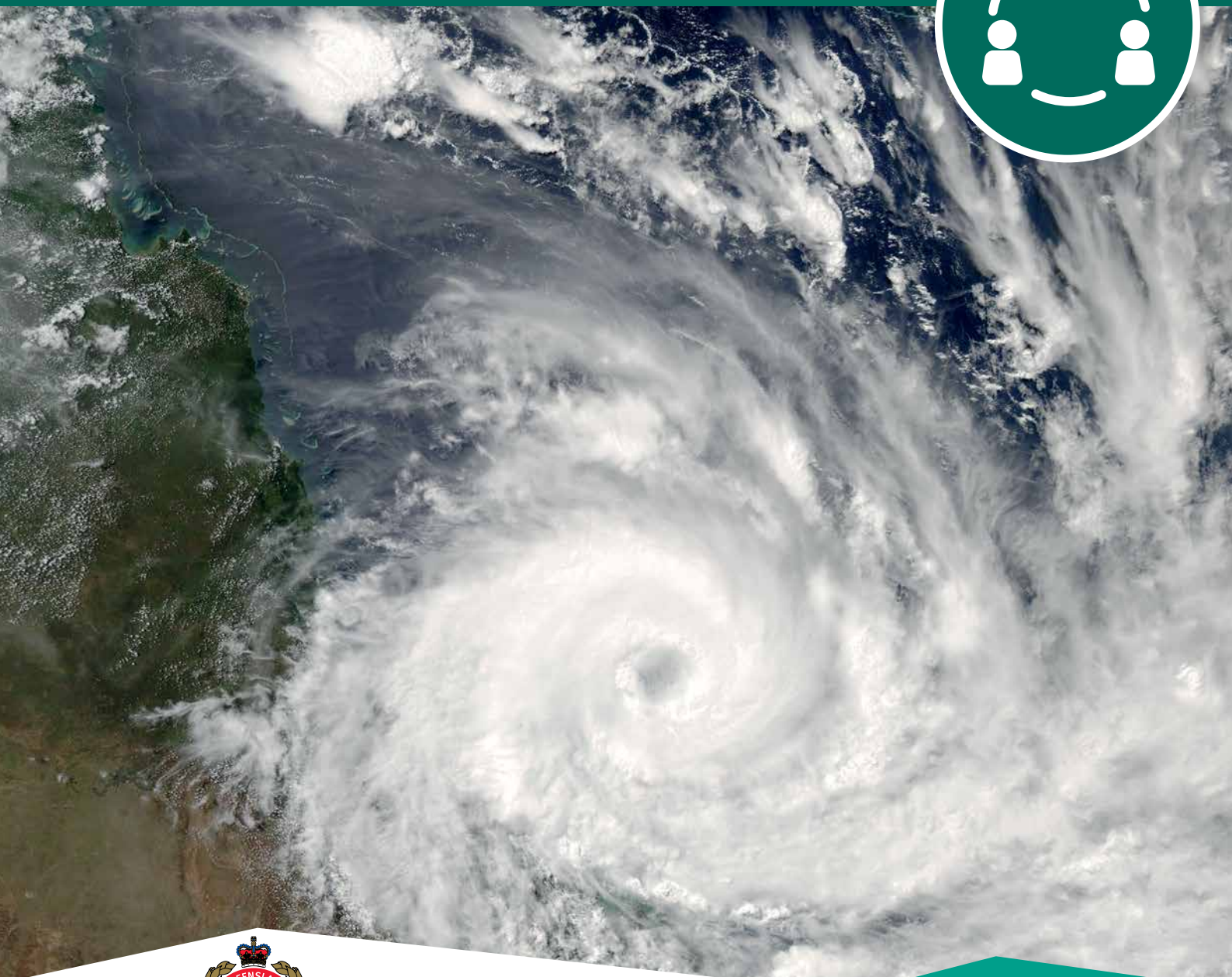
UNDERSTAND | **ADAPT** | TRANSITION

Queensland Climate Adaptation Strategy

Emergency Management Sector Adaptation Plan for climate change



Queensland Government

This Sector Adaptation Plan was developed by the emergency management sector with the support of the Queensland Government. Sector Adaptation Plans are important components of the *Queensland Climate Adaptation Strategy*, outlining sector-led responses to the challenges presented by climate change.

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Acknowledgements

This Emergency Management Sector Adaptation Plan has been developed by, and in partnership with, Queensland Fire and Emergency Services (QFES) and the emergency management sector. The Department of Environment and Science would like to thank QFES and the National Climate Change Adaptation Research Facility for their leadership and development of this body of work.

QFES would like to acknowledge key sector contributors including; Queensland Police Service, Queensland Ambulance Service, Queensland Reconstruction Authority, the Queensland Council of Social Services, NRM Regions Queensland, Australian Red Cross, Local Government Association of Queensland, Inspector-General Emergency Management (IGEM) and a range of other industry stakeholders who provided valuable input through participation in the consultation process and reviewing plan.

Foreword

The emergency management sector must constantly examine the risks that it is being challenged by now and scan the horizon for what may be emerging. This will ensure that it continues to be ready to deliver efficient and effective disaster management using the comprehensive approach of prevention, preparedness, response and recovery.

As identified in the 2017 State Natural Disaster Risk Assessment, Queensland is exposed to a range of hazards that can lead to significant consequences for our community. The impacts of these hazards will vary depending on local factors, such as geography, condition of the built and natural environment, resilience of the community, as well as organisational risk management and preparedness.

The changes in the frequency, intensity, distribution and duration of climate extremes resulting from climate change, coupled with the intensification of population growth and urban development in hazard-prone areas are likely to increase exposure and risks to Queensland communities and infrastructure. The implications for emergency and disaster management due to the variation in climate projections means risk management strategies must be continuously enhanced. We need to remain agile for dealing with climate-related disasters that have a high-level of impact on the delivery of sector services and, long term climate shifts that have the potential to erode capacity and capability over time.

The World Economic Forum ranked 'failure of climate change mitigation and adaptation' as its highest risk in terms of impact and third highest in terms of likelihood (2016). As such, the Emergency Management Sector Adaptation Plan (EM-SAP) envisages 'an adaptive emergency management sector that is fully engaged with the risks and opportunities of a changing climate, building resilience together with the communities of Queensland.' This is consistent with the over-arching Queensland Government's Climate Adaptation Strategy (Q-CAS) 2017-2030 vision of 'an innovative and resilient Queensland that manages the risks and harnesses the opportunities of a changing climate'. It also provides a platform for the Queensland Disaster Resilience Strategy commitment to 'identifying adaptation opportunities following disasters and in anticipation of climate change' and 'making Queensland the most disaster resilient state in Australia'.

The eight priorities within the EM-SAP seek to further engrain climate change into sector strategic investment and disaster management planning at all levels, positioning the sector to remain a trusted broker of climate related risk data and information for communities. This approach will enable Queensland to more deeply understand its current and future disaster risk, strengthening governance and investment in line with the Sendai Framework for Disaster Risk Reduction 2015-2030 and Sustainable Development Goal 13 for Climate Action.

Queensland Fire and Emergency Services has already commenced examining methods to incorporate climate projections into the Queensland Emergency Risk Management Framework (QERMF) ensuring Queensland's Disaster Management Arrangements are supported by contemporary and forward-looking climate science. Robust and scientifically based risk assessments, including climate data and information, enables decision makers at all levels of disaster management groups and the sector to reflect anticipated climate change in disaster management plans.

The EM-SAP has been developed and designed by the sector for the sector, both government and non-government alike. As the sector prepares to move into the next phase of implementation planning, we encourage sector organisations to examine what they can do to contribute to these priorities and apply the principles in practice.

Finally, we would like to take the opportunity to thank all stakeholders who have and continue to support resilience building within the emergency management sector and communities of Queensland.

Hon. Craig Crawford MP
Minister for Fire and Emergency Services

Katarina Carroll APM
Commissioner, Queensland Fire and Emergency Services

Executive summary

The Emergency Management Sector Adaptation Plan (EM-SAP) has been developed to support the sector to manage the risks associated with a changing climate, and to harness the opportunities provided by responding to the challenges. Led by the emergency management sector, the EM-SAP ensures relevance and the participation of sector stakeholders, encourages sector leadership, and promotes adaptation initiatives. The plan is built on existing disaster management arrangements and other state government planning in Queensland, to establish key directions for action and inform future planning by the sector in alignment with the Queensland Climate Adaptation Strategy (Q-CAS).

Different parts of Queensland are prone to a variety of natural hazards, including floods, droughts, bushfires, cyclones and heatwaves. The impacts of these hazards will vary depending on local factors, such as geography, condition of the built and natural environment, resilience of the community, as well as organisational management and preparedness. Changes in the frequency and intensity of climate extremes resulting from climate change, along with the intensification of population growth and urban development in hazard-prone areas, are likely to increase exposure and risks to Queensland communities and infrastructure. In order to support affected communities, infrastructure and businesses during these extreme events, emergency management approaches are likely to become more crucial. If disaster events do become more extreme or frequent, they will increasingly disrupt communities, organisations and economies, and the resourcing associated with the current arrangements may be strained in future.

In order to support the sector to understand these risks and plan for adaptation, the EM-SAP aims to:

- establish the climate hazard and emergency management sector context
- identify and confirm the broad climate change impacts on the services provided by the sector
- identify existing adaptation initiatives occurring across the sector
- identify priority adaptation issues and needs for the sector, including critical gaps, barriers to adaptation and future challenges and opportunities
- undertake broad adaptation planning and policy recommendations within the sector.

Substantial stakeholder engagement was undertaken for the project. Stakeholders included those from the emergency management sector and organisations that support Queensland's Disaster Management Arrangements, volunteer organisations, public and private infrastructure operators, and experts from research and academia. Input was also obtained from identified key cross-sectoral stakeholders, including the Queensland Council of Social Service and NRM Regions Queensland.

The Plan

The vision for the EM-SAP is 'an adaptive emergency management sector that is fully engaged with the risks and opportunities of a changing climate, building resilience together with the communities of Queensland'.

Eight Priority Adaptation Measures for the sector have been developed in response to the needs and priorities identified during consultation with stakeholders, and through the evaluation of existing leading practice and literature relating to climate adaptation measures.

These are:

1. Sector-led awareness and engagement about climate change
2. Integration of climate change into sector governance and policy
3. Enhancing the sector's understanding of climate change risk and its ability to adapt
4. Research and development of new knowledge and supporting tools
5. Allocation of resources to support sector adaptation
6. Increasing the resilience of infrastructure critical to the sector and community
7. Promoting and enabling community resilience-building and self-reliance
8. Volunteerism, volunteering and workforce management.

These priorities are unpacked further in the plan, which starts on page 4. This plan forms the foundation for further collaborative implementation planning to be conducted in 2018–19, which will aim to detail how the EM-SAP will be implemented and by whom. This will continue to be sector-led, in consultation with sector stakeholders.

Contents

Introduction

This body of work delivers a climate change Sector Adaptation Plan for the emergency management sector in Queensland (EM-SAP). This is a high-level plan to support the sector in managing the risks associated with a changing climate, and to harness the opportunities provided by responding to the challenges. The EM-SAP was developed by the sector to ensure relevance and participation of sector members, encourage sector leadership and promote adaptation initiatives. The plan built on existing disaster management arrangements and other state government planning in Queensland to establish key directions for action and inform future planning by the sector in alignment with the Queensland Climate Adaptation Strategy (Q-CAS) and other relevant sector strategies.

Background

The Queensland Government has committed to implementing the Q-CAS, which was endorsed and released in mid-2017. The Q-CAS vision is 'an innovative and resilient Queensland that manages the risks and harnesses the opportunities of a changing climate'. There are four pathways in the Q-CAS, including the 'Sectors and Systems' pathway. This pathway supports sector-led development of Sector Adaptation Plans (SAPs) that outline how government will work with stakeholders to identify adaptation needs and prioritise adaptation actions. SAPs will provide a mechanism for stakeholders to collaborate, prioritise adaptation activities, address complex and cross-cutting issues, identify opportunities and potential financing mechanisms, and ensure adaptation measures are complementary.

Figure 1 represents the four pathways through which plans for climate adaptation are being developed under the Q-CAS, the place of the EM-SAP, and the cross-cutting issues.

