climate change, which can be attenuated by the individual or system’s adaptive capacity.

**Adaptive capacity** refers to the ability or potential to respond successfully to climate variability and change, including adjustments in behaviour, resources and technologies (IPCC 2007a). It is comprised of a society’s or system’s financial, human, technological, infrastructural, institutional and natural capital.

and different timescales over which impacts will be experienced seem to have resulted in a recent policy preference for addressing underlying vulnerability.

While the two approaches to adaptation – impacts and vulnerability – are conceptually distinct, in practice features of both can be found in the same policies and strategies. Rarely are measures aimed solely at specific climate change risks. Instead, climate change is increasingly viewed as *an* additional stressor, albeit a powerful one, within a broader environmental, social, economic or policy context.

A purely risk-based approach that ignores underpinning causes of vulnerability or that cannot be implemented because of limited adaptive capacity is almost certainly doomed to fail. On the other hand, policies that purport to take a vulnerability approach need to understand the major risks from climatic changes, and are likely to introduce some risk-specific measures. They also need to have sufficient goal specificity to be politically palatable and be capable of monitoring and evaluation. In practice, therefore, we are likely to see a hybrid of risk-management and adaptive-capacity-building approaches.

A focus on addressing the elements of vulnerability means that adaptation must be understood as a “dynamic process relying on institutional mechanisms to enable the implementation of selected measures and the building of local capacity” (Hulme et al 2009, p. 11), rather than a specific policy goal. Goals will shift over time, as climate change impacts become more pronounced or better understood and short-term options lose their efficacy.

The Human Settlements component of SEQ-CARI adopts this hybrid approach. The project will coordinate closely with the SEQ-CARI work on sectoral adaptive capacity being carried out by the University of the Sunshine Coast and CSIRO’s climate projection work. With these inputs and the regular and close involvement of sectoral stakeholders at the local, regional and state levels, the project will identify the general risks from the impacts of climate change for the region as a whole, and

more detailed assessments of risks and opportunities for each of the five case study locations. Using a scenario-based methodology, it will then explore barriers to and facilitators of adaptation in order to identify and develop adaptation options that are relevant to the specific case study location but which can also offer guidance for similar communities elsewhere in the region and beyond.

### 3. CLIMATE PROJECTIONS AND IMPACTS FOR SOUTH EAST QUEENSLAND

#### 3.1 Regional climate projections

Australia is more vulnerable to climate change than any other industrialised nation (CSIRO 2008). We are already experiencing the impacts of a changing climate (Hennessy et al 2007). These impacts are likely to increase, given the growing national and international consensus that some additional warming of global average temperatures is already “in the system” and unavoidable, even with strenuous and immediate mitigation measures. Recent data suggest that earlier projections from the Intergovernmental Panel on Climate Change (IPCC), including those in the 2007 Fourth Assessment Report, have been conservative and that climate impacts may be more severe than predicted (e!Science News 2009; Steffen 2009).

The quality of evidence of climate change projections is rapidly evolving, but the following broad changes are likely to occur in South East Queensland over the next 100 years:

- Expected increase in high temperatures and the number of days over 35°C, with associated impacts on human health and peak energy demand (Walsh et al 2002);
- Sea level rise, associated with global warming, expected to be 1.3 mm per year and around 0.5m by 2070 (Department of Climate Change 2009a; Wang et al 2010);
- Increase of the intensity and variability of storms affecting the coastline, increasing the risk of storm surges and extreme erosion events (Department of Climate Change 2009a);
- Change in annual average precipitation, occurring in more intense events and possibly causing reduced water availability for cities, industries, agriculture and natural ecosystems (Abbs et al 2007; Department of Infrastructure and Planning 2009a, p. 9).

#### Changes in Climatic Averages

Changes in annual mean temperatures and rainfall have been forecast for SEQ as a consequence of climate change. In terms of temperature change, the region has already experienced an increase in annual average temperatures since 1950 (see Figure 1) and a rise between 0.5°C and 1.5°C is likely to happen by 2030 (BOM 2009; Suppiah et al 2007).

The region will also experience an increase in mean minimum temperatures (Hennessy et al 2007). Higher mean maximum and minimum temperatures will result in an increase in the number of days with temperatures above 35°C. These are expected to increase across SEQ, with a predicted 1-3 days by 2030 and 2-26 days by 2070 for Brisbane depending on future greenhouse gas emissions (Suppiah et al 2007).

Projections regarding future precipitation are less confident than for temperature as Australian rainfall is highly influenced by the El Niño-Southern Oscillation (ENSO) and the Interdecadal Pacific Oscillation (IPO) (Power et al, in Gallant et al 2007). Past time series data indicates that SEQ’s mean and extreme rainfall has been declining, particularly in the coastal region where a decline by almost 55mm per decade has been observed since 1950 (Gallant et al 2007).

Although rainfall projections carry significant uncertainties it is expected that there will be changes in average annual rainfall, with an increase in the frequency of dry days and a decrease in the frequency of wet days (CSIRO 2007). Hotter temperatures combined with changes in annual precipitation could lead to a decrease in soil moisture in the region, particularly in inland areas (Walsh et al 2002). This has obvious implications for SEQ’s energy use, natural systems, water availability and agriculture (Walsh et al 2002). Adaptation initiatives in urban areas, such as green spaces, cityscapes and landscaping are also likely to be affected by those changes.

#### Sea level rise

In addition to changes in temperature and precipitation, sea levels are projected to rise

over this century. From 1920 to 2000, sea levels across Australia rose by approximately 1.2 mm per year (the global average being 1.8 mm), but that rate accelerated since the 1990s (Church et al 2006). Current estimates for SEQ predict a rise by 0.2m by 2030 and 0.5m by 2070 (Wang et al 2010).

**Increase in extreme weather events**

Extreme weather events, such as intense rainfall and severe storms, already affect the SEQ region and climate change may lead to changes in the frequency and intensity of these events. For instance, coastal areas of SEQ are expected to experience an increase in the occurrence of extreme daily rainfall events (Abbs et al 2007). As SEQ is one of the most flood-prone regions in Australia, an increase in extreme rainfall events could inundate the inhabited flood plains of several catchments, such as the ones located in the Gold Coast (Abbs et al 2007). In addition, an increase in hail risk between 2 to 4 days per year is projected for the region (CSIRO 2007).

There are limitations in the use of global and

regional models to make projections related to climate change and thunderstorms and uncertainties still remain on the forecast of future patterns of east coast lows affecting the region (CSIRO 2007). However, an increase in the number and frequency of more intense cyclones and a southern shift in their tracks is likely to occur in the future (Department of Climate Change 2009a, p. 28).

The combination of mean sea level rise and increased severe storms, particularly cyclone intensity means that there will also be an increased threat posed by storm surges in SEQ (Symes et al 2009). For example, 1-in-100-year combined tide, storm surge and wave events are likely to result in storm tide levels in Moreton Bay of 2.5m (Symes et al 2009; Wang et al 2010).

Even small shifts in climate averages, such as storm intensity and wind speeds, have significant implications for existing human settlements in terms of damage to private assets and insurance payouts (Harper et al 2001). Impacts on infrastructure and the built