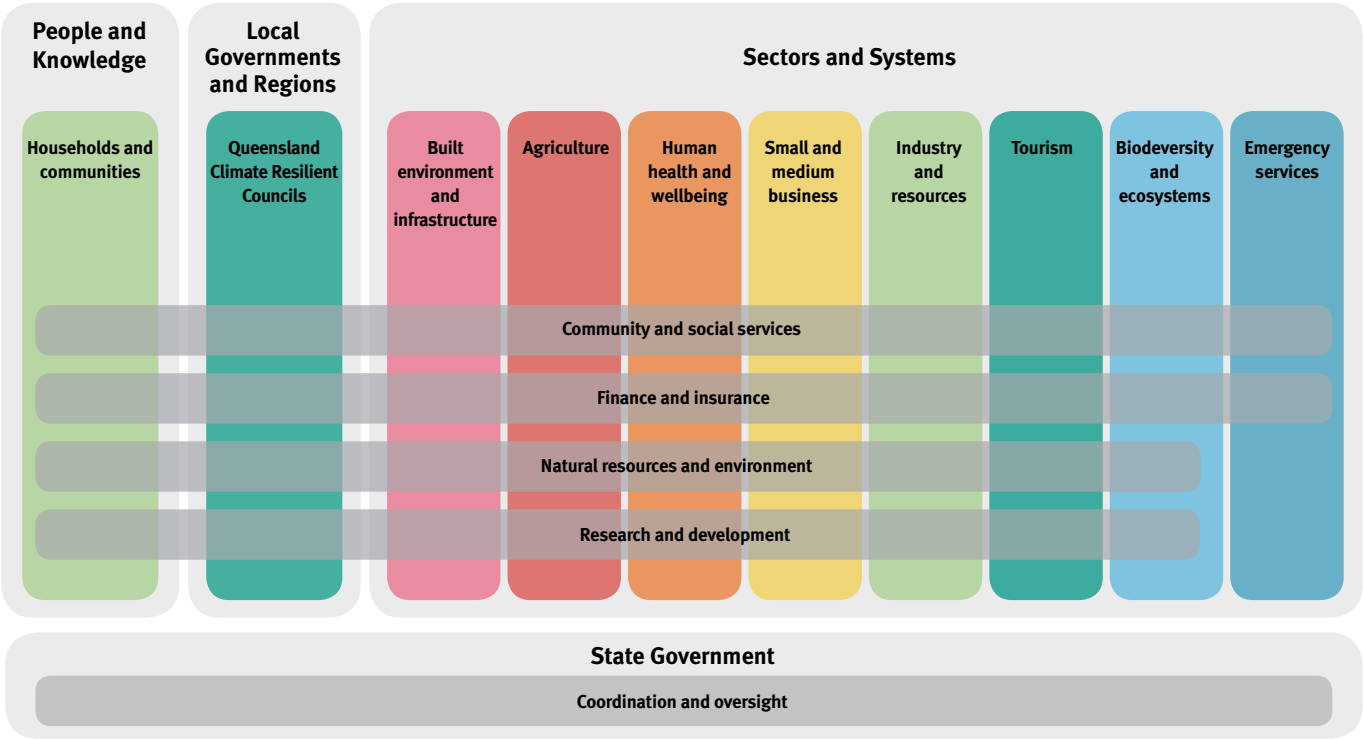


Figure 1. Represents the four pathways through which plans for climate adaptation are being developed under the Q-CAS, the place of the EM-SAP, and the cross-cutting issues.

Note: The EM-SAP was originally envisaged to focus on emergency services (far right). This was changed to be inclusive of the broader emergency management sector, given the relevance of climate change across all stakeholders and the need for a comprehensive approach across prevention, preparedness, response and recovery. This change resulted in 'natural resources and environment' and 'research and development' becoming cross-cutting issues for the emergency management sector, which is not illustrated in the figure above.

Scope

Queensland is prone to a variety of natural hazards, including floods, droughts, bushfires, cyclones and heatwaves. The impacts of these hazards will vary depending on local factors, such as geography, condition of the built and natural environment, resilience of the community, as well as organisational management and preparedness. Changes in the frequency and intensity of climate extremes resulting from climate change, along with the intensification of population growth and urban development in hazard-prone areas, are likely to increase exposure and risks to Queensland communities and infrastructure [1]. In order to support affected communities, infrastructure and businesses during these extreme events, emergency and disaster management approaches are likely to become more crucial. If disaster events do become more extreme, they will increasingly disrupt communities, organisations and economies [2].

Disaster management refers to arrangements for managing the potential adverse effects of an event, including, for example, arrangements for mitigating, preventing, preparing for, responding to and recovering from a disaster [3, 4]. The approaches and resourcing associated with these current arrangements may be strained in future by climate change. In order to support the sector in understanding these risks and plan for adaptation, EM-SAP aims to:

- establish the climate hazard and emergency management sector context
- identify and confirm the broad climate change impacts on the services provided by the sector
- identify existing adaptation initiatives occurring across the sector
- identify priority adaptation issues and needs for the sector, including critical gaps, barriers to adaptation and future challenges and opportunities
- undertake broad adaptation planning and policy recommendation within the sector.

The plan is the foundation for further collaborative implementation planning to be conducted in 2018–19, which will detail how the SAP will be implemented, when actions will be undertaken, and by whom. This will continue to be sector-led, in consultation with sector stakeholders.

The EM-SAP was developed with stakeholders across the sector and organisations that support Queensland's Disaster Management Arrangements (QDMA) *(Figure 2)*.

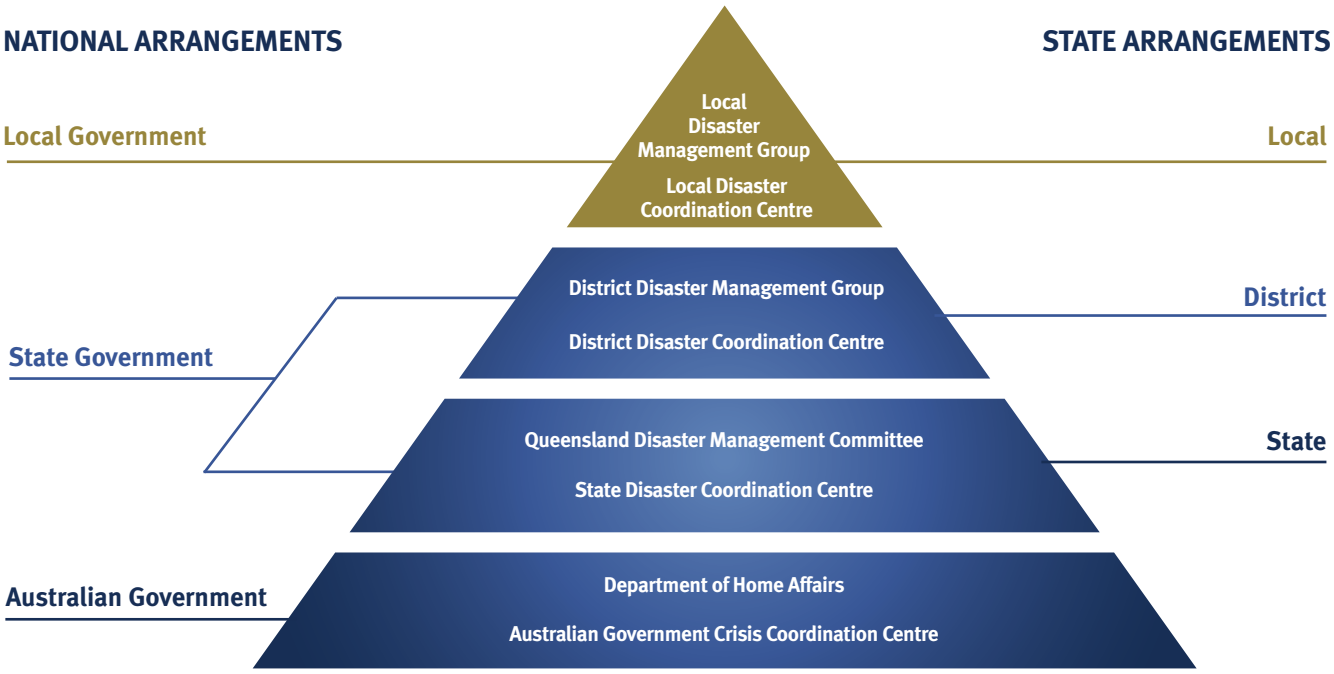


Figure 2: Represents the QDMA (source: www.disaster.qld.gov.au).

Note: Similar to the Queensland Disaster Management Committee, the Australian New Zealand Emergency Management Committee also contribute to arrangements at a national level.

The Disaster Management Act 2003 [4] and the Disaster Management Regulation 2014 [5] form the legislative basis for disaster management, and guide arrangements within the Queensland Government (Figure). The QDMA are formed around three levels of governance: local, district and state, including an additional tier between state and Federal governments if required (Figure 2).

The *Disaster Management Act 2003* indicates that local governments are primarily responsible for managing disaster events in in conjunction with the Local Disaster Management Group (LDMG). The LDMG assists local government in preparing a local disaster management plan (LDMP). A District Disaster Management Group (DDMG) is established for each disaster district to develop a district disaster management plan (DDMP), and to act as a support mechanism for the local level. The DDMP is developed through regular review of the disaster management plans of local governments within the district and their LDMPs.

At a state level, the State Disaster Coordination Group provides support to the State Disaster Coordinator and the State Disaster Coordination Centre to ensure preparedness, assisting with appropriate responses and delivery of resources to district and local stakeholders. The most senior level of committee under the arrangements is the Queensland Disaster Management Committee, which is responsible for regular review of the State Disaster Management Plan and provision of strategic direction during disaster events.

The Queensland Prevention, Preparedness, Response and Recovery Disaster Management Guideline [3] provides practical guidelines for the implementation of the QDMA.

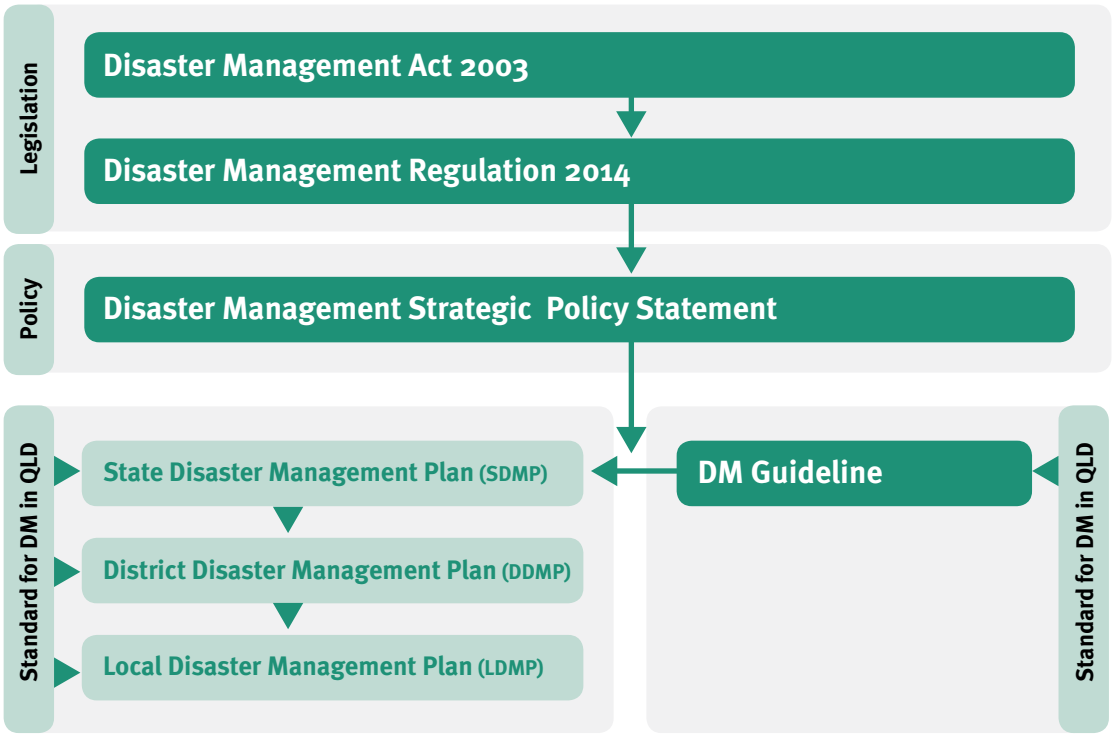


Figure 3: Disaster management policy framework [3].