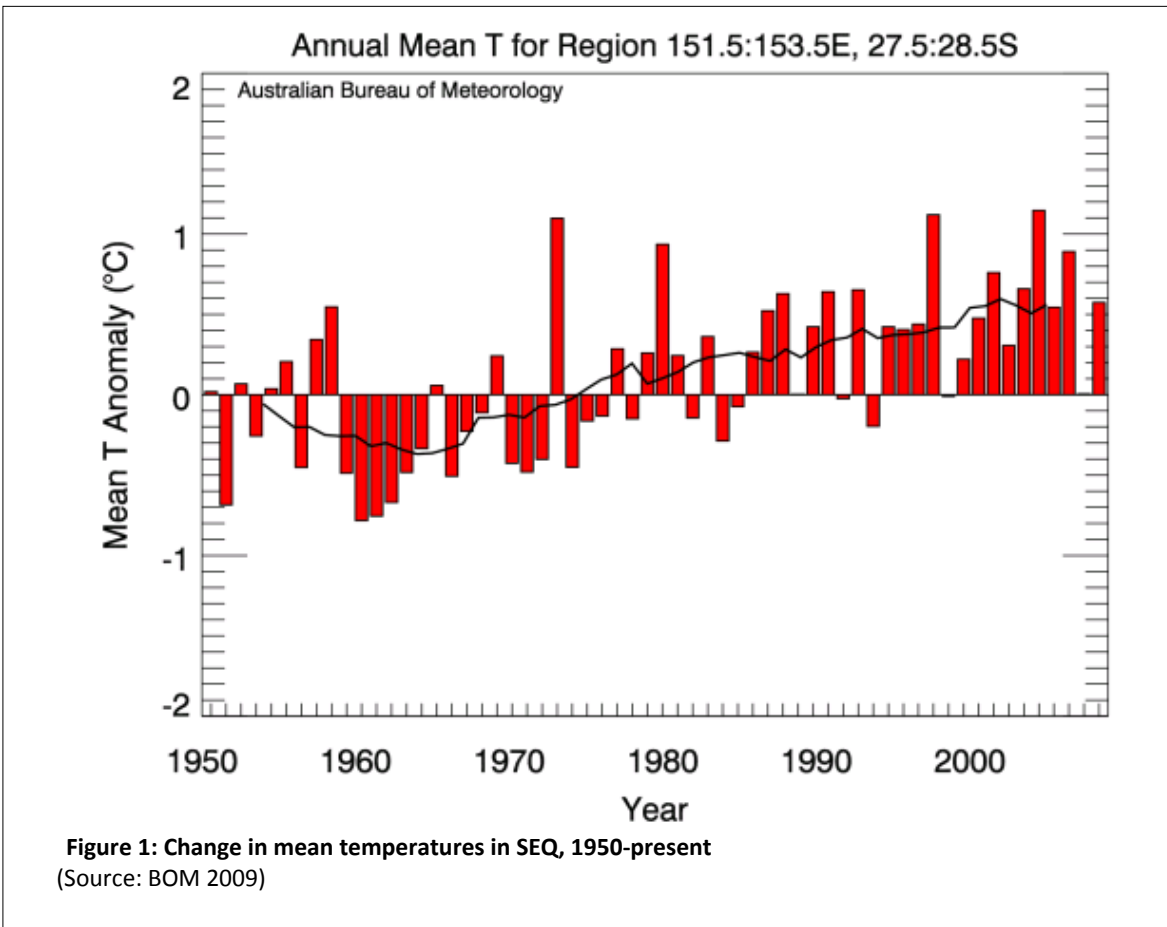


Figure 1: Change in mean temperatures in SEQ, 1950-present (Source: BOM 2009)

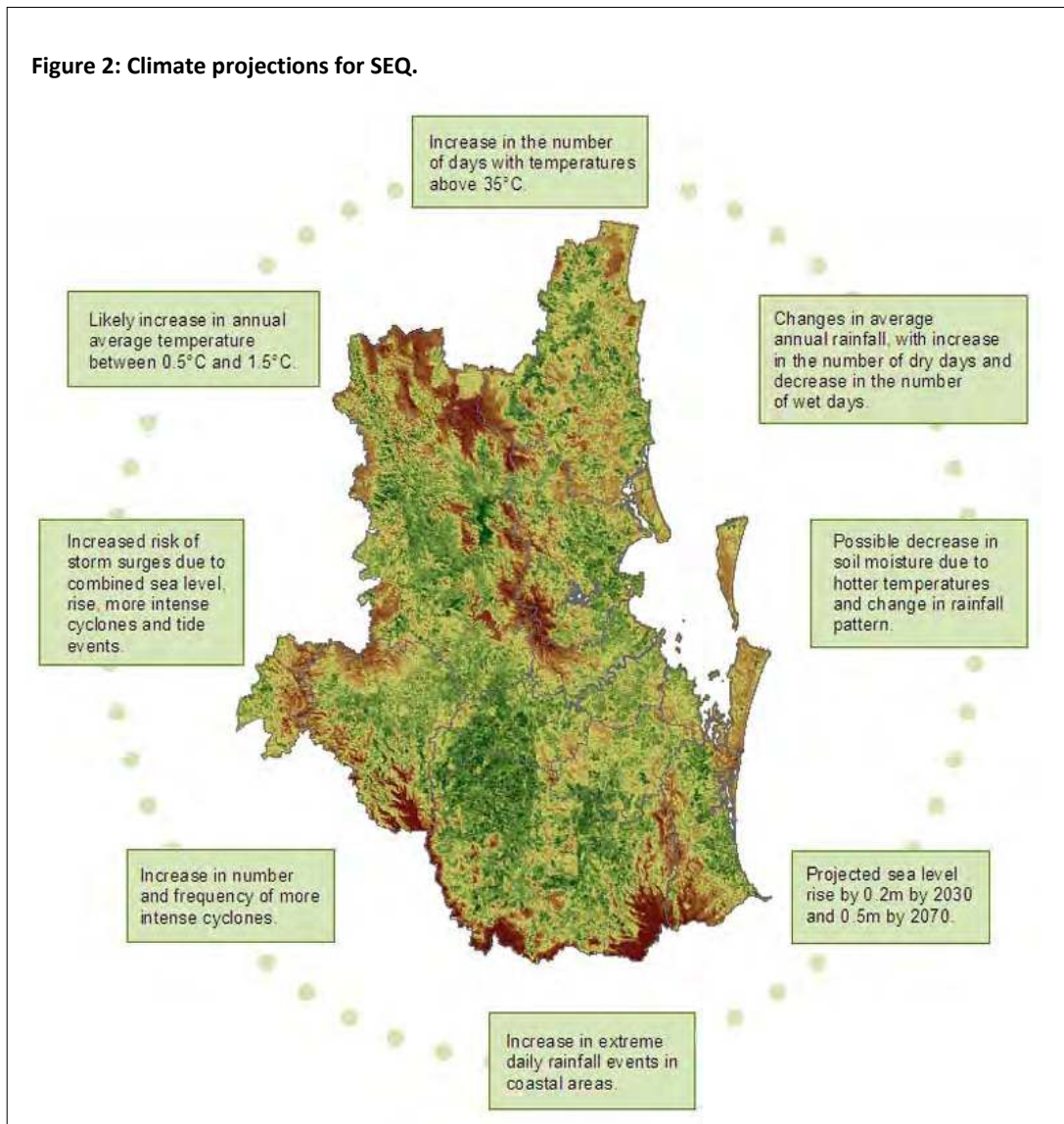
form will have significant implications for land use planning, various local government infrastructure, community services and natural assets (see Figure 2).

### 3.2 Climate change impacts and risks in SEQ

The SEQ region has long been at risk from natural hazards, such as flooding, bushfires and storm surge (Granger & Hayne 2001). Currently, the region's population is approximately 3 million and an additional 1.1 million new residents are expected by 2026 (Office of Economic and Statistical Research 2010). The forecasted regional population growth associated with its coastal location greatly increases the region's vulnerability to the impacts of climate change. This has prompted the IPCC to identify SEQ as one of

six vulnerability 'hot spots' in Australia (Hennessy et al 2007).

Population growth and associated development increases the level of damage that can be inflicted by natural hazards (Granger & Hayne 2001). The SEQ region is no exception to these trends. Urban development and planning in the region have accepted risk limits based on the expected historical return period of severe storms (including high winds and heavy precipitation), storm surges, floods, etc. Below these thresholds, severe weather events usually result in relatively light damage to property and human health. However, above these thresholds damage, injury and death can increase in a non-linear way (Allen Consulting Group 2005).



Any increase in severe weather events linked with climate change, such as heavy rainfall and storm surges could cause significant impact to SEQ human settlements. This is particularly so in older urban areas that have experienced an increase in population density and have hardened surfaces above ageing stormwater infrastructure (Allen Consulting Group 2005).

The last thirty to forty years have been relatively calm in the region in terms of extreme weather events and the current land-use planning and coastal infrastructure have followed this trend (Lazarow et al 2008; Tomlinson & Helman 2006). Future climate change is likely to alter these historical guides, therefore the location and design of future development and infrastructure will have to recognise the risks posed by a changing climate to minimise the impacts on new development (Allen Consulting Group 2005).

## 4. ADAPTATION ISSUES IN SEQ HUMAN SETTLEMENTS

The SEQ region comprises an area of 22,000 km<sup>2</sup>, with an extending coastline of 240 km from the Queensland-New South Wales border in the south to Noosa in the north, and 160 km west towards Toowoomba (Wang et al 2010). Currently encompassing 11 local authorities (see Map 1 on page 2), the region has a strong legacy of regional planning and for the last decades it has put in place frameworks for growth management (Low Choy et al 2007).

Population growth is set to continue in the region which has now also to adapt to the challenges posed by climate change (Department of Infrastructure and Planning 2009a). Effective climate adaptation options for the region will need to address sector-specific issues as well as cross sectoral responses which may be integrated to optimise the outcomes proposed by such options.

An initial scoping of current climate change projections and impacts for SEQ has identified a number of trends and issues that require attention in the decision making process governing the region (see Table 1). Such trends and issues are related to the specific sectors covered by this study: urban planning and management including coastal management, emergency management and human health.

### 4.1 Issues and trends for urban planning and management

The population of South East Queensland continues to grow, placing considerable development pressure on new parts of the region. In addition to these new pressures, SEQ, like many parts of Australia, also inherits a legacy of earlier planning decisions and land use commitments based on expected historical return periods of weather events such as floods.

The location of existing infrastructure and settlements in areas highly exposed to the projected impacts of climate change places those buildings and assets, and the people

who live or work in them, at increased risk of harm. For instance, in SEQ 75% of the 200,000 properties built pre-1960 are located within 10 km of the coast and could be subject to coastal hazards, such as sea level rise and storm surges (Wang et al 2010). The same trend of coastal location applies to commercial and services buildings as well as a significant portion of transport networks (Wang et al 2010).

At present, the principal focus of planners is on minimising exposure of new developments to future risks, but urban renewal and consolidation initiatives aimed at accommodating increasing population pressures in existing settlement areas will also have to consider increased exposure to climate-related hazards. In both contexts, planning decisions will have to consider the relationship between climate change projections and existing and future urban growth areas. Planning decisions will also need to take into account climate change scenarios to guide future strategy and policy development.

Urban planning and management therefore faces a two-tier challenge: how to incorporate climate change considerations in planning for new development in the region; and how best to manage the redevelopment and retrofit of existing settlements.

Challenges for urban planning and management in SEQ include:

- How to account for climate change impacts in local and regional statutory and non-statutory plans, and how to balance those with other non-climatic drivers of regional-scale landscape change?
- How best to strike the balance between mandatory and voluntary adaptation and engage the non-government sector in the climate adaptation decision making process?
- The need for horizontal and vertical coordination and integration between planning and other adaptation instruments within the region, and between land use and infrastructure planning (including provision and maintenance of infrastructure).

- Ensuring that adaptation strategies and planning for the urban landscape do not undermine adaptation options for adjacent natural areas or compromise the long term biodiversity conservation value of those areas.
- Identifying and overcoming legal and other barriers to climate change adaptation through statutory and non-statutory planning.
- How best to prioritise policy response to specific climate change impacts at local and regional level?

## 4.2 Issues and trends for coastal management

Climate change in SEQ's coastal zone, in terms of sea level rise, changing wave climate patterns and heavier storm surges, is likely to lead to major impacts on the community, economy and environment. 85% of the Australians live within the coastal zone and about 711,000 residences are within 3 km of the coast and less than 6 m above sea level. These figures are even more pronounced for the SEQ region, with five coastal councils (Gold Coast, Brisbane, Redland, Moreton Bay and Sunshine Coast) hosting more than 50% of the total Queensland population.

The number of coastal residents and tourists has grown to unprecedented levels in the last two decades and is projected to keep on growing in the future, with the coastal lifestyle and the "sea change" phenomenon major drivers for population growth. Coastal infrastructures, including defence structures, ports, harbours, waterways and artificial beaches, are critical assets supporting a wide array of industries (e.g. transport, fisheries, and tourism) but can be heavily affected by gradual changes in sea level and extreme events.

Planning and management strategies at state and regional level are now starting to incorporate the best projections of sea level rise, but do not account for wave climate and storm variability, for which projections for SEQ are not yet available. Planning for adaptation should commence even in a context of uncertainty about future scenarios, as failure

to address risks today may make it more costly to adapt in the future (Mummary 2008).

To minimise problems of fragmentation and poor coordination across local authorities, state or Commonwealth coordinated government guidelines are needed.

In this context, challenges for coastal management in SEQ include:

- How to incorporate climate change projections, including sea level rise and storm variability, in the current planning instruments in a way that enables those instruments to be updated when new science emerges?
- How to identify the best technical options for coastal adaptation and assess the cost and benefits of different adaptation strategies, justified for different socio-economic contexts?
- How to communicate coastal climate change issues to local communities in order to facilitate the adoption of new provisions and strategies for climate adaptation?

## 4.3 Issues and trends for emergency management

Over recent years, there has been a paradigm shift in disaster management approaches, away from a focus on response to a stronger emphasis on an all-hazards approach to prevention or mitigation of the consequences (Pitman 2006; COAG 2002). This transformation to a community safety paradigm is characterised by:

- Shared community responsibility;
- Identifying and protecting those at risk;
- Securing sustainable reductions in the source of hazard;
- Reduction in unreasonable fear of the hazard;
- Development of community based programs;
- Development of multi-agency partnerships; and
- Community level engagement and empowerment (Elsworth et al 2009).

An improvement in all phases of disaster management – prevention, preparedness,

response and recovery – will be needed to deal with the expanding and changing risks caused by climate change. Improved prevention involves strengthening coordination across government and improving land use planning and management by making disaster risk reduction a specific consideration in building codes and planning regimes. Strategies to improve preparedness for natural disasters require alignment of state, district and local disaster management plans, community awareness and understanding of events, better resourcing and use of community networks to enhance disaster management resilience, and anticipation of post disaster needs.

There currently appears to be very limited community engagement with disaster awareness and preparedness except among people who have recently experienced an event (Dyer et al 2001; Department of Infrastructure, Transport, Regional Development and Local Government 2008).

Response to an event requires a combination of operational capability and coordination across the various elements of the disaster management system, consistent application of response planning tools, a strong volunteer force and, where possible, pre-deployment of personnel and assets in anticipation of an emergency or disaster. The emergency management sector is increasingly reliant on an extensive network of volunteers, but there are limits to this resource. The volunteer sector will need to be strengthened to manage the expected increase in disasters resulting from climate impacts. Barriers to volunteer service need to be addressed by each level of government to overcome the current decline in the numbers of volunteers in the emergency management sector.

Evacuation during extreme events will be an important mechanism by which to minimise potential impacts on human health and well-being. Early evacuation is the most effective solution for the aged or infirm, but comes with risks of adverse health effects from prolonged evacuation (Kirkpatrick & Bryan, 2007). Impaired mobility will affect the ability of individuals to evacuate and emergency

planners in the SEQ region need to understand the true numbers of people with special needs and identify patients reluctant to evacuate well in advance.

Recovery refers to the regeneration of a community following a disaster. It includes minimising any exacerbation of the consequences of a disaster, regenerating the social, emotional, economic and physical wellbeing of the individuals and communities, and taking opportunities to reduce future exposure to hazards and their associated risks (Norman 2006). Community recovery requires a holistic approach that encompasses social, economic, infrastructure, and environmental considerations, preparation of a comprehensive plan for short and long term recovery needs, a proactive communication strategy, disaster relief arrangements, and sound business continuity practices (State Disaster Management Group 2005).

Challenges for the emergency management sector in SEQ in the face of climate risks include:

- Ensuring that increased climate risks are integrated into state and local disaster management plans;
- Improving and/or rethinking the governance, coordination of, and communication between the agencies involved in emergency management within the SEQ region;
- Managing or changing the community expectation that all emergency events can and will be anticipated and managed;
- The implications for SEQ of Queensland's reliance on a high level of volunteer support, in circumstances where any increase in the frequency of severe weather events will place greater demands on volunteer time (McLennan et al 2009);
- How emergency managers should deal with complexity and uncertainty over trends in how future climate change will affect the location, likelihood/frequency and severity of disasters are poorly understood; and
- Trade-offs between options, ranging from warning systems and emergency responses to improved land use planning and

enhanced building design and construction in preventing or reducing risk, to risk transfer mechanisms such as insurance.