The continuous improvement of the QDMA is supported by the Emergency Management Assurance Framework (EMAF) [6] and the *Standard for Disaster Management in Queensland*. The EMAF supports accountability, builds consistency across all levels of the QDMA, and reinforces a shared responsibility for delivering better disaster management outcomes for the community. The Standard describes the attributes of effective disaster management, outlines required outcomes, and provides indicators that contribute to the likelihood of disaster management entities achieving these outcomes. The principles adopted in this plan are consistent and aligned with those in the EMAF.

The Plan

Vision

An adaptive emergency management sector that is fully engaged with the risks and opportunities of a changing climate, building resilience together with the communities of Queensland.

Principles

This SAP aligns with principles identified in the Q-CAS, led by three principles specific to the sector:

1. Adaptation should address the comprehensive approach to disaster management—prevention, preparedness, response and recovery.
2. Adaptation should be considered using a systems approach, ensuring that it is responsive to local conditions and the needs of the entire community.
3. Adaptation should address both acute major events and continuous incremental change.
4. Adaptation programs should be risk-based and people-focused.
5. A healthy natural environment is fundamental to successful adaptation, providing critical ecosystem services and support for community wellbeing.
6. Adaptation involves continuous improvement.
7. Adaptation responses should be evidence-based, effective, flexible, equitable, inclusive, and able to respond to new information.
8. Adaptation is best achieved through collaboration, with responsibility shared across all levels of government, industries and communities.
9. Adaptation, resilience and risk management should be integrated into all levels of policy, planning and implementation.
10. Adaptation must be sustainable and avoid perverse outcomes, including detrimental impacts on communities, other sectors, the economy or the natural environment.
11. Adaptation action is complementary to mitigation action, and should avoid maladaptive outcomes.

The rationale for the sector-specific principles are:

- *Principle 1*—within the emergency management sector, there is a long-standing framework for planning and operational activity called the comprehensive approach. The comprehensive approach recognises four phases of emergency management—prevention, preparedness, response to events, and recovery. Adopting an additional principle that explicitly acknowledges this framework connects adaptive policies and actions to existing sector policies and actions, and frames climate adaptation communication and messaging in familiar terms for participants in the emergency management arrangements.
- *Principle 2*—future demand on sector services will be largely influenced by overall resilience of the community and other sectors (e.g. infrastructure, health and wellbeing, ecosystems and biodiversity). It will also be influenced by a number of existing issues relating to emergency management that will be amplified by climate change (e.g. aging population, increased urbanisation, reliance on infrastructure and supply chain systems, future land-use planning and legacy issues). This makes it important that the interactions between these other sectors and the different pressures are understood and accounted for by taking a holistic systems view. Further, it is also recognised that climate change impact will vary locally, and therefore adaptation of the sector needs to be scalable and contextual.
- *Principle 3*—climate change will potentially increase the frequency, intensity, duration and distribution of extreme events such as bushfires, heatwaves and coastal inundation. It will also create more challenging conditions for longer term stresses such as sea-level rise, drought and higher average temperatures. All have the potential to impact on elements of the sector, including the health and wellbeing of the sector workforce due to the reduction of recovery time between concurrent extreme events and degraded conditions of the operating environment. It is critical that adaptation measures across both acute and long-term stresses are considered.

Priority Adaptation Measures

Eight priority adaptation measures have been developed in response to the needs and priorities identified during consultation with stakeholders, and through evaluation of existing leading practice climate adaptation measures (also see Appendix 2). These priorities are not listed in any specific order, although it was broadly acknowledged that 'awareness and engagement about climate change' across stakeholders (including the community) will provide a basis for the other priorities to be implemented.

1. Sector-led awareness and engagement about climate change
2. Integration of climate change into sector governance and policy
3. Enhancing the sector's understanding of climate change risk and its ability to adapt
4. Research and development of new knowledge and supporting tools
5. Allocation of resources to support sector adaptation
6. Increasing the resilience of infrastructure critical to the sector and community
7. Promoting and enabling community resilience building and self-reliance
8. Volunteerism, volunteering and workforce management.

To lay the foundation for implementation planning, the rationale, identified actions, outcomes and challenges that inform each priority have been outlined.

Priority 1: Sector-led awareness and engagement about climate change

Rationale	• Behavioural and attitudinal change regarding climate change cannot be achieved without increasing awareness and understanding of climate change science within the sector and the broader community.
	• The emergency management sector is uniquely positioned as a trusted source of information due to its role in disaster management, its presence during times of community stress, and its pre-existing community engagement programs.
Identified actions	• Build on existing community education and engagement programs within and outside the sector to include climate change science and associated impacts, and create awareness and engagement where they don't exist.
	• Incorporate or provide access to climate change education and training for the emergency management workforce.
	• Partner with schools, tertiary institutions and professional peak bodies to incorporate climate adaptation and emergency management as a consistent theme in curriculum and professional development training and education programs.
Outcomes	• A community that is informed about climate change, is aware and accepting of the science and its shared responsibilities.
	• A sector that is supporting community awareness through education and engagement programs.
	• A sector workforce with a strong awareness of climate change, equipped with the knowledge to address anticipated challenges effectively.
	• Development of expertise within the sector to assist sector organisations in identifying risks associated with climate change and support the identification of adaptation needs and priorities.
Challenges	• An overall low level of pre-existing community education and awareness of climate change risks.
	• Misunderstanding or low level of awareness among the sector workforce about climate change, the projected impacts on the sector, and adaptation options.

Priority 2: Integration of climate change into sector governance and policy

Rationale	• The need to adapt to a climate change-affected future is being advocated by the state government, making it an important consideration for all sectors.
	• Increasingly, climate change is being viewed by the finance sector (e.g. banking, insurance, investment) as a corporate governance obligation and, due to the strong links between the emergency management sector and insurance and finance, the sector must ensure it is considering climate-related risks appropriately.
	• As a leader in reducing or managing climate change impacts, sector organisations need to ensure that they have clearly agreed policy positions for advocacy, and for internal and cross-sector planning.
Identified actions	• Implement clear and long-term policy on climate adaptation within sector organisations.
	• Facilitate integrated planning across the sector and within government for the management of climate change and adaptation activities.
	• Influence legislative reform that supports a consistent approach to climate change at all levels of government.
	• Examine sector procurement policy to understand future sustainability and adaptability to climate change, and where possible, to drive appropriate change in supply chains.
Outcomes	• The sector has clear direction and accountability regarding climate adaptation, and is taking a consistent approach.
	• The sector provides leadership and best practice to foster effective climate adaptation across other sectors, and the community more broadly.
	• Procurement practice within the sector contributes to increased climate adaptation practice and develops more resilient and sustainable supply chains.
Challenges	• Moving away from a perception of the sector being response and recovery focused, with a view to achieving a better balance between prevention and preparedness.
	• Achieving a consistent long-term policy position on climate change across the sector that goes beyond traditional business and political cycles.
	• Maintaining a consistent message with competing sector and organisational leadership priorities.

Priority 3: Enhancing the sector's understanding of climate change risk and its ability to adapt

Rationale	• The sector needs to understand and plan for potential climate-related risk to its organisations given the pivotal role they have in supporting the community during disaster events, which will be exacerbated by climate change. • In order for the sector to position itself as a 'trusted broker' for evidenced-based climate change information, it needs to ensure it is adapting to climate change appropriately. • The sector needs to remain agile and have the ability to adapt to climate-related risk as it becomes apparent in the near and long term.
Identified actions	• Incorporate climate change consideration into organisational resilience practices, including enterprise risk management, business continuity planning, crisis management, emergency management and security management. • Develop an approach consistent with the 'State Government pathway' (refer to Figure 1) that enables a consistent evaluation of climate risk across sector organisations. • Incorporate climate change into emergency risk management approaches that enable risk-informed emergency management planning practice based on likely and credible worst-case scenarios. • Work with local governments, disaster management groups and natural resource management groups to manage 'natural infrastructure' to reduce harm from natural disaster events. • Deliver the necessary data, tools and information to disaster management groups about climate change. • Examine the feasibility of a review that conducts an assessment of existing and planned sector facilities and their interdependencies against future climate change projections, with the aim of reducing future climate risk.
Outcomes	• Sector organisations are aware of the risks posed by climate change to their functioning and ability to deliver goods or services, and are actively planning and implementing solutions. • Climate change is incorporated into organisational planning in the sector across assets and operations. • The sector has a robust understanding of its holistic position in relation to climate change. • Emergency management planning is enhanced through the appropriate consideration of, and planning for, anticipated climate change at a local, district and state level. • The unnecessary creation of previously unforeseen risks posed by climate change is avoided or minimised. • The sector has the collective capacity and capability to manage future complexities and demands amplified by, or arising from, climate change. • The emergency management system is well connected and effective, including all levels of government, and relevant private sector and community organisations.
Challenges	• Misunderstanding or preconceived perceptions of climate change and its impact on sector organisations, assets and services due to limited education opportunities or access to information. • Effectively and efficiently incorporating climate change into existing risk management processes. • Availability of relevant data and effective interpretive processes for decision-making.

Priority 4: Research and development of new knowledge and supporting tools

Rationale	• Climate change science and adaptation approaches are continuing to evolve and mature and, as such, need to constantly be resourced, reviewed and applied in sector decision-making and planning.
	• Climate change research into sector-specific applications also requires the ongoing support of end-users to ensure that projects and outputs are continually informed by practitioners and can be practically applied.
Identified actions	• Provide support and partnerships for research projects that inform sector climate adaptation, such as those that explore climate change science, application-ready data for activities such as risk assessment, and development of innovative adaptation solutions.
	• Provide access to data and decision support tools for understanding local-scale climate change risks.
	• Use advanced technology to support sector activities and decision-making in climate change applications, such as enhancement of personal protective equipment to cater for anticipated climate change, use of remote sensing and imagery, and evolving mitigation options.
	• Develop a dynamic suite of guidelines and tools that foster information sharing and provide examples of sector approaches or case studies of better practice for climate adaptation.
Outcomes	• The sector is well positioned with contemporary knowledge and science to enable adaption to climate change, and is addressing emerging needs with new and innovative approaches.
	• The sector workforce has access to fit-for-purpose guidance helping it to adapt to climate change effectively and consistently with leading practice.
	• Sector stakeholders have access to applicable and localised datasets for decision-making and climate adaptation action down to a local level.
Challenges	• Climate futures present a range of complexity and variation as to how natural hazards and projections will manifest.
	• Research and development can take time to conduct well, and may not materialise in the required timescales for decision-making.
	• The resourcing of sector organisations has a number of variables and competing priorities, which may reduce the investment in climate change-related research and development.

Priority 5: Allocation of resources to support sector adaptation

Rationale	• Adapting to climate change will require significant financial commitment and is likely to challenge the allocation of resources. • Appropriate resourcing will be required to enable the sector to adapt to climate change, and will serve to enable the other priorities identified in this plan. • Targeted funding will enable a focus on climate change, and seed projects that seek to embed adaptation within sector organisations.
Identified actions	• Influence funding stream alignment within and beyond the sector where possible to allow for climate adaptation initiatives. • Encourage sector organisations to allocate resources for research and development, risk assessment and planning, and capacity and capability enhancement for the purposes of climate adaptation. • Forge partnerships that foster investment in climate adaptation between and beyond sector stakeholders, particularly those that support cost-sharing or sharing of other resources. • Identify opportunities across all levels of government to enhance the coordination of resources targeting climate adaptation.
Outcomes	• The sector is positioned well for the future projected resourcing demands anticipated by climate change. • Climate adaptation is engrained in regular sector organisation planning, and therefore budgetary processes. • Sector and non-sector stakeholders are provided with a range of supplementary resourcing options that allow for appropriate and innovative climate adaptation initiatives. • Funding opportunities for climate adaptation are aligned and available. • The allocation of resources to address climate change-related concerns is occurring organically within organisations as part of organisational resilience practices.
Challenges	• Grants-based funding does not necessarily provide the long-term investment required for climate adaptation. • Due to the potential size and complexity of some climate adaptation requirements, funding may continue to be finite. • Knowledge sharing about available funding streams within and beyond the sector can be variable.

Priority 6: Increasing the resilience of infrastructure critical to the sector and community

Rationale	• The sector will need to continue to operate under the future conditions that climate change will present, which will require the resistance, reliability, redundancy, response and recovery of infrastructure and systems that it relies on.
	• The same rationale applies to infrastructure that the broader community relies on to function, which, on failure, creates an increased demand on the sector.
Identified actions	• Understand infrastructure interdependencies and the vulnerability of the sector, and plan and implement adaptation solutions.
	• Influence the incorporation of climate scenarios into land-use planning for essential infrastructure and communities.
	• Foster partnerships and joint planning between the sector and infrastructure operators and owners.
	• Where possible, ensure sector organisations are involved in land-use and infrastructure planning processes and are resourced to effectively contribute.
Outcomes	• The sector is involved in the prioritisation of infrastructure planning and investment, helping to reduce future risks posed by climate change.
	• Providers of essential infrastructure services that support the sector understand their risks from climate change and are managing them.
	• Demand on sector services is reduced due to enhanced infrastructure resilience and continuity of lifelines to the community.
Challenges	• The ability of the sector to operate beyond its traditional paradigms and influence infrastructure owners/ operators, land-use planners, building code custodians, developers and so on.
	• Land-use and infrastructure planning decisions are made by multiple stakeholders with competing priorities, which may result in poor emergency management outcomes and future risk associated with climate change.
	• Adequate sector resourcing to provide appropriate influence and input into relevant processes varies across the sector.

Priority 7: Promoting and enabling community resilience building and self-reliance

Rationale	• Increased frequency, intensity, duration and distribution of some extreme events are predicted under different climate change scenarios, which will put communities at risk, resulting in increase of demand on sector goods and services. • Assisting and enabling the community to understand climate change impacts and how they can be better prepared, and to assume shared responsibility, will contribute to fostering community resilience. • It is envisaged that increasing the resilience of communities and levels of 'self-reliance' will assist in managing any unnecessary increase in demand on the sector.
Identified actions	• Continue to advocate for and facilitate activities that foster community resilience. • Influence land-use and urban planning through incorporation of climate change scenarios and risk information. • Undertake engagement activities that incorporate community self-reliance and resilience-building activities in preparation for, and use during times of disaster. • Work closely with other government and non-government organisations to increase the resilience of the community to climate change.
Outcomes	• The community has increased resilience to the effects of climate change and extreme events, and reduced reliance on immediate support from the sector. • Fewer developments and land use that allow for activities and homes in areas at risk from future events exacerbated by climate change. • The sector is collaborating with other sectors to ensure that activities to increase community resilience are implemented effectively and consistently.
Challenges	• Existing social issues and vulnerabilities have the potential to be amplified by climate change. • The capacity and capability of communities varies significantly across the state, which will require diverse and dynamic approaches to climate adaptation and resilience building.

Priority 8: Volunteerism, volunteering and workforce management	
Rationale	• The sector workforce is set to be affected by climate change on a professional and personal level given it will influence the health and wellbeing of individuals at work and at home. • Volunteering, which is already under pressure, will also experience influence from climate change as the population potentially relocates, or conditions prevail that will limit those who are able to perform functions and tasks effectively. • The coupling of these issues with an anticipated increase in demand on services, and the sector's high reliance on its volunteer workforce, presents an issue for the sector.
Identified actions	• Evaluate the impact of climate change on the availability of volunteers across the sector to continue to deliver goods and services across the state. • Incorporate climate change risks into volunteering and workforce strategies and planning across sector organisations, and in emergency management planning. • Foster partnerships between sector organisations, the community and beyond to enhance collaboration and cross-utilisation of the existing and future volunteer and paid workforce.
Outcomes	• Volunteers remain a key component of the sector service delivery model, and provide the diverse workforce and skills required. • New and emerging approaches are used to harness the community in spontaneous, short and long-term volunteering opportunities. • The sector has a sufficient and multiskilled workforce to enable it to continue service delivery and meet the needs of the community under future climate conditions. • The sector has partnered where appropriate to deliver tailored and bespoke approaches to support its workforce in communities across the state in the near and long term.
Challenges	• Increased demand on sector workforce coupled with the pressures of an aging population and downturn in volunteering. • The need for cross-sectoral collaboration to address volunteering issues and climate adaptation.

The identified Priority Adaptation Measures have been mapped across the four distinct phases of emergency management (prevention, preparedness, response and recovery) in Appendix 3. This provides a guide to sector organisations about how each of these adaptation measures can be contextualised using this model. Many of the Priority Adaptation Measures fall in the areas of prevention and preparedness.

How the plan was developed

The EM-SAP was intended to be sector-led in design and implementation to empower sector stakeholders in building the plan and identifying capacity requirements for adapting to a changing climate. Therefore, the Queensland Department of Environment and Science (DES) engaged Queensland Fire and Emergency Services (QFES) to lead the EM-SAP development. QFES partnered with the National Climate Change Adaptation Research Facility (NCCARF) to ensure that the most contemporary climate science and understanding was used, and to ensure consistency with other Sector Adaptation Plans.

A project steering committee was formed to guide development of the plan. Its members included representatives from QFES, Queensland Police Service, Queensland Ambulance Service,

Queensland Reconstruction Authority, Local Government Association of Queensland (LGAQ), Australian Red Cross, Queensland Council of Social Services (QCOSS), NRM Regions Queensland (NRMRQ), and DES. The committee played a critical role in defining the scope of the project, assisted in identifying and sharing project materials with relevant stakeholders, and provided feedback on the discussion paper and draft Plan. Two working groups were also formed—the Climate Technical Reference Group and the Emergency Management Advisory Group—which also reviewed and provided feedback on the discussion paper and draft Plan from climate science and emergency management perspectives respectively. Figure outlines the EM-SAP development process.

Consultation

The project engaged with stakeholders across the emergency management sector, and other organisations that support the QDMA. This included state, district and local disaster management groups, State Government departments, local governments, emergency service organisations, volunteer organisations, public and private infrastructure operators, and experts from research and academia. Input was also obtained from the key cross-sectoral stakeholders QCOSS and NRM Regions Queensland. Organisations that participated in the workshops are listed in Appendix 1.

Engagement process

A key part of the engagement process was to find out from stakeholders what they viewed as the challenges and opportunities for the sector and their organisations in relation to climate adaptation, and how their actions might impact on the communities they serve. It was also essential to understand what steps organisations are already taking in regard to climate adaptation, and identify any programs that have been implemented successfully and could be considered elsewhere. A discussion paper [7] was developed and circulated among sector stakeholders via multiple conduits including state, district and local disaster management groups. The discussion paper provided a snapshot of the project, and a brief overview of the policy framework of emergency management in Queensland and its cross-cutting relevance with other sectors. It also presented a succinct review of what is known about climate change in Queensland, identified scientific and government climate change data resources, and outlined the consultation process.

The engagement process is described in Figure 4. Workshop sites were chosen to enable representation by stakeholders from large urban (Brisbane), regional (Yeppoon) and more remote population centres, including those with large Indigenous communities (Cairns). They also enabled input from stakeholders exposed to very different climate futures, and associated risks. Throughout the process, 156 stakeholders participated in the consultation (80 by survey, 74 through workshops and two via telephone interviews).

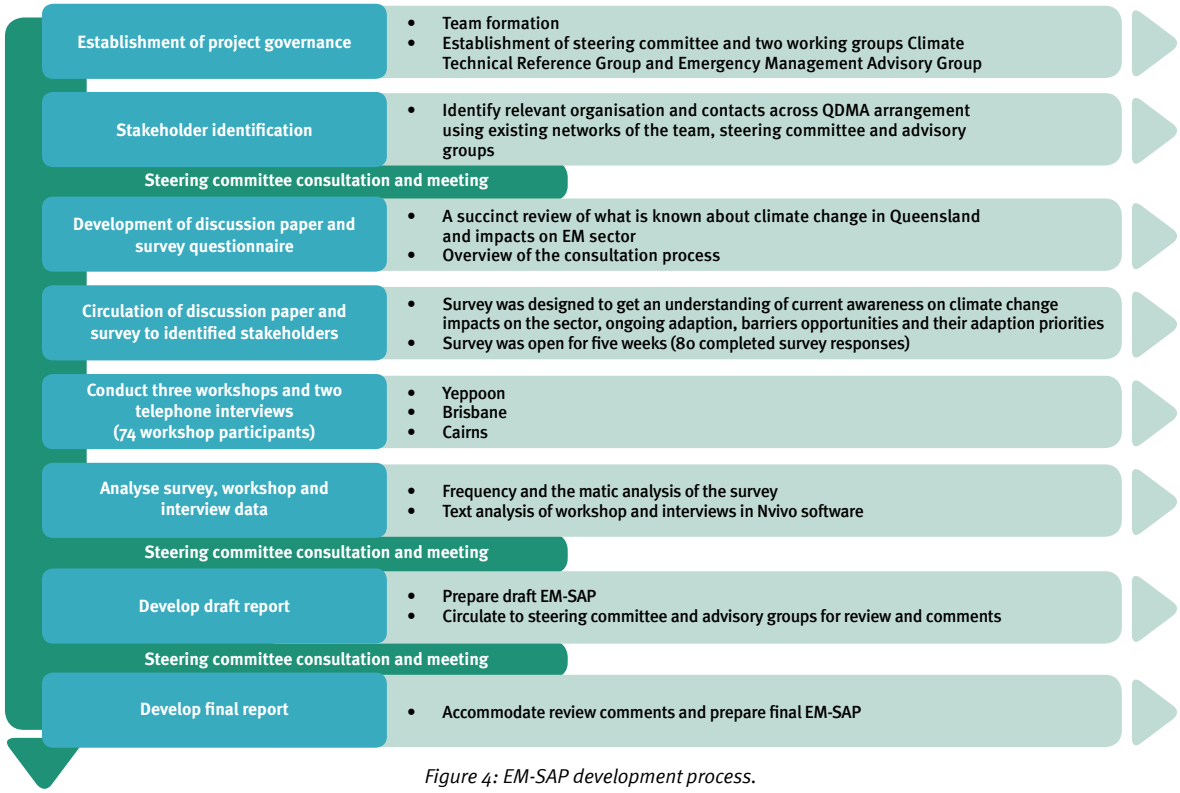


Figure 4: EM-SAP development process.

The Science of Climate Change | 14

Queensland Government

The science of climate change

This section summarises the basic science of climate change using published scientific literature, in particular the most recent Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report [8] and Climate Change in Australia – Information for Australia's Natural Resource Management Regions: Technical Report by CSIRO and the Bureau of Meteorology (BoM) [9]. While the IPCC synthesises global scientific knowledge on climate change periodically and informs climate change actions and polices worldwide, the CSIRO and BoM technical report specifically focuses on climate change around Australia, so underpinning Australia's climate change planning and actions.

What is climate change and sea-level rise?

Climate and sea levels change over time scales from decades to millions of years, in response to solar variations, changes in the Earth's orbit around the sun, volcanic eruptions, movement of the continents, and natural variability such as the El Niño-Southern Oscillation, Indian Ocean Dipole and the longer term Interdecadal Pacific Oscillation. However, since the start of the Industrial Revolution, humans have had increased influence because their activities add significantly to greenhouse gases (e.g. carbon dioxide, methane, nitrous oxide, and synthetic gases etc.) in the atmosphere (Figure 3). Greenhouse gases are transparent to much of the radiation from the sun, and allow it to pass through the atmosphere to warm the Earth. As outgoing radiation from the Earth is mainly in wavelengths that are absorbed by the greenhouse gases, some of that energy is captured and re-radiated back, warming the atmosphere and the Earth's surface. This is known as the greenhouse effect, and contributes towards global warming and other effects on our climate, such as changes in rainfall distribution and storm intensity.

Around 93 per cent of the additional heat created by global warming has so far been absorbed into the oceans. As water warms, it expands. This expansion has been the major cause of sea-level rise, with a smaller contribution from land-based glacier and ice sheet melt. In the 20th century, global average sea levels increased by 19 cm, and are currently rising by 3.2 mm/year. Over time, the contribution from ice melting is expected to increase substantially.