#### 4.4 Issues and trends for human health

The impact of climate on human health is both direct (e.g. thermal stress, flood and fire injury and death) and indirect, through disease (e.g. Ross River fever), contamination (e.g., food and water supply) and environmental degradation, such as poor air quality and loss of crop land (McMichael et al 2003; Confalonieri et al 2007; Patz et al 2005). Direct health impacts tend to be dramatic but, in relative terms, restricted in time and scope. Indirect impacts are more insidious with the potential for enduring and widespread social consequences. The drama of the immediate physical damage wrought by natural disaster, portrayed in images of incinerated structures, floating towns and highways of wind destruction, tends to obscure personal and social costs. Nevertheless, the longer-term damage to households and communities should not be underestimated.

The actual health consequences of climate change are strongly influenced by the socio-economic context. The more cohesive and/or wealthy the community and the more developed the institutional and technological structure, the greater the capacity to respond to both the catastrophic and structural health challenges of climate change. The age structure of the impacted population is also important with the aged, infants and people with underlying poor health being particularly vulnerable. The health impacts of climate change also vary widely by environmental setting. Affected areas may, for example, be tropical or temperate, rural or urban, coastal or inland and so forth.

In sum the health impacts of climate change are complicated by social and environmental factors and cannot be directly correlated with the simple metrics of climate change such as variation in temperature and rainfall or, even, projections of extreme events. Climate change is expected to result in changes to existing health issues, rather than lead to the emergence of new issues. There is, therefore,

a need to concentrate on known health burdens that are likely to be exacerbated by climate change impacts, and the most effective, efficient and equitable approaches to those exacerbated risks.

Challenges for the health sector in SEQ include:

- Obtaining a clearer understanding of the extent of the future health burden and a greater focus on disease prevention in the region;
- Rethinking health planning timeframes from short term to more medium- and long-term;
- Ensuring that effective surveillance and response systems are in place to manage any increases in infectious diseases;
- Rethinking communications policies and procedures, to include behavioural, knowledge and attitudinal shifts (Frumkin and McMichael 2008);
- Developing integrated and inter-agency measures that help reduce the potential impact of events on vulnerable populations, especially as many climatic risks to health lie beyond the usual scope of the public health sector; and
- Developing measures to articulate the work of local public health responses into broader inter-state or national responses. This is especially important as the impact of extreme events may cross state boundaries or involve a broader national response.

**Table 1. Climate change impacts and associated sectoral issues for SEQ.**

Sector	Climate Change Impacts and Associated Issues			
	Higher temperatures	Variable rainfall	Extreme weather	Sea level rise
<b>Urban Planning and Management (incl. Coastal Management)</b>	<ul style="list-style-type: none"> <li>• Property damage through bushfire</li> <li>• Intensification of heat island effect</li> </ul>	<ul style="list-style-type: none"> <li>• Flood risk to consolidated urban areas</li> <li>• Inadequate water supply for urban areas</li> </ul>	<ul style="list-style-type: none"> <li>• Increased damage to private property from storms, landslides, floods, bushfires, storm surges</li> </ul>	<ul style="list-style-type: none"> <li>• Severe storms combined with rising sea levels cause severe erosion/inundation leading to property damage and reduced property values</li> </ul>
<b>Emergency Management</b>	<ul style="list-style-type: none"> <li>• Impacts on electricity and flow on effects for essential services, e.g. communications networks, ability to use high rise elevators, sewerage and other services</li> </ul>	<ul style="list-style-type: none"> <li>• Flooding of underground carparks reducing private vehicle access</li> <li>• Evacuation routes impeded</li> </ul>	<ul style="list-style-type: none"> <li>• Stranding/impacts on evacuation routes especially for elderly residents and those requiring assistance</li> <li>• Hazards from debris</li> </ul>	<ul style="list-style-type: none"> <li>• Hazards from erosion of river bank and damage to infrastructure</li> </ul>
<b>Human Health</b>	<ul style="list-style-type: none"> <li>• Mortality and morbidity during heat wave events (especially significant with an ageing population)</li> <li>• Spread of vector-borne and food-borne diseases</li> <li>• Death and injury resulting from bushfire</li> <li>• Increased stress on public health systems during heatwave events</li> </ul>	<ul style="list-style-type: none"> <li>• Spread of vector-borne diseases</li> </ul>	<ul style="list-style-type: none"> <li>• Risks to human life and health from flooding and storms</li> </ul>	<ul style="list-style-type: none"> <li>• Risks to human life and health from flooding and storm surges</li> </ul>
<b>Infrastructure</b>	<ul style="list-style-type: none"> <li>• Pressure on the energy grid during heatwave events and associated risks of supply failure and business disruption</li> <li>• Accelerated deterioration of heat-sensitive infrastructure, such as road surfaces.</li> </ul>	<ul style="list-style-type: none"> <li>• Pressure on water supply systems</li> <li>• Damage of existing infrastructure due to flooding</li> <li>• Failure of sewage and wastewater systems during intense rainfall.</li> </ul>	<ul style="list-style-type: none"> <li>• Increased damage to public infrastructure from storms, landslides, floods, bushfires, storm surges</li> <li>• Disruption to essential services such as electricity, water, sanitation</li> <li>• Business disruption in disaster-affected areas</li> </ul>	<ul style="list-style-type: none"> <li>• Severe storms combined with rising sea levels damage public coastal infrastructure</li> <li>• Rising sea levels will cause water tables to rise, with flow on effects for underground infrastructure</li> <li>• Increased exposure of concrete foundations to salt water may affect structural integrity and longevity.</li> </ul>
<b>Regional amenity</b>	<ul style="list-style-type: none"> <li>• Changes to regional biodiversity and landscape values, with associated reduction in amenity for residents and</li> </ul>	<ul style="list-style-type: none"> <li>• Impacts on ecosystem services and regional liveability</li> </ul>	<ul style="list-style-type: none"> <li>• Impacts on perceptions of region as an attractive tourist destination</li> </ul>	<ul style="list-style-type: none"> <li>• Beach erosion will limit public access to beach and beach amenity</li> <li>• Associated impacts on tourism</li> </ul>

## 5. ROLES AND RESPONSIBILITIES

This section provides an overview of the government agencies and non-governmental organisations at the national, state and local levels whose activities will influence climate change adaptation in human settlements in South East Queensland. It covers agencies involved in climate change adaptation work broadly and sector-specific (e.g. urban planning and management, coastal management, emergency management and human health).

It highlights the wide array of government and non-government agencies that will be involved in adaptation decision-making for human settlements in the SEQ region (see Figure 3 for a summary of those agencies) and thus the challenge of developing and coordinating sectoral as well as cross-sectoral adaptation measures and policies. The emergency management sector, in particular, illustrates the complexity of arrangements with several government departments as well as inter-departmental committees and groups with emergency management responsibilities operating at and across each level of government.

### 5.1. National Government Agencies

#### *General Agencies*

##### *5.1.1 The Department of Climate Change*

The Department of Climate Change was established in 2007 originally as part of the Prime Minister and Cabinet Portfolio. The Department contributes to the Government's climate change framework based on three pillars of reducing Australia's greenhouse gas emissions, adapting to the unavoidable impacts of climate change and helping to shape a global situation. It is the responsibility of the Department to administer two key national adaptation initiatives: the National Climate Change Adaptation Program and the Local Adaptation Pathways Program (LAPP) (see further details in section 6).

##### *5.1.2 COAG Working Group on Climate Change and Water*

The COAG Working Group on Climate Change and Water is comprised of officials from all Australian Governments and is chaired by the Minister for Climate Change and Water. Its Terms of Reference primarily relate to the development of a national emissions trading scheme, the implementation of a national renewable energy target and urban and rural water reform. However there is a longer-term focus on accelerating the implementation of actions under the National Adaptation Framework.

#### *Sector-specific Agencies*

Institutions likely to influence climate adaptation in the emergency management and human health sectors are covered in this section. For the urban planning and management sector such institutions are the same as ones listed in the section 5.1.

##### *5.1.3 Emergency Management agencies*

The Commonwealth does not have specific Constitutional power in respect of emergency management. Commonwealth power is derived from Australia's international treaty obligations and its budgetary authority. The primary role of the Australian Government is to support the development by the states and territories of a national emergency management capability and to provide national coordination and resources in cases of major national disasters. Several agencies operate at the national level to coordinate Australia's emergency management assistance, oversee the different arrangements and provide advice on emergency management issues.

#### **Emergency Management Australia (EMA)**

Australian Government assistance to states and territories is coordinated by Emergency Management Australia, within the Attorney-General's department. EMA has adopted the comprehensive, all-hazards, all-agencies approach to emergency management.

Figure 3. Overview of government and non-governmental agencies linked to climate change adaptation in the SEQ context.

NATIONAL - General Agencies	STATE - General Agencies	LOCAL	NON-GOVERNMENTAL SECTOR	RESEARCH AGENCIES
<ul style="list-style-type: none"> <li>Department of Climate Change (DCC)</li> </ul>	<ul style="list-style-type: none"> <li>Premier's Council on Climate Change</li> </ul>	<ul style="list-style-type: none"> <li>Local Government Association of Queensland (LGAQ)                             <ul style="list-style-type: none"> <li>Queensland Disaster Management Alliance</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Urban Development Institute of Australia (UDIA)</li> </ul>	<ul style="list-style-type: none"> <li>Australian Bureau of Meteorology (BOM)</li> </ul>
<ul style="list-style-type: none"> <li>COAG Working Group on Climate Change and Water</li> </ul>	<ul style="list-style-type: none"> <li>Department of Environment and Resource Management (DERM)                             <ul style="list-style-type: none"> <li>Office of Climate Change (OCC)</li> </ul> </li> <li>Queensland Climate Change Centre of Excellence (QCCCE)</li> </ul>	<ul style="list-style-type: none"> <li>Council of Mayors (SEQ)</li> </ul>	<ul style="list-style-type: none"> <li>Planning Institute of Australia (PIA)</li> </ul>	<ul style="list-style-type: none"> <li>Geoscience Australia</li> </ul>
<b>NATIONAL - Sectoral Agencies</b> <ul style="list-style-type: none"> <li>Emergency Management agencies                             <ul style="list-style-type: none"> <li>Emergency Management Australia (EMA)</li> <li>Ministerial Council for Police and Emergency Management</li> <li>Australian Emergency Management Committee (AEMC)</li> </ul> </li> <li>Australian Government Disaster Recovery Committee (AGDRC)</li> <li>Australian Government Department of Defence</li> <li>National Flood Risk Advisory Group (NFRAG)</li> <li>National Spatial and Information Management Working Group</li> <li>Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA)</li> </ul>	<ul style="list-style-type: none"> <li>Department of Primary Industries and Fisheries (DPI&amp;F)</li> <li>Department of Transport and Main Roads (DTMR)</li> </ul>	<ul style="list-style-type: none"> <li>Queensland Coastal Councils Group</li> </ul>	<ul style="list-style-type: none"> <li>Australian Institute of Landscape Architects (AILA)</li> </ul>	<ul style="list-style-type: none"> <li>CSIRO - Climate Change Adaptation Flagship</li> </ul>
<ul style="list-style-type: none"> <li>Human Health agencies                             <ul style="list-style-type: none"> <li>Commonwealth Department of Health and Ageing</li> <li>The Australian Health Protection Committee</li> <li>National Incident Room</li> </ul> </li> </ul>	<b>STATE - Sectoral Agencies</b> <ul style="list-style-type: none"> <li>Urban Planning and Management agencies</li> <li>Department of Infrastructure and Planning (DIP)</li> </ul>		<ul style="list-style-type: none"> <li>State Disaster Welfare Committee                             <ul style="list-style-type: none"> <li>St Vincent de Paul Society</li> <li>Red Cross</li> <li>Salvation Army</li> <li>Adventist Development and Relief agency</li> <li>Anglicare and Lifeline</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>National Climate Change Adaptation Research Facility (NCCARF)</li> </ul>
	<ul style="list-style-type: none"> <li>Emergency Management agencies                             <ul style="list-style-type: none"> <li>Department of Community Safety (DCS)</li> <li>Emergency Management Queensland (EMQ)</li> <li>Department of Communities, Community Services</li> <li>Department of Environment and Resource Management (DERM)</li> </ul> </li> </ul>		<ul style="list-style-type: none"> <li>State Emergency Service and other emergency volunteer organisations                             <ul style="list-style-type: none"> <li>Rural Fire Service</li> <li>Emergency Services Cadets</li> <li>Queensland Ambulance Service</li> <li>Volunteer Marine Rescue Association</li> <li>Surf Life Saving Queensland</li> <li>Australian Volunteer Coast Guard</li> <li>Royal Life Saving Society.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>National Health and Medical Research Council (NHMRC)</li> </ul>
	<ul style="list-style-type: none"> <li>Human Health agencies                             <ul style="list-style-type: none"> <li>Department of Health</li> <li>Queensland Emergency Medical System Advisory Committee (QEMSAC)</li> </ul> </li> </ul>		<ul style="list-style-type: none"> <li>International Council for Local Environmental Initiatives (ICLEI)</li> </ul>	<ul style="list-style-type: none"> <li>Universities                             <ul style="list-style-type: none"> <li>University of Sunshine Coast</li> <li>University of Queensland</li> <li>Griffith University</li> </ul> </li> </ul>
			<ul style="list-style-type: none"> <li>Australian Medical Association (AMA)</li> </ul>	
			<ul style="list-style-type: none"> <li>The Australian Red Cross</li> </ul>	

Assistance takes the form of (Department of Infrastructure, Transport, Regional Development and Local Government 2008; Productivity Commission 2009):

- Material and technical assistance in the event of large scale emergencies;
- Financial assistance to states, territories and authorities for natural disaster prevention/mitigation through the Natural Disaster Relief and Recovery Arrangements;
- Information, best practice materials and training programmes;
- Funding for risk management programmes and comprehensive risk assessment; and
- Community awareness activities (through EMA, the Australian Bureau of Meteorology and Geoscience Australia).

**Ministerial Council for Police and Emergency Management**

The Ministerial Council for Police and Emergency Management (MCPEM) oversees national emergency management arrangements and implementation of the Natural Disaster Reform Package. Chaired by the Commonwealth Attorney-General, it consists of Ministers responsible for emergency management from the Commonwealth, and each of the States and Territories, and New Zealand, and the president of the Australian Local Government Association (ALGA) (Commonwealth-State Relations Secretariat 2009).

The *Model Arrangements for Leadership during Emergencies of National Consequence* are designed to guide national efforts in coordinating the response to, and recovery from, emergencies of national consequence and serve as a guide for the MCPEM in developing Australia’s governance arrangements for catastrophic natural disasters (Commonwealth of Australia 2009).

**Australian Emergency Management Committee (AEMC)**

The AEMC provides advice and direction on national, strategic emergency management issues and reports to the Ministerial Council for Police and Emergency Management. It is comprised of the Secretary of the

Commonwealth Attorney-General’s Department, officials responsible for emergency management in each of the States and territories, the chief executive officer of the ALGA and an official from the Commonwealth Department of Infrastructure, Transport, Regional Development and Local Government responsible for Natural Disaster Relief Arrangements (Commonwealth - State Relations Secretariat 2009).

At present, the impact of climate change on emergency management is not a specific standing item on the AEMC agenda, but there is strong support for that to happen (Insurance Council of Australia 2008). The AEMC has identified four pillars for future work for emergency management in Australia: 1) Resilience; 2) National Catastrophic Disaster Plan; 3) Volunteering; and 4) Climate change (EMA 2009b).

**Australian Government Disaster Recovery Committee (AGDRC)**

The Disaster Recovery Committee comprises 27 agencies and is chaired by the Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA). The Committee coordinates the delivery of tailored disaster recovery assistance for individuals, families and communities in order to provide whole-of-government social and community recovery packages (Australian Bureau of Statistics 2008). It works with states and territories through the Community and Disability Services Ministers’ Advisory Council (CDSMAC) Disaster Recovery Sub-committee.