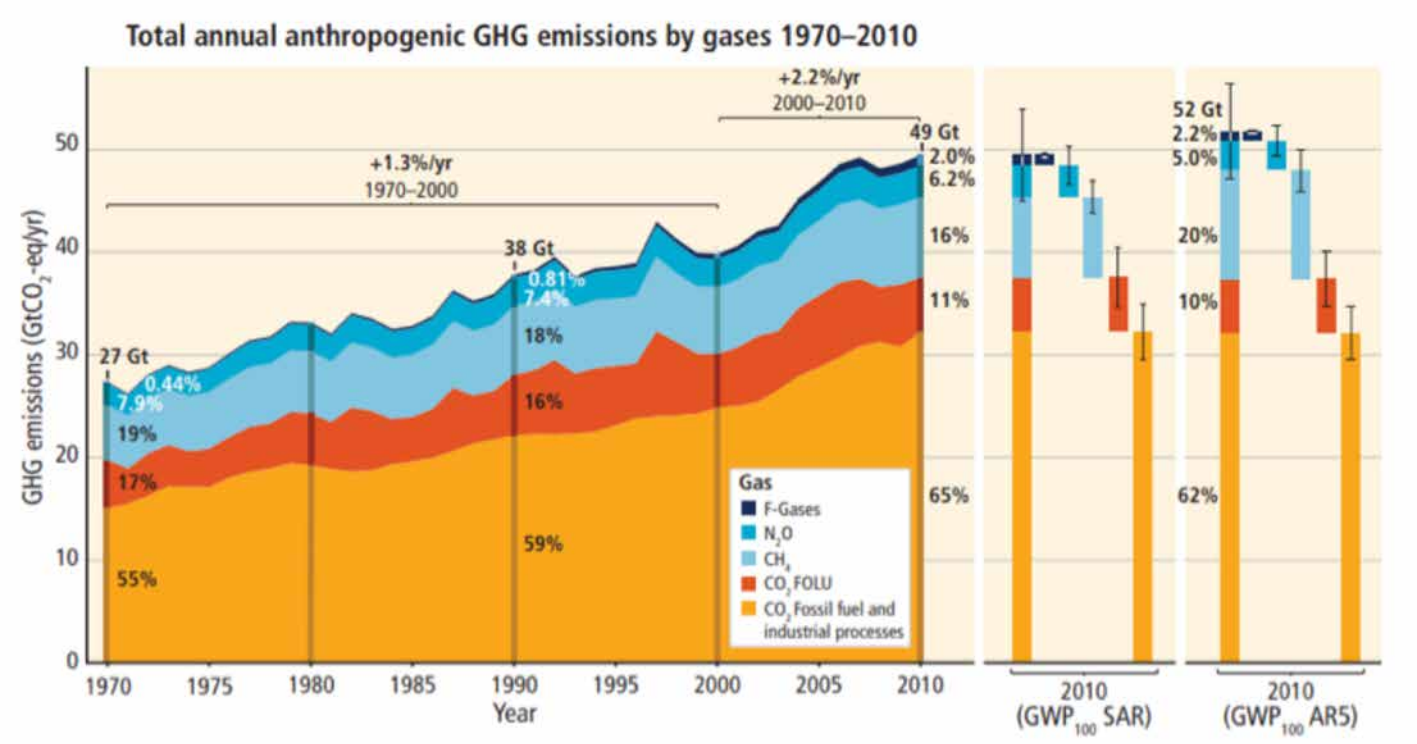


Figure 5: Total annual anthropogenic GHG emissions. Explanatory note (Gas types) - CO2 from forestry and other land use (FOLU); methane (CH_4); nitrous oxide (N2O); fluorinated gases covered under the Kyoto Protocol (F-gases). Right side of the figure shows the associated uncertainties (90% confidence interval) indicated by the error bars [8].

Some of the additional carbon dioxide in the atmosphere (around 30–40 per cent) dissolves into the oceans, where it decreases the alkalinity of the water (an effect known as ocean acidification). This has the potential to make it more difficult for some organisms such as shellfish and plankton to form calcium carbonate, the material used for making shells and coral reefs. There are potentially knock-on effects for marine food chains, and for tourism and fishing industries [10].The effect is at present slight, but will increase in the future unless action is taken to reduce carbon dioxide emissions.

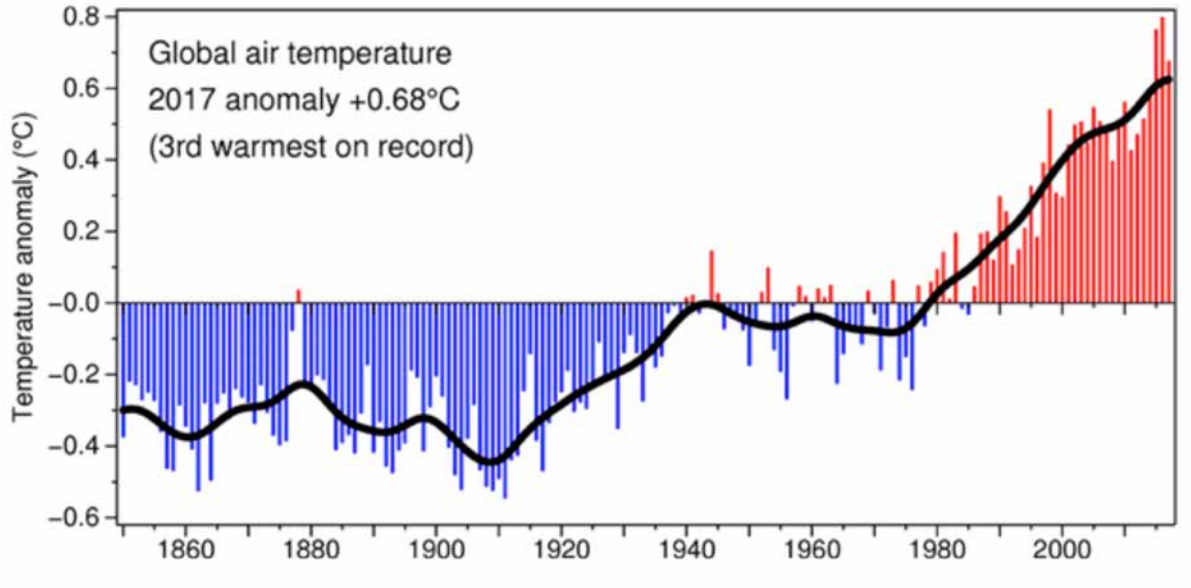


Figure 6: Global land and sea surface temperature record from 1850 to 2017,© Climatic Research Unit 2018: http://www.cru.uea.ac.uk (accessed 14 March 2018).

Recent climate change

Temperature observations from around the world, including satellite observations, can be used to understand how global warming is affecting temperatures. Figure 4 shows the global long-term trend, constructed by averaging from all records over the land and sea (sea surface temperatures are measured by ships and, more recently, by satellite). The temperature has risen by about 1°C since the start of records in 1850.

Future climate change projections

To understand what the changes are likely to be in our climate as a result of increased greenhouse gas concentrations, three-dimensional climate models, or General Circulation Models (GCMs) are used. GCMs are computer-based simulations of the Earth-Ocean-Atmosphere System. The laws of physics and chemistry that explain how the climate functions have been well understood for a very long time, and in GCMs, these are represented mathematically. By changing the greenhouse gas concentrations in these GCMs, future climate change scenarios can be constructed. However, it is important to recognise that these scenarios are not predictions—they are simply 'plausible futures'. Some climate variables are better simulated by GCMs than others, so we can be more confident about some variables, such as sea-level rise and temperature, and less confident about others, such as wind and rainfall [11].

Climate change projections and scenarios

Uncertainties exist in GCM outputs due to factors such as natural variability, how we will live in the future, and the future energy mix of global and local economies (e.g. fossil fuels vs renewables). Therefore, scientists use 'scenarios' to describe future climate, and these underpin impacts analysis, adaptation planning and community engagement. A climate change scenario is a coherent, internally consistent and plausible description of a possible future climate state. It is a quantitative representation constructed from climate model data.

In its Fifth Assessment Report [8] in 2014, the IPCC used Representative Concentration Pathways (RCP) as a basis for building future climate scenarios. RCPs are future greenhouse gas concentration trajectories that are used for running GCMs. There are four RCPs, each designated by a number indicating how much we expect the Earth's energy balance will increase (in watts per square metre of the Earth's surface), with consequential increases in the average global temperature. By the end of the century, the most severe is RCP8.5, and the least severe is RCP2.6. Only in the RCP8.5 pathway do emissions of greenhouse gases continue to rise until 2100 (Figure 5). To achieve the other three pathways, emissions must be reduced, and to achieve the 2.6 pathway, emissions must start to reduce now. Over the past 15–20 years, global emissions have most closely tracked the RCP8.5 pathway [8, 12, 13].

The choice of scenario for understanding future risks to the emergency management sector will depend on a number of factors, such as the timeframe of the risk assessment (e.g. short, medium and long term) and the criticality of the asset / system under consideration. As an example, for understanding short- to medium-term risks to a hospital (high criticality) at the early stage of planning, a risk-averse approach might be used by selecting a high greenhouse gas concentration scenario (RCP8.5) [14]. In addition, changes to the climate out to years 2030–2040 are driven almost entirely by greenhouse gases that have already been emitted. Thus, choice of RCP makes little or no difference in the short term.

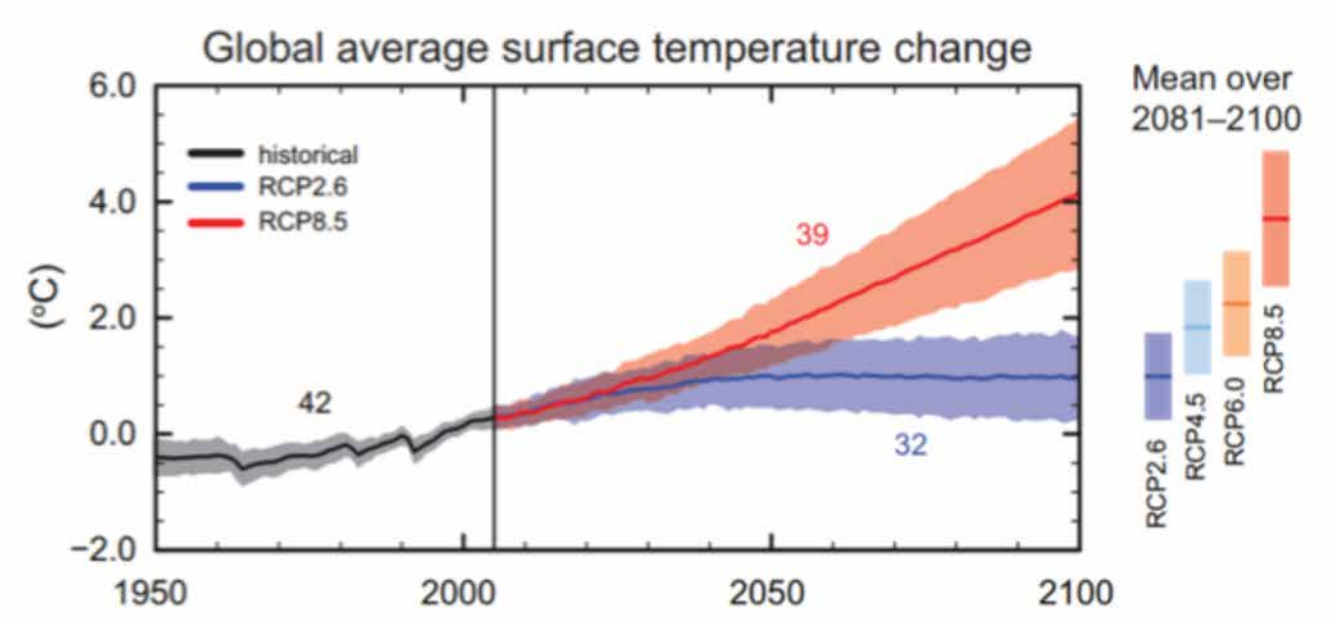
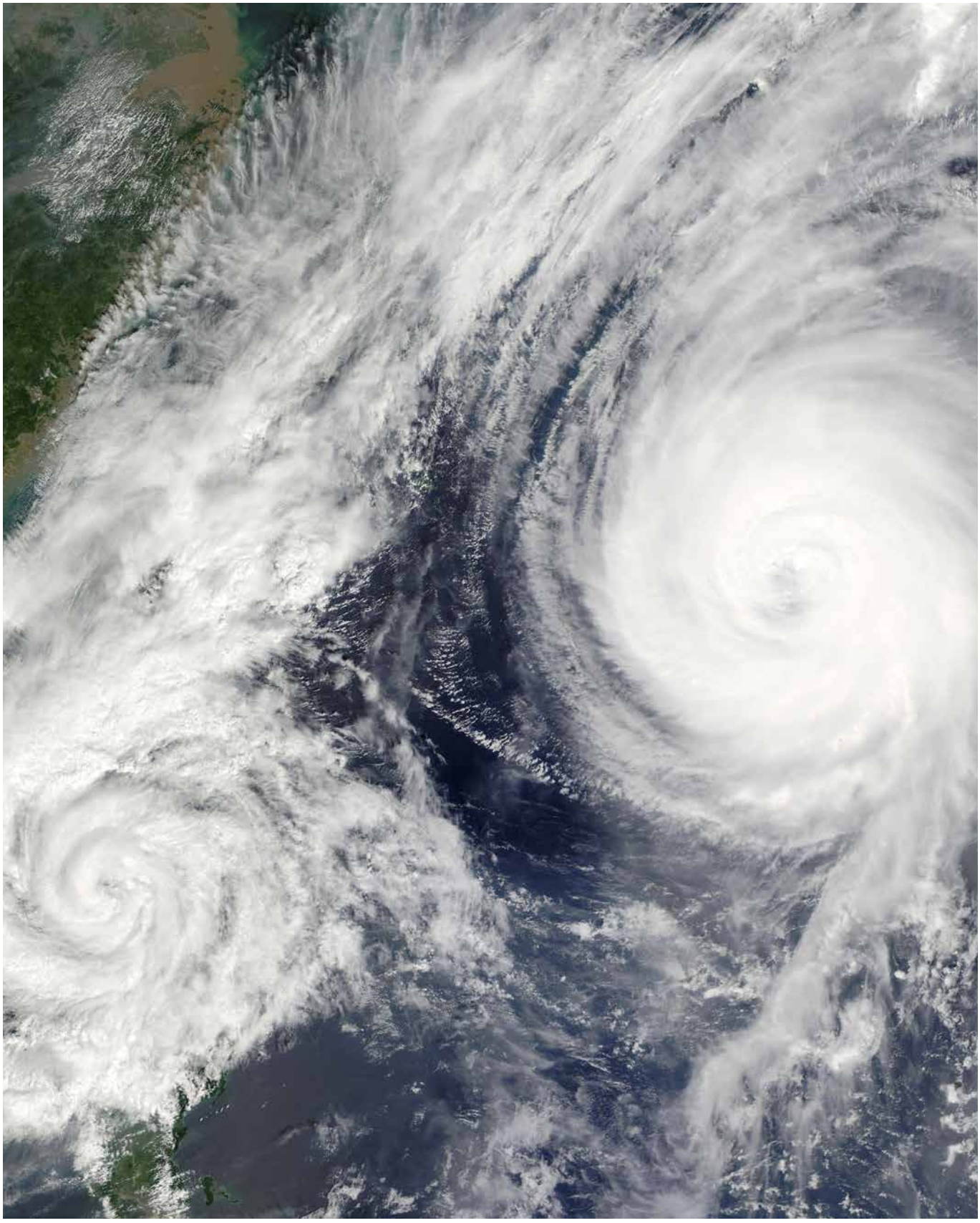


Figure 7: Change in global annual mean surface temperature relative to 1986–2005. The mean and associated uncertainties averaged over 2081–2100 are given for all RCP scenarios as coloured vertical bars [8].

The implications for emergency management of the variation in climate projections include that risk management strategies must be developed for dealing with events with potentially high impacts on the delivery of sector services, even if their probability of occurrence is low [15]. This approach is the most suitable in attempting to increase the capacity of the emergency management sector and increase the resilience of communities when faced with uncertain and complex circumstances.



Summary of current knowledge on climate change in Queensland

Overview of potential future climate change in Queensland

Increased temperature and heatwaves

The annual median temperature of Queensland is projected to increase by 1.4°C under lower emissions and 1.9°C under high emissions by 2050. There is high level of certainty of increased frequency and intensity of heatwaves, with more extremely hot days and fewer extremely cool days [9, 16, 17] (Figure 6).

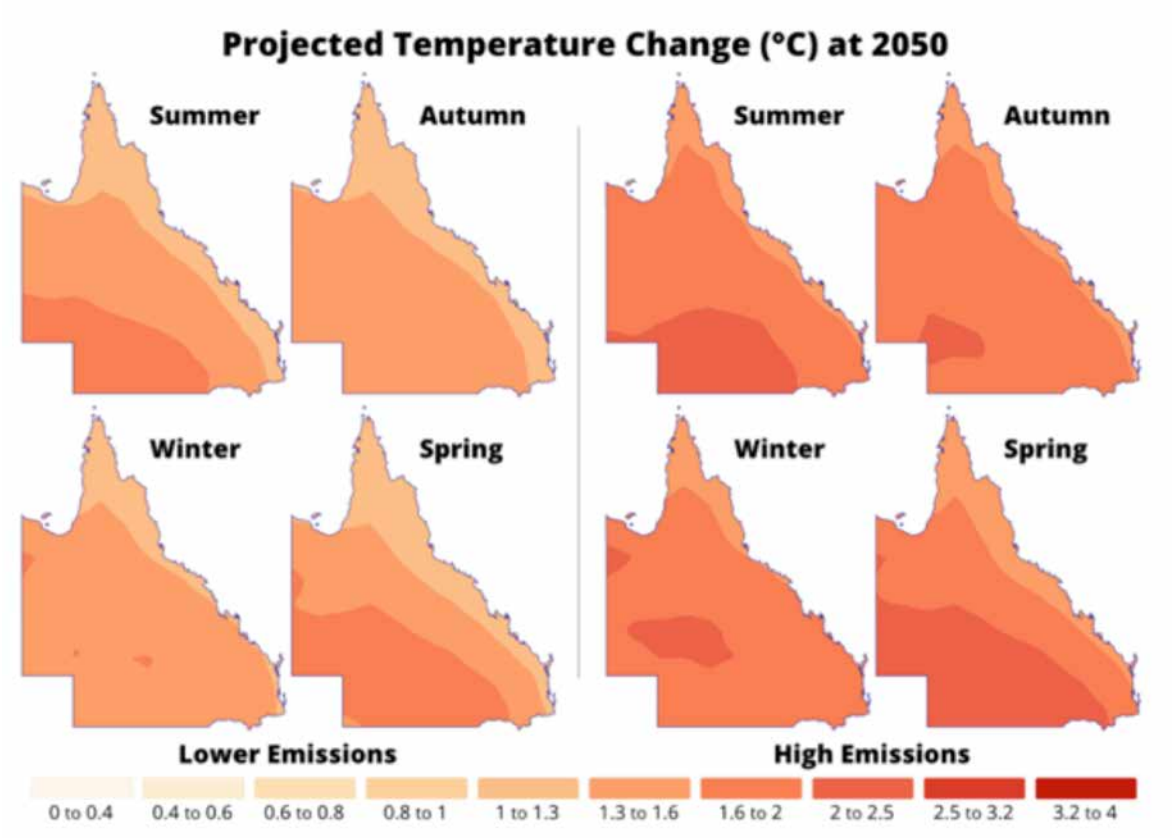


Figure 8: Temperature projection for Queensland for 2050 under lower emission (RCP 4.5) and higher emission (RCP8.5) scenarios.

Source: The Climate Change in Queensland map application tool (http://qgsp.maps.arcgis.com/apps/MapJournal/index.html?appid=1f3c05235c6a44dcb1a6faebad4683fc)

Fire danger

There is strong evidence that Queensland will experience an increased frequency of high fire risk days, with uncertainty about the magnitude of change [17–21].

Rainfall events

In general, Queensland can expect longer dry periods interrupted by more intense rainfall events (Figure 7). Some research suggests extreme El Nino and La Nina events may become more frequent [22, 23]. There is high level of agreement that some areas of Queensland will become drier (especially in winter and spring), and some areas will be likely to experience intensified rainfall events. These intense rainfall events will increase the risk of flooding, but uncertainty remains over which areas will be affected and the impact extent [9, 24, 25].

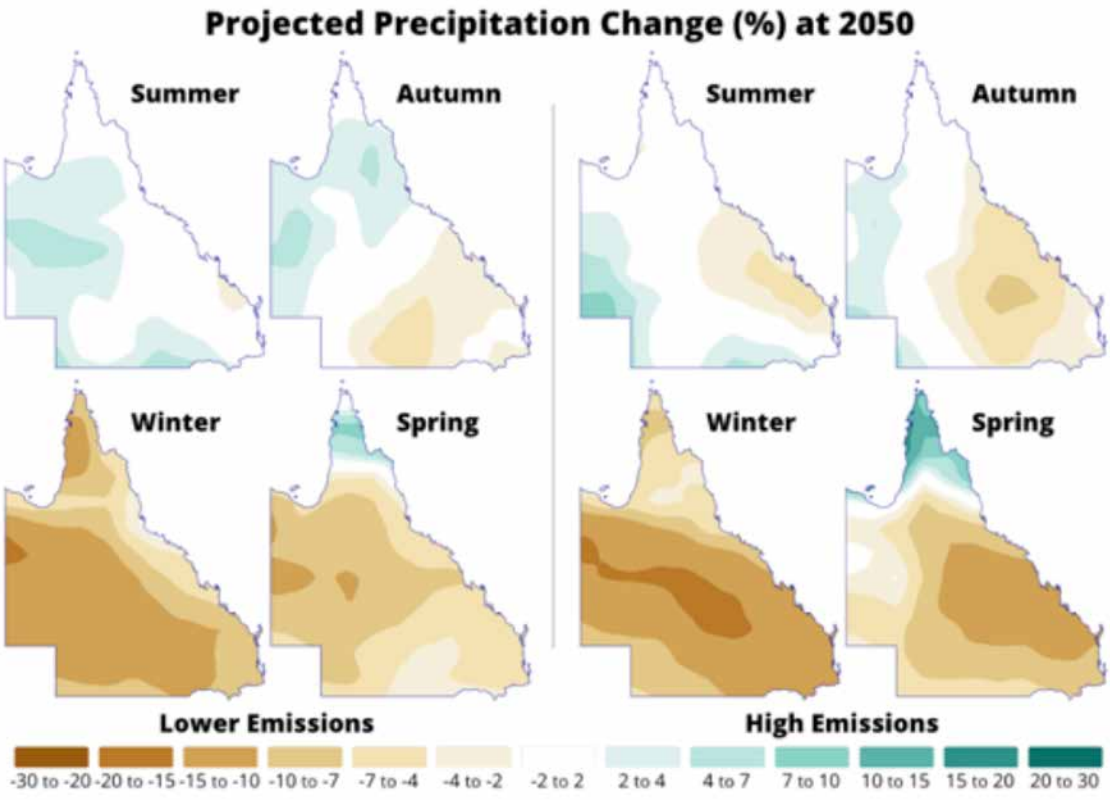


Figure 9: Rainfall projections for Queensland for 2050 under lower emission (RCP 4.5) and higher emission (RCP8.5) scenarios. Source The Climate Change in Queensland map application tool (http://qgsp.maps.arcgis.com/apps/MapJournal/index.html?appid=1f3c05235c6a44dcb106faebad4683fc)

Rising sea levels and increased storm surge events

There is a high level of certainty of sea-level rise resulting from thermal expansion of the ocean, but the rate and extent of additional sea-level rise caused by ice melt remains uncertain [16, 26].

Along the Queensland coast, sea level is expected to rise 13cm by 2030 (the model range is 8–18cm), and 65cm by 2090 (the model range is 45–87cm) under the high emission scenario [9, 26, 27]. The upper limit could be higher if rates of ice sheet melt are higher than currently modelled. A rise in sea level is likely to increase inundation of low-lying areas and erosion of soft shores.

Tropical cyclones

Uncertainty remains over the influence of climate change on the location, frequency and severity of tropical cyclones in Queensland. However, model projections show a future decrease in the number of tropical cyclones globally, but with an increase in the proportion of high intensity tropical cyclones.[21, 37-39].