The Not-for-Profit Advisory Group, a sub-committee of the AGDRC, consists of key community service, volunteer and relief organisations (e.g. Australian Red Cross, the Salvation Army and St John’s Ambulance), and facilitates consultation between the Australian Government and community-based and non-government organisations on the issues of disaster preparedness and recovery.

**Australian Government Department of Defence**

The Department of Defence is becoming an increasingly important player in responding to natural disasters, following its high profile role

for defence forces following Cyclone Larry and the Victorian bushfires. The role of the defence forces in cases of natural disaster is governed by the Defence Assistance to the Civil Community (DACC) Policy and Procedures 2004.

These procedures operate on the principle that the state or territory has primary responsibility for combating disasters and civil emergencies, and that defence resources are made available in situations that are beyond the resources, skills and timeframes of state agencies (Pitman 2006). The guidelines cover counter-disaster emergency assistance across three levels of emergency, and indemnity and insurance issues for personnel acting under the guidelines.

#### **National Flood Risk Advisory Group (NFRAG)**

The National Flood Risk Advisory Group consists of representatives from Australian and state and territory government agencies, the Australian Local Government Association, insurance industry and research. NFRAG provides expert advice and a national focus for flood management by (Geoscience Australia 2010):

- Identifying and promoting nationally-consistent best practice flood risk management;
- Advising on nationally-consistent flood risk management policy;
- Providing specialist, expert advice on the implementation of COAG's review recommendations and reform commitments associated with flood risk management;
- Promoting community safety with respect to flooding and flood risk in support of the National Community Safety Strategy Group;
- Identifying and prioritising research needs for improving the quality of flood risk management; and
- Facilitating and improving communication between flood emergency managers, flood risk managers and land use managers.

#### **National Spatial and Information Management Working Group**

This Group was formed in 2007 from the

amalgamation of the National Information Management Advisory Group and the National Spatial Information for National Security Working Group. It was set up to enhance decision support capabilities through access to, and use of, relevant information, including spatial information. Its activities aim to support critical infrastructure protection and counter-terrorism as well as emergency management within and between the national, state and territory governments and local governments (NSIM 2008; Geoscience Australia 2010).

#### **Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA)**

The Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA) is the lead Australian Government agency for disaster recovery. It developed the Australian Government Disaster Recovery Arrangements, which provide for the coordination of the Australian Government's assistance for disaster recovery (FaHCSIA 2009).

In addition, FaHCSIA supports a whole-of-government and whole-of-community approach to increasing the resilience of communities to disasters. FaHCSIA plays a role in helping communities prepare for, cope with and recover from the impacts of disasters through prevention, preparedness, response and recovery activities. Such activities include strategies, tools and training to help prepare communities for disasters, and programmes that encourage and develop community resources and networks that can be used when disasters occur (FaHCSIA 2009).

#### *5.1.4 Human Health agencies*

##### **Commonwealth Department of Health and Ageing**

The Commonwealth Department of Health and Ageing leads the national government's work on health care. The department has support programs in a range of areas that may be affected by climate change related issues, including chronic disease, rural health, aged care and palliative care, Aboriginal and Torres Strait Islander Health and mental health, and environmental health.

Responsibility for providing advice on environmental health issues lies with the Office of Health Protection. The Office of Health Protection collaborates with other Commonwealth bodies, particularly the Department of Environment and Water Resources, DCC, the National Environmental Protection Council and the National Health and Medical Research Council. It provides advice on human health issues related to water quality, air quality, National Environmental Protection Measures, climate change and other environmental risks.

#### **The Australian Health Protection Committee**

In June 2006, the Australian Health Ministers' Advisory Council (AHMAC) established the Australian Health Protection Committee (AHPC) to provide a nationally coordinated approach to health disaster management. The AHPC provides advice to AHMAC on Australia's preparedness for health emergencies and approaches and coordinates the national health response to significant incidents.

#### **National Incident Room**

The National Incident Room was established to ensure a nationally consistent and coordinated response to a national health emergency. Emergencies that would lead to the activation of the National Incident Room may include:

- Significant outbreaks of communicable disease, e.g. an influenza pandemic
- Chemical, biological or radiological incidents
- Mass casualty incidents, e.g. an earthquake
- Any emergency where there are a significant number of people needing medical treatment which requires a coordinated national approach (i.e. extreme weather event)
- Any emergency where a contingent of Australian medical personnel is required for deployment.

## **5.2 State Government Agencies**

### **General Agencies**

#### **5.2.1 Premier's Council on Climate Change**

Established in 2008, the Premier's Council on Climate Change comprises fourteen individuals drawn from a range of relevant areas of expertise including industry, environment, academic and community sectors from across Queensland and Australia. The Council is intended to ensure that the State's climate change mitigation and adaptation efforts are informed by the best available local and national knowledge and experience.

#### **5.2.2 Department of Environment and Resource Management (DERM)**

The Department of Environment and Resource Management (DERM) has responsibility for natural resource management, including water, land, cultural heritage, regional and property vegetation plans and coastal management.

#### **Office of Climate Change**

The Office of Climate Change (OCC) was established in 2007 as an agency within DERM, to lead the development of climate change policy and programs. OCC has produced several new policies that explicitly address climate change, including the *Climate Change Strategy 2007* (under review), *Climate Smart 2050*, *ClimateSmart Adaptation 2007-2012* and *ClimateQ* (OCC 2009a). OCC administers the Climate Change Fund and supports the Premier's Council on Climate Change. It also works across government to drive and coordinate climate change action.

#### **Queensland Climate Change Centre of Excellence**

The OCC hosts the Queensland Climate Change Centre of Excellence (QCCCE). The QCCCE was formed in 2006 by bringing together climate expertise from across government in order to provide decision-makers throughout the State with information and scientific data on the impacts of climate

change. QCCCE's work focuses on four core areas: climate system research; impacts, adaptation and mitigation; information and knowledge systems; and, special projects (OCC 2009b).

The Centre collaborates with Australian and international research agencies, industry and all levels of government to ensure that data is relevant to the development of a strategic response to climate change risks. Key projects include the development of Regional Climate Change Summaries covering historical data and regional projections for rainfall, temperature, sea level rise and evaporation to inform the Queensland Climate Change Strategy and provide data to regional planners, local government, businesses and community groups.

### **5.2.3 Department of Primary Industries and Fisheries (DPI&F)**

The Department of Primary Industries and Fisheries (DPI&F) is part of the Department of Employment, Economic Development and Innovation. As part of its portfolio of work DPI&F supports primary industries and fisheries with research, extension and promotion activities, and develops regulation and policies to protect and conserve Queensland's resources (DPI&F 2009).

The department is involved in emergency and disaster assistance, as it offers advice and assistance (including financial assistance) to primary producers affected by disasters (DPI&F 2009).

### **5.2.4 Department of Transport and Main Roads (DTMR)**

The Department of Transport and Main Roads (DTMR) is responsible for the functionality of Queensland's transport infrastructure, both private and public. Infrastructure provision includes minor and major roads and rail service and infrastructure.

The department also provides policy advice in infrastructure planning regarding ports, land tenure, and aviation among others. Maritime Safety Queensland is attached to the department, and its role is to overlook

safety issues in waterways, ports and other maritime areas. New projects and upgrading of infrastructure take place according to the *South East Queensland Infrastructure Plan and Program 2008-2026* (DTMR 2010).

## **Sector-specific Agencies**

### **5.2.5 Urban planning and management**

#### **Department of Infrastructure and Planning (DIP)**

The Department of Infrastructure and Planning (DIP) is responsible for planning and growth, infrastructure and projects, plumbing and building, and local government. DIP has prepared the *SEQ Regional Plan* and the *Draft SEQ Climate Change Management Plan*. It is also responsible for infrastructure planning that may be affected by climate change, such as the ones planned under the *South East Queensland Infrastructure Plan and Program 2008-2026* (SEQIPP) and *Southern Moreton Bay Marine Infrastructure Master Plan*.

### **5.2.6 Emergency Management**

Emergency management in Queensland is the responsibility of several government departments, with differing levels of responsibility with regards to the disaster management phases of prevention, preparedness, response and recovery. In addition, Queensland has developed its own formal disaster management system to ensure effective coordination of resources and capabilities at all levels of government (see Box 3).

#### **Department of Community Safety (DCS)**

The Department of Community Safety was created in March 2009 and is under the responsibility of the Minister for Police, Corrective Services and Emergency Services. It includes Emergency Management Queensland, the Queensland Ambulance Service, and the Queensland Fire and Rescue Service.

#### **Emergency Management Queensland**

Emergency Management Queensland (EMQ) coordinates the State's emergency and disaster management arrangements and

disaster mitigation programmes. While it does not specifically address climate change adaptation, it does focus on community preparedness and response to natural disasters including floods, severe storms, and cyclones (State Disaster Management Group 2006).

#### **Department of Communities, Community Services**

The Department of Communities is the lead agency for the coordination of community recovery support and assistance. It provides short-, medium- and long-term recovery support through its community engagement and development services, and financial assistance offered through the Emergent Assistance, Essential Households Content and Structural Assistance grants (Department of Communities 2009a).

The Department's 2009-2013 Strategic Plan includes a strategy of leading "the implementation of the *TowardsQ2* target delivery plan to increase the proportion of Queenslanders volunteering in their community" and a key performance indicator of monitoring and reporting progress on "the effectiveness of community recovery responses following disasters", both of which are important for the recovery phase of disaster management (Department of Communities 2009b).

#### **Department of Environment and Resource Management (DERM)**

The Department of Environment and Resource Management is involved in flood risk and stormwater management activities, including developing policy, providing technical support for flood mitigation subsidy programmes and helping administer the State Planning Policy 1.03 on mitigating the adverse impacts of flood, bushfire and landslide (DERM 2009c).

#### **5.2.7 Human Health**

##### **Department of Health**

The Queensland Department of Health (QH) is the state agency responsible for health policy and plans. Through the Population Health Unit within the Division of the Chief Health Officer, QH provides strategic health advice and

programs in the area of environmental health and provides a critical role in managing high profile environmental health issues.

Queensland Health also has a role in preparing local communities to respond to emergency situations likely to impact on health, such as flood recovery programs and heat wave programs, and work with other agencies to assess and respond effectively to population health risks associated with climate change.

#### **Queensland Emergency Medical System Advisory Committee (QEMSAC)**

The Queensland Emergency Medical System Advisory Committee (QEMSAC) is an interdepartmental committee chaired by General Manager Health services as the State Medical Controller. The Committee provides advice to relevant Directors-General and ministers on emergency medical system matters as part of major event and disaster planning.

### **5.3 Local Government**

In March 2008, the eighteen local authorities in SEQ were amalgamated into eleven city and regional councils as part of a state-wide rationalisation of local government. The eleven local authorities that form SEQ are:

- Brisbane City Council
- Gold Coast City Council
- Ipswich City Council
- Lockyer Valley Regional Council
- Logan City Council
- Moreton Bay Regional Council
- Redland City Council
- Scenic Rim Regional Council
- Somerset Regional Council
- Sunshine Coast Regional Council
- Toowoomba Regional Council (part)

The region's eleventh local authority, Toowoomba Regional Council includes a number of former local authorities that were never previously part of SEQ.

#### **5.3.1 Local Government Association of Queensland**

The Local Government Association of Queensland (LGAQ) is the peak body representing local government in Queensland.

### **Box 3. Queensland's Disaster Management System**

The Queensland Disaster Management System is a multi-tiered system of committees and coordination centres, created with the aim of ensuring a coordinated and effective capacity to help prevent, prepare for, respond to and recover from disasters in Queensland. Each of these levels has a committee structure supported by a disaster coordination centre, which manages and coordinates support for communities affected by disasters.

At the community level, local governments have primary responsibility for the management of a disaster. However, if they do not have sufficient resources to manage the disaster, they can request support from their Disaster District Coordinator. If the Disaster District's resources are inadequate, assistance will be obtained from the State. Finally, if State resources are insufficient, support can be obtained from the Australian Government via EMA.

The following key groups are involved in the response process at the different levels:

**Local Government**     *Local Disaster Management Group* - chaired by the Mayor; manages the response to a disaster at the local level; develops and maintains Local Disaster Management Plans.

*Local Government Disaster Coordination Centre* - supports disaster management group coordinate all information, resources and services required for disaster operations.

**Disaster District**     *District Disaster Management Group* - composed of representatives from regionally-based Queensland government departments who are able to provide and coordinate whole-of-government support to communities; districts are based on police districts and chaired by the senior police officer in that district, who is designated as the Disaster District Coordinator; provides coordinated state government support when requested by local governments.

*District Disaster Coordination Centre* - supports disaster management group coordinate all information, resources and services required for disaster operations.

**State Government**     *Major Incidents Group* - established on incident by incident basis; provides high level Ministerial guidance and support in the event of a significant incident with major community consequences; membership of the group may include the Premier, Treasurer, Attorney-General, and the Ministers for Police, Emergency Services and Health.

*State Disaster Management Group* - principal organisation for disaster management throughout the state; developed the Disaster Management Strategic Policy Framework (2005); responsible for disaster mitigation and disaster planning and preparation at state level, and for coordinating whole-of-government response and recovery operations; ability to access inter-state and/or Commonwealth assistance when required.

*State Disaster Coordination Group* - working body of the State Disaster Management Group at state level; membership consists of designated liaison officers from each of the Departments represented on the State Disaster Management Group; primary mechanism through which coordinated whole-of-government state level support is provided to communities.

*State Disaster Coordination Centre* - supports disaster management group coordinate all information, resources and services required for disaster operations.

**Australian**     *Emergency Management Australia*

**Government**     *National Emergency Management Coordination Centre – part of EMA*

Through its Environment and Planning section, LGAQ advocates a leadership role for local government in understanding and addressing the impacts of climate change, and working with government, industry and the community to implement effective strategies for both mitigation and adaptation (Local Government Association of Queensland 2009).

#### **Queensland Disaster Management Alliance**

The Queensland Disaster Management Alliance is a partnership between the Local Government Association of Queensland (LGAQ) and the Department of Community Safety. This Alliance has been driven by the recognition that local governments play a critical role in planning for and managing disasters that impact on their communities. The aim of the Alliance is to “ensure that changes to disaster management are implemented in an effective and efficient way that will result in improved community safety and increased community resilience” (State Disaster Management Group 2004).

The Alliance provides the Department of Community Safety and local governments with a framework for collaboration and coordination to achieve disaster management reform. The Alliance is focused on enhancing local governments’ capacity to undertake local risk assessments and disaster risk reduction and mitigation activities, conduct comprehensive emergency and disaster management planning and programming, develop and provide effective response, relief and recovery arrangements, and participate in post emergency and disaster assessment and analysis. In addition, the Alliance supports emergency service volunteers and ensures they have the resources, training, protection and support required for effective local emergency and disaster response (State Disaster Management Group 2004).

#### **5.3.2 Council of Mayors (SEQ)**

The Council of Mayors (SEQ) was established in 2005 as an independent political advocacy organisation comprised of local governments in SEQ and aims to influence Commonwealth and State policy and funding priorities. While the primary focus of the Council of Mayors is

currently on infrastructure, traffic congestion and public transport, one of the four goals is to promote sustainability, including the development of a regional vision and support for councils to adapt to climate change (Council of Mayors (SEQ) 2008).

The Council is involved in climate change adaptation through its participation and representation on the State Government’s SEQ Climate Change Management Strategy Steering Committee and the consultation group reviewing the Queensland Government’s *ClimateSmart 2050 Strategy*.

#### **5.3.3 Queensland Coastal Councils Group**

The Queensland Coastal Councils Group is being initiated through the Queensland Coastal Forum to provide a united voice on local government matters regarding integrated coastal management in Queensland. The group has emerged based on the need for sharing coastal management information among government officials within local governments and raising the discussion of the similar issues that they face. The role of this group will become significant as climate change adaptation strategies and measures will be implemented and planned for coastal infrastructure and environment.

The Group works to produce clear policy and guidelines in coastal management that the LGAQ can further use in the negotiations with the regional and state governments (Hunt & Stuart 2009). The Queensland Coastal Forum functions also as a discussion arena for adaptation strategies and matters as well as cross-sectoral measures specific to climate change .