Available scientific information to assess climate change risks

Climate change and sea-level rise projections play a crucial role in understanding future risks to Queensland communities. These projections are developed by climate scientists and available in different formats and variable levels of detail. A number of governments and scientific organisations deliver future hazard information at a high level, suitable for using in policy-making and strategic management decisions. Table 1 shows a list of the key scientific and government bodies providing knowledge and data of future hazards for Queensland, including climate change and sea-level rise projections.

Table 1: Sources of future hazard information for Queensland

Type of hazard/ climate variable	Source of information	Type of information that is available	Climate change scenarios and time frame of data	Potential application in emergency management
Mean Climate, Heatwaves, Extreme Indices, Droughts and Floods	Queensland Future Climate Dashboard https://www.longpaddock.qld.gov.au/ (to be updated in the near future)	Provides regional climate change summaries for a range of different regions and metrics	RCP 8.5 for year 2030, 2050, 2070 and 2090 across seasons with 10 km of spatial resolution	Suitable for getting detailed future climate change information at regional levels e.g. disaster management districts and Local Government areas of Queensland.
Heat wave, excessive rainfall, drought, coastal inundation	Climate Change in Australia website http://www.climatechangeinaustralia.gov.au/climatechangeinaustralia.gov.au/	Provides general information about climate change as well as regional summaries for 5 climate sub clusters roughly aligned with NRM regions for 14 climate variables based on global coarse resolution climate models (~200 km). It also provides comprehensive technical data and information to provide projections or inform decision-making.	4 RCP and 3 SRES scenarios at 5-year intervals from 2025 to 2090; monthly, 3-monthly, 6-monthly and annual changes	Can be used for obtaining an overview of future climate at a broad scale (Natural Resource Management Regions).
Information on impacts and adaptation in for coastal areas.	CoastAdapt (NCCARF) https://coastadapt.com.au/	The program provides a number of technical and adaptation guidelines for the coastal context.	Summary of mean climate based on Climate Change in Australia website http://www.climatechangeinaustralia.gov.au/	Suitable for getting an overview of impacts and adaptation in for coastal areas.
Coastal erosion and inundation	Department of Environment and Science https://www.ehp.qld.gov.au/coastalplan/coastalhazards.html#erosion_prone_area_maps	Coastal hazard area maps indicate the footprint of the inundation from a defined storm event or storm tide event with a 1% (or one-in-100 year) annual return probability and declared erosion prone areas	It considers state wide 0.8m rise of sea level by 2100	Suitable for identifying hazard prone coastal areas

*SRES (special report on emissions scenarios) are emission scenarios developed by Nakicenovic and Swart (2000) [31] and used as a basis for some of the climate projections in earlier IPCC assessment reports (up to AR4 in 2010). SRES start with socioeconomic circumstances from which emissions trajectories and climate impacts are projected into the future.

Why is climate change important for the emergency management sector?

Why is climate change important for the emergency management sector?

Impacts of climate change on extreme events

Heatwaves

Heatwaves have caused more deaths in Australia since 1890 than bushfires, cyclones, earthquakes, floods and severe storms combined [32]. Queensland is experiencing warmer weather over time, with an increase in exposure to higher temperatures and heatwaves causing heat stress, illness and deaths [33, 34]. Extreme heat increases the risk of heat-related illness across the population, and can also exacerbate pre-existing conditions such as cardiac and respiratory conditions. Children, the elderly and manual workers exposed to extreme heat (e.g. working outdoors or indoors without adequate cooling during heatwaves) are most at risk [32, 35]. More than 100 excess deaths in Brisbane were attributed to the summer of 2004 heatwave [33]. One study assessed the impact of heatwaves on mortality and emergency hospital admissions from non-external causes in Brisbane between 1996 and 2005 and found a statistically significant increase in mortality among the elderly and people with cardiovascular, renal or diabetic disease [34].

In 2014, the World Health Organization estimated an additional 250,000 potential deaths annually around the world between 2030 and 2050 due to the impacts of climate change [36]. Scientists have shown that just a half degree increase in average summer temperature, as has occurred over the past century, strongly influences the probability of occurrence of a dramatic heatwave, such as that in 2003 in Europe which killed more than 40,000 people [37, 38]. A recent study estimated that under a high-emission scenario, temperature-related excess mortality in Brisbane will increase by 92.5 per cent towards the end of the century relative to baseline numbers from 2000–2009[39].

However, heatwaves only become disasters if the community is unable to respond to the meteorological conditions [40]. Aging populations, socioeconomic vulnerability and poor urban planning can all contribute towards reducing a community's capacity to adapt to heatwaves [41, 42]. The emergency management sector in Queensland plays a key role under these circumstances, with increased peak demand for its services to manage or respond to heat exposure events, including demand for early warning and risk communication with communities. A study that investigated the effects of heatwaves on ambulance attendances in Brisbane found a 50.6 per cent increase in ambulance attendance for a 9.5°C increase above a reference temperature of 29°C [43].

Extreme conditions during heatwaves can also impact on critical infrastructure. Heatwave events can trigger power outages due to increased peak demand. This in turn can cause service failure among multiple critical infrastructure systems. Prolonged periods of increased temperatures coinciding with high demand for water may also damage water infrastructure, leading to the risk of contamination through bacterial growth[44]. Transport infrastructure such as rail lines can buckle under excessive and prolonged heat causing short-term disruption to major services, which can lead to traffic congestion in roads and reduce the ability of emergency services to respond to assistance requests of all types [44]. The number of days of high fire risk across south-east Australia is increasing, which has the potential to increase the number and intensity of bushfire events [45]. Complexities for the sector exist where extreme heat events coincide with fire events (as they often do at present), and this may increase in future [35].

Coastal inundation and erosion

Sea-level rise and associated changes in extreme waves can accelerate the erosion of coastal margins, threatening surrounding land, property and infrastructure. Rising seas may also lead to an increase in coastal flooding, either by providing a higher median sea level and increasing the height of storm surges, or by acting as a higher seaward barrier, restricting the escape of floodwaters caused by excessive run-off [46]. Australia relies heavily on the coastal zone for livelihood, with approximately 85 per cent of the population living within 50 km of the coast, and 710,000 addresses below 6 m elevation [47]. A number of critical infrastructure facilities such as airports, parts of major highways and sewage treatment plants are also located close to the coast, and some of them in Queensland are in low-lying, hazard-prone areas. A national first-pass risk assessment of sea-level rise conducted by the Federal Government in 2011 estimated the replacement cost of Queensland buildings and infrastructure as a result of a 1.1m sea-level rise at between $35 and $55 billion [48].

With a higher median sea level in the future, coastal waves during storms and cyclones will reach extreme heights more frequently, inundating low-lying coastal settlements [49]. The foundations of infrastructure close to erodible shores will be at risk as a result of erosion of soft shores and coastal margins [50, 51]. These coastal hazards can affect exposed infrastructure leading to power outages, contamination by sewage, destruction of road networks and temporary suspension of rail, maritime and air services. Although coastal management does not reside with the emergency management sector, the occurrence of extreme coastal events can lead to increased demand on sector services, such as search and rescue operations, restoration of affected infrastructure, utilities and houses, removal of dangerous obstacles, and provision of support and accommodation for affected communities [15].

Figure 10: The combined estimated replacement value (A$ billion) for residential, commercial and transport infrastructure for a 1.1 metre sea-level rise [48].

Inland flooding (including excessive rainfall and severe weather events)

The risk of flood events is influenced, not only by the intensity of precipitation in the river basin, but also by the flow regime that is strongly affected by land use in the catchment [40]. Projected increases in the intensity of heavy rainfall would contribute to increases in precipitation-generated local flooding (e.g. flash flooding and urban flooding) [52]. Such events may interrupt essential services such as electricity, water, sewage treatment and health care, and also have direct impacts on housing, business and industry. Flooded roads disconnect and isolate communities, hospitals etc., resulting in demands on the emergency management sector to support and maintain the functioning of those affected. The economic costs of flooding are significant. For example, the health and social costs associated with the 2011 Queensland floods amounted to $7.4 billion, and the costs due to damage to infrastructure and commerce amounted to $6.7 billion [53]. Economic losses from floods have greatly increased over the years, and these increases are likely to continue, principally driven by the expanding exposure and value of assets at risk [54].

Bushfires

Fire threats to tropical and subtropical Queensland have been increasing over the years. Weekly bushfire frequencies in Australia increased by 40 per cent between 2008 and 2013, with tropical and subtropical Queensland the most severely affected regions [55]. Projected changes in the forest fire danger index indicate this trend is likely to continue [9]. A number of climatic factors that influence bushfires are likely to change as a result of climate change (e.g. higher temperatures, changes in drought frequency, drier soils, changing vegetation structures, strong winds, increased storm activity), and where these factors increase in frequency and intensity, this is expected to lead to more high fire risk days and higher bushfire potential in parts of the state[9, 56].

Bushfire is mostly observed in natural bushland areas across Queensland, with some interaction with the peri-urban and urban landscape. Nearby infrastructure such as power and communication nodes, roads and rail networks, and air services are likely to observe short- to medium-term disruption periods, with potentially damaging impacts during future fire events. Demand for emergency management sector resources will increase as communities situated in at-risk areas come under threat more frequently. Additionally, short-term disruption to road and rail networks may also impact access, resupply and response efforts within the affected communities. Disruption and loss to local and regional economies and industry may occur, and the impacts will depend on the severity of the event [44].

With extension of the fire danger season in future, firefighting agencies will face increasing demand for services, increased cost and fire suppression difficulty, prolonged and complex recovery, and employee and volunteer fatigue [15, 57].

Tropical cyclones

In comparison to heatwave and sea-level rise, tropical cyclones (TCs) are the product of more complex atmospheric interactions, and therefore their future projection is much more uncertain [40]. However, scientists suggest that increases in atmospheric carbon dioxide concentrations will provide more energy to fuel TCs, which may lead to higher intensity wind speeds. As a result, some future projections based on theory and modelling tend to indicate that fewer but more intense TCs can be expected [58–61]. Other papers suggest that both storm frequency and intensity may decline due to climate change [62, 63], or the possibility of cyclone activities moving further southward [64], so the situation with respect to future projections of TC occurrence remains highly uncertain.

The impact of TCs in Queensland depends on their intensity, location of landfall and correlation to astronomical high tides. They have the potential to disrupt power and communication networks and cause the closure of transport facilities in affected areas. As a result, remote communities can be isolated, making it difficult for the emergency management sector to operate and provide the necessary relief to the community.

The presence of highly vulnerable people in the impact area can further increase the complexity of emergency operations.

Some critical infrastructure, such as hospitals, medical and care facilities, are located in hazard-prone areas, and are highly vulnerable to the effects of a TC (e.g. high winds, flooding and storm surge) that may lead to structural damage to buildings [44]. Disruption of these critical services can be compounded by the addition of secondary hazards such as riverine and flash flooding, and by increasing high tide levels due to sea-level rise.

The influence of climate change on sector policy

In 2016, the World Economic Forum listed 'failure of climate change mitigation and adaptation' as its highest risk in terms of impact, and third highest in terms of likelihood [65]. While mitigation focuses on reduction of greenhouse gas emissions to reduce future atmospheric concentrations, adaptation focuses on addressing the impacts and risks that may arise in future as a result of climate change. The following summary outlines a number of agreements, frameworks and policies that influence sector priorities and activities.

Climate mitigation policies

At an international level, the Paris Agreement [66], which entered into force in late 2016, provides the basis for international mitigation efforts, with an aim of keeping the average global temperature rise this century below 2ºC above pre-industrial levels, and limiting the increase to 1.5ºC. The 2017 review of climate change policies [67] conducted by the Australian Government provides an exhaustive list of national-scale mitigation policies. At a state level, the Queensland Climate Transition Strategy [68] outlines how Queensland intends to transition to a zero net emissions future that supports jobs, industries, communities and the environment. The sector will need to consider what the arising transitional risks will be, and how it may contribute to these transition targets moving forward (see 'Link between mitigation and adaptation').

Climate adaptation policies

At an international level, the Sendai Framework for Disaster Risk Reduction 2015–2030 [69], to which Australia is a signatory, is the new global blueprint to reduce risk and build resilience to disasters. Its expected outcome to 2030 is to realise 'substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries'.