#### **5.4 Industry bodies and non-government organisations**

There is a wide range of non-governmental organisations and industry bodies whose members and activities will be affected by a changing climate. The following groups are a small sub-set of those organisations likely to be strongly involved in adaptation efforts. The broader list will be identified as part of the stakeholder identification process to be

undertaken as part of the human settlements research (see Appendix 2).

#### *5.4.1 Urban Development Institute of Australia*

The Urban Development Institute of Australia (UDIA) is the peak representative body for the urban development industry. Climate change is identified as one of UDIA's current policy priorities (Urban Development Institute of Australia 2009).

#### *5.4.2 Planning Institute of Australia*

The Planning Institute of Australia (PIA) supports actions, such as the inclusion of climate change in long-term strategic planning, implementing Climate Risk Management Programmes, adaptation action at all levels and the use of strategies to reduce community vulnerability. PIA incorporates the impact of climate change in the development of all PIA's policies and has developed position statements on many related planning issues (PIA 2007). The PIA (QLD) is developing a four-stage project to develop planning tools to prepare communities and industries for the likely impacts associated with climate change.

#### *5.4.3 Australian Institute of Landscape Architects*

The Australian Institute of Landscape Architects (AILA) hosts the Climate Change Adaptation Skills for Professionals Program which aims to "integrate understanding of the implications of climate change into education and training for professionals involved in developing planned adaptive responses to the impacts of climate change" (AILA 2009). As part of this initiative, AILA has developed National Landscape Principles to increase the expertise of landscape architects in developing adaptive responses to climate change impacts and strategically direct landscape interventions towards more sustainable outcomes. AILA is compiling a library of case studies to assist in understanding the implementation of these principles.

#### *5.4.4 State Disaster Welfare Committee*

The Queensland State Disaster Welfare action is coordinated by State government but relies on a planned approach from voluntary

agencies. These agencies each have a specific role during disasters and are coordinated by the Department of Community Safety. Voluntary agencies that are involved during disasters include the St Vincent de Paul Society, Red Cross, Salvation Army, Adventist Development and Relief agency, Anglicare and Lifeline.

#### *5.4.5 State Emergency Service and other emergency volunteer organisations*

The SES was established under the *State Counter Disaster Organisation Act 1975* as the primary community-based volunteer organisation to provide a dedicated response capability in support of statutory emergency services. The SES is an integral part of the state disaster management system. SES units and groups are set up by local governments to provide assistance to disaster stricken communities, perform search and rescue operations in an emergency situation, and to provide education programmes to communities to help them prepare for, respond to and recover from disasters (Department of Community Safety 2009).

Volunteer organisations involved in these activities include: Rural Fire Service, Emergency Services Cadets, Queensland Ambulance Service, Volunteer Marine Rescue Association, Surf Life Saving Queensland, Australian Volunteer Coast Guard, and Royal Life Saving Society. The contribution of the different volunteer and non-governmental organisations is coordinated within the Disaster Management Framework, discussed in section 6.

#### *5.4.6 International Council for Local Environmental Initiatives ICLEI*

The International Council for Local Environmental Initiatives (ICLEI) is an international organisation originating directly from "Agenda 21" of the 1992 Rio Earth Summit. It has the responsibility of assisting local governments across the world to address initiatives under Chapter 28 of "Agenda 21" – specifically Local Agenda 21 sustainability initiatives. It provides technical consulting, training and information services to build

capacity, share knowledge and support local governments in the implementation of sustainable development at a local level.

ICLEI runs the Cities for Climate Protection (CCP) campaign, with the involvement of over 700 local governments worldwide (including pre-amalgamated SEQ local authorities of Brisbane City Council, Gold Coast City Council, Logan City Council, Redlands Shire, Caboolture Shire and Maroochy Shire). This initiative assists cities to adopt policies and implement mitigation measures to reduce local greenhouse gas (GHG) emissions, improve urban air quality and enhance liveability and sustainability.

Adaptation was added to the ICLEI strategic plan in 2006. Part of this strategy included the formation of the ICLEI Oceania Adaptive and Resilient Communities (ARC) Program (of which Brisbane City Council and Gold Coast City Council are members). It is a capacity-building program on planning for the impacts of climate change at council and community level. Under this program, ICLEI Oceania has also developed the Local Government Climate Change Adaptation Toolkit which is intended to build council's capacity to make decisions using climate projections and impact models and use adaptive management and has been tested by five Australian councils.

#### *5.4.7 Australian Medical Association (AMA)*

Although the AMA does not have direct responsibility for adaptation responses and policies it does provide advice through position statements and submissions. In 2008 the AMA released its revised climate change and human health position statement which established the association's shared goals in relation to climate change mitigation and adaptation.

#### *5.4.8 The Australian Red Cross*

The Australian Red Cross provides community-level services to enhance disaster prevention, preparedness, response and recovery. The availability of the 'Telecross REDi service'—a free telephone support service—has been an important tool used during natural disasters and emergencies (i.e. the South Australia heat

wave in 2010) to monitor aged people in their homes.

## **5.5 Research Agencies**

### *5.5.1 Australian Bureau of Meteorology (BOM)*

The Bureau of Meteorology (BOM) provides information about national weather, climate and water related issues. It also has an important role in supplying regular climate forecasts as well as early warning systems to assist Australians to deal with natural disasters. In addition, the Bureau contributes to research outcomes in the area of meteorology, hydrology and oceanography. For instance, the Bureau is a co-partner with CSIRO of the Centre for Australian Weather and Climate Research (CAWCR) which leads Australia's climate modelling and projections work. It provides information about climate projections to many local and state government agencies in the region.

### *5.5.2 Geoscience Australia*

Geoscience Australia is the national provider of geoscientific information and knowledge in respect of natural resource exploitation, environmental management, and the safety of critical infrastructure. A number of projects involve geospatial vulnerability analysis of climate change impacts, including coastal digital elevation modelling.

### *5.5.3 CSIRO Climate Adaptation Flagship*

CSIRO's Climate Adaptation National Research Flagship is focused on developing adaptation responses to counter the expected damaging effects of climate change. It will analyse future climate changes in Australia, deliver strategies to manage their impact, and develop new ways to combat and even benefit from these challenges. The Climate Adaptation Flagship encompasses both climate variability and climate change, continuing research on adapting to existing climate variability through advanced technologies such as seasonal climate prediction. However, given that climate change may cause natural or managed system thresholds to be crossed, and climate change will increase climate variability,

adaptation to climate change is the main focus of this Flagship.

#### *5.5.4 National Climate Change Adaptation Research Facility (NCCARF)*

Hosted at Griffith University, NCCARF was established in 2008 to lead and coordinate adaptation research across Australia, with a key role to synthesise knowledge, coordinate research activities, broker research partnerships and provide information for decision makers on climate change adaptation priorities.

#### *5.5.5 National Health and Medical Research Council (NHMRC)*

The National Health and Medical Research Council (NHMRC) is Australia's peak body for supporting health and medical research in Australia, developing health advice for the Australian community, health professionals and governments and providing advice on ethical behaviour in health care and in the conduct of health and medical research. It provides funding for research that links health issues and climate change and in recent years has made climate change adaptation an important priority area.

#### *5.5.6 Universities*

Several universities are working on climate change adaptation issues from different perspectives. The institutions involved in this project are Griffith University, Sunshine Coast University and the University of Queensland. Sunshine Coast University is focussing on the adaptive capacity of sectors and groups in South East Queensland, while the University of Queensland project is addressing the adaptation needs of biodiversity in the region.

One of the research projects currently undertaken by the University of Sunshine Coast will provide information related to the adaptive capacity of stakeholders in SEQ. This project will examine how socio-economic trends interact with possible climate change impacts forecast to affect the region.

The University of Queensland leads research into the impacts of climate change upon the region's ecosystems and biodiversity, particularly in rainforests, mangrove and salt

marshes. It will also develop conservation plans in order to deal with the risks and uncertainties posed by climate change upon the region's biodiversity and ecosystem services.

Griffith University hosts a number of research facilities that provides leading research in important areas linked to climate change adaptation. These include urban studies (Urban Research Program), coastal management (Griffith Centre for Coastal Management) and environmental management (Environmental Futures Centre).