Australia has also committed to the United Nations 2030 Agenda for Sustainable Development, and the 17 Sustainable Development Goals (SDGs) [70]. The SDGs represent an important guiding framework, with several of particular relevance to the emergency management sector. For example, SDG 13 (Climate Action) includes targets for strengthening resilience and adaptive capacity to climate-related hazards and natural disasters (in all countries), integrates climate change measures into national policies, strategies and planning, and improves education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

At a national level, the National Strategy for Disaster Resilience (NSDR), 2011 [71] provides a basis for increasing natural disaster resilience, including climate change across the nation. The purpose of the Strategy is to provide high-level guidance on resilience strategies to federal, state, territory and local governments, business and community leaders, and the not-for-profit sector. The NSDR acknowledges climate change as a major threat to Australia's national security and resilience.

There are a number of state-specific strategies and frameworks in place

in Queensland that respond to climate change and extreme events. To assist with the state level implementation of the NSDR, the Queensland Strategy for Disaster Resilience (QSDR) was released in 2017, and 'provides a framework to align disaster resilience activities with Queensland Government priorities, including the Q-CAS [72]. Through the QSDR, the Queensland Government commits to 'understanding the risks associated with a warming climate with improved coastal management' and 'identifying adaptation opportunities following disasters and in anticipation of climate change' [72]. More recently, the Queensland Reconstruction Authority released Resilient Queensland: 2018–2021 to coordinate the state-wide delivery of the QSDR. It is an engagement and implementation plan to ensure outcomes are delivered against the objectives of the QSDR, including a changing climate [73].

The Q-CAS [74] provides the basis for climate adaptation for the state, and outlines how the state will prepare for current and future impacts of a changing climate to reduce risk and increase resilience. As part of this approach, the EM-SAP will reflect and build on existing policy, as it outlines policy direction and priority action areas for adaptation within the sector.

The 2017 Queensland State Natural Hazard Risk Assessment [44] and the Queensland Emergency Risk Management Framework (QERMF) [44] support the communication of risk information across the QDMA and adopts a multi-hazard approach (Figure 11). The QERMF was endorsed in August 2017 by the Queensland Disaster Management Committee as Queensland's approach to the management of natural disaster risks at all levels of the QDMA, and complements existing and widely recognised risk management standards. Moving forward, QFES will be examining how climate change scenarios can be incorporated into the QERMF.

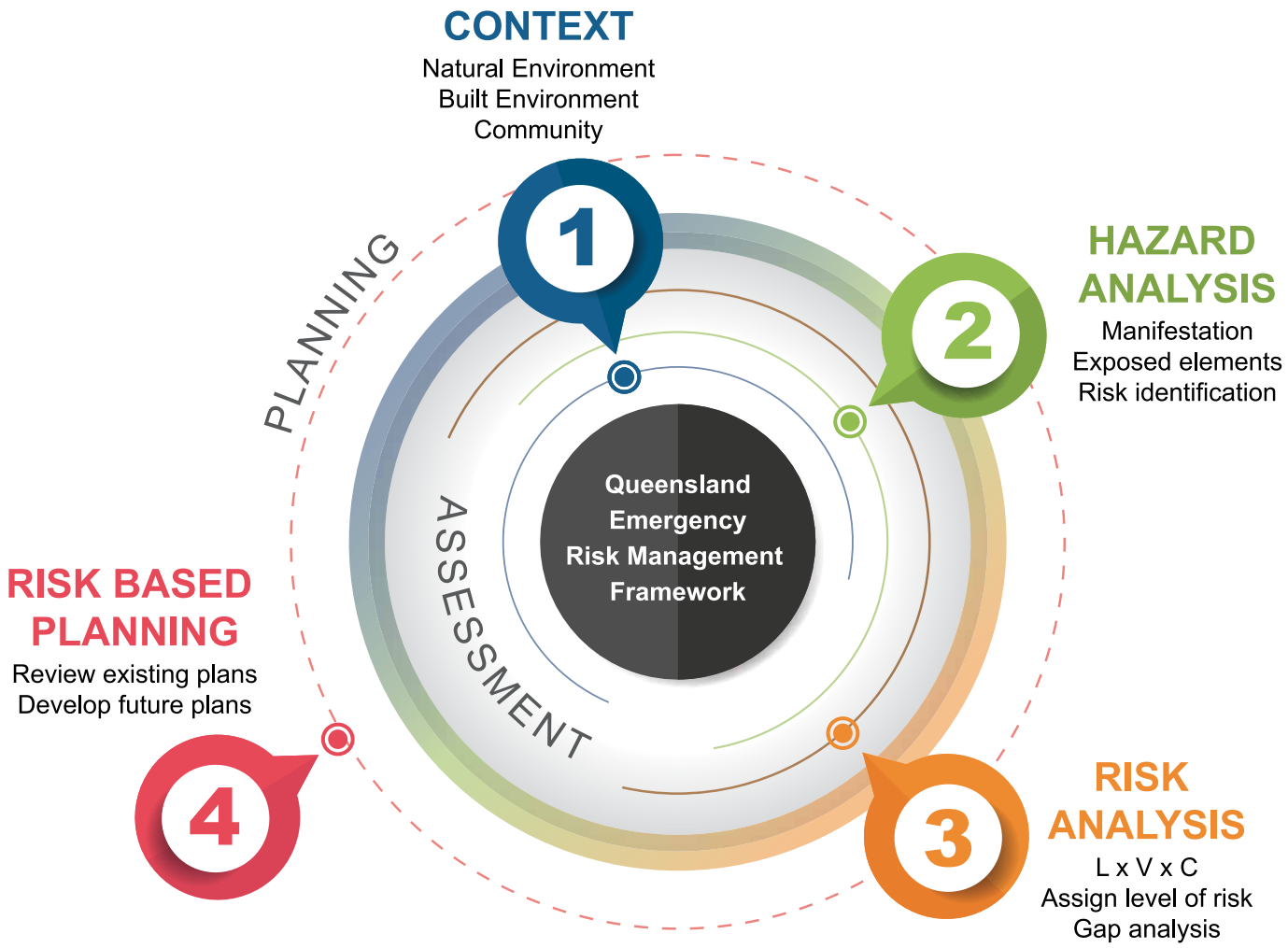


Figure 11: Queensland Emergency Risk Management Framework [75].

Other relevant activity guiding climate adaptation for the sector

A position paper recently approved by the Australasian Fire and Emergency Service Authorities Council (AFAC) identifies the potential climate change impacts and risks to the sector, in particular the physical, transitional and legal risks [76]. The paper provides high-level recommendations for the sector that will continue to influence the national direction in this space.

The Centre for Policy Development and the Future Business Council commissioned and published a legal opinion by Noel Hutley QC in 2016 [77]. This opinion reflects the extent to which Australian corporate law requires board directors to take climate change into account when making decisions about organisational strategy, performance and risk disclosure. It suggested that directors who fail to properly consider the impact of foreseeable climate change risks on their business could be held personally liable in a court for breaching their duty of due care. This decision has been endorsed by the Australian Prudential Regulation Authority and the Australian Institute of Company Directors, and is now resonating across all sectors, in particular, banking and finance, and emergency management.

Link between climate change mitigation and adaptation

To build resilience to climate change impacts and prepare for a low-carbon world, the sector needs to consider its own contribution to climate change, and begin to address its contribution to Australia's emissions (see Principle 8). There is scope and opportunity for the sector to improve resilience of its own organisations by transitioning to low-carbon and environmentally friendly technology. For example, by investing in solutions such as renewable energy and battery storage, the reliance on centralised power and communications infrastructure can be reduced, which will contribute to enhanced sector resilience during disasters (see Case study 1). Additionally, the sector may also reduce transition risk posed by the evolution of goods and services within other sectors (e.g. automotive industry, utilities) by taking a proactive approach in its asset and organisational management.

Sector examples of climate adaptation | 28

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Sector examples of climate adaptation

The following section includes five case studies that provide examples of existing climate adaptation activities within the sector. Further examples can be found in Theme 2 under Appendix 2.

Case study 1: Development of a robust communications network to support emergency management in the remote Wujal Wujal community

Wujal Wujal, a remote Indigenous community on Cape York Peninsula, often suffers major challenges during heavy rain, with all roads out of town routinely cut off, and the Bloomfield River flooding and dividing the town. Unreliable telecommunications service during such severe weather events was a major barrier in community response and emergency management. In previous years, telecommunications have failed on several occasions during extreme events for periods in excess of 48 hours. To increase emergency management capacity, Wujal Wujal Aboriginal Shire Council has set up a new communications network that is independent of the Telstra landline and mobile 3G system, and can be used for emergency management to provide warnings to communities, even if the landline and mobile networks fail. The project was funded by the former Queensland Department of Infrastructure, Local Government and Planning.

Figure 12: Left image: Back-up battery system. Middle image: Communication access point. Right image: Online community forum.

An Australian first, the Wujal Wujal valley-wide Emergency Management Network and Community Forum provides those working and living within the community with a means of telecommunications that is wind- and rain-resistant and robust, and has sufficient capacity to enable local council, police, health services and volunteers to manage conditions pre- and post-emergency event when and if normal telecommunications systems are compromised. The network operates independently of the energy supplier Ergon, with each equipment site equipped with solar and battery systems (Figure 12, left-hand side). The network operates parallel to Council's existing servers and is firewalled and secure.

Key network functionalities are:

- The network provides intra-community communications by voice, text and email using a VoIP application on 'smart devices', even if the telecommunications network has failed.
- Council is able to batch issue warnings, notifications and information to network users and groups of users by voice, text and email.
- Internet access is available through the network for select users.
- Video and image transfer is available.
- Council can view and operate infrastructure, including water and wastewater treatment, collection and storage facilities through the network.
- Users are able to access Council-approved websites, including Transport and Main Roads (flood cams), Bureau of Meteorology and Ergon.

The network, which was designed and developed in 16 weeks, is based on a microwave radio-linked backbone with three main towers (Figure 12, middle). It has two communication servers that share the workload, each capable of automatically controlling network operations should the other fail. Cyclone-hardened wi-fi access points take signals to and from the radio backbone, and deliver services to the user via wi-fi to hand-held smart devices and PCs equipped with a wireless network card. Services on the network can be accessed using publicly available free Android and iOS apps. Most households in the community have at least one smart phone user. This hard communications network is supported by 'soft services', providing access to this functionality to the community. This includes broadcast voice and text messages to smart phones and an online platform to disseminate relevant information (Figure 12, right-hand side).

Case study 2: Queensland Future Climate Dashboard

Understanding the need to provide reliable regional scale simulations of future climate, the Science Division from DES has downscaled 11 state-of-the-art global climate models to 10 km grid cells. Higher spatial resolution means that regional climate models take into account local biophysical properties such as topography, vegetation and land–sea contrast, and better simulate local climate as a result. In addition, Queensland's future climate simulation provides continuous projections until the end of the century, rather than previously used time windows. However, these improvements to the spatial and temporal resolutions produce larger files and create new barriers for data accessibility.

In order to facilitate data access and support climate adaptation policies and management, DES has conceptualised and implemented a new online platform with information about future climate. The Queensland Future Climate Dashboard summarises information from 11 state-of-the-art climate models with regional scale simulations until 2099. The dashboard is a visualisation platform composed of drop-down menus, maps, plots and tables, so users can customise, visualise and export summarised future climate information according to their interest.

The Queensland Future Climate Dashboard provides high resolution simulations for 30 different metrics grouped in six climate themes:

1. mean climate
2. heatwaves
3. extreme temperature indices
4. extreme precipitation indices
5. droughts
6. floods.

The information for regional projections was spatially aggregated from 10 km pixel-size grids to specific regions. The five specific regions in which projections are presented are:

1. local government areas
2. Regional Plan areas
3. bioregions
4. major river basins
5. disaster districts.

In addition, users can visualise and download future climate data across calendar seasons, wet and dry periods and years. Information is summarised for four 20-year time slices centred in 2030, 2050, 2070 and 2090.

The Queensland Future Climate Dashboard offers a fully interactive interface where users can customise maps and plots, as well as download summary statistics, screenshots and spatial data for different purposes, such as local and regional planning, biodiversity management, water management and emergency services. By combining cutting-edge high-resolution climate models and latest trends in big data visualisation within an interactive platform, DES expects to bridge climate science and adaptation through an easy-to-use platform for end-users (see figure 13).

Visit the dashboard at https://longpaddock.qld.gov.au/climate-adaptation/

High Resolution Climate Change Projections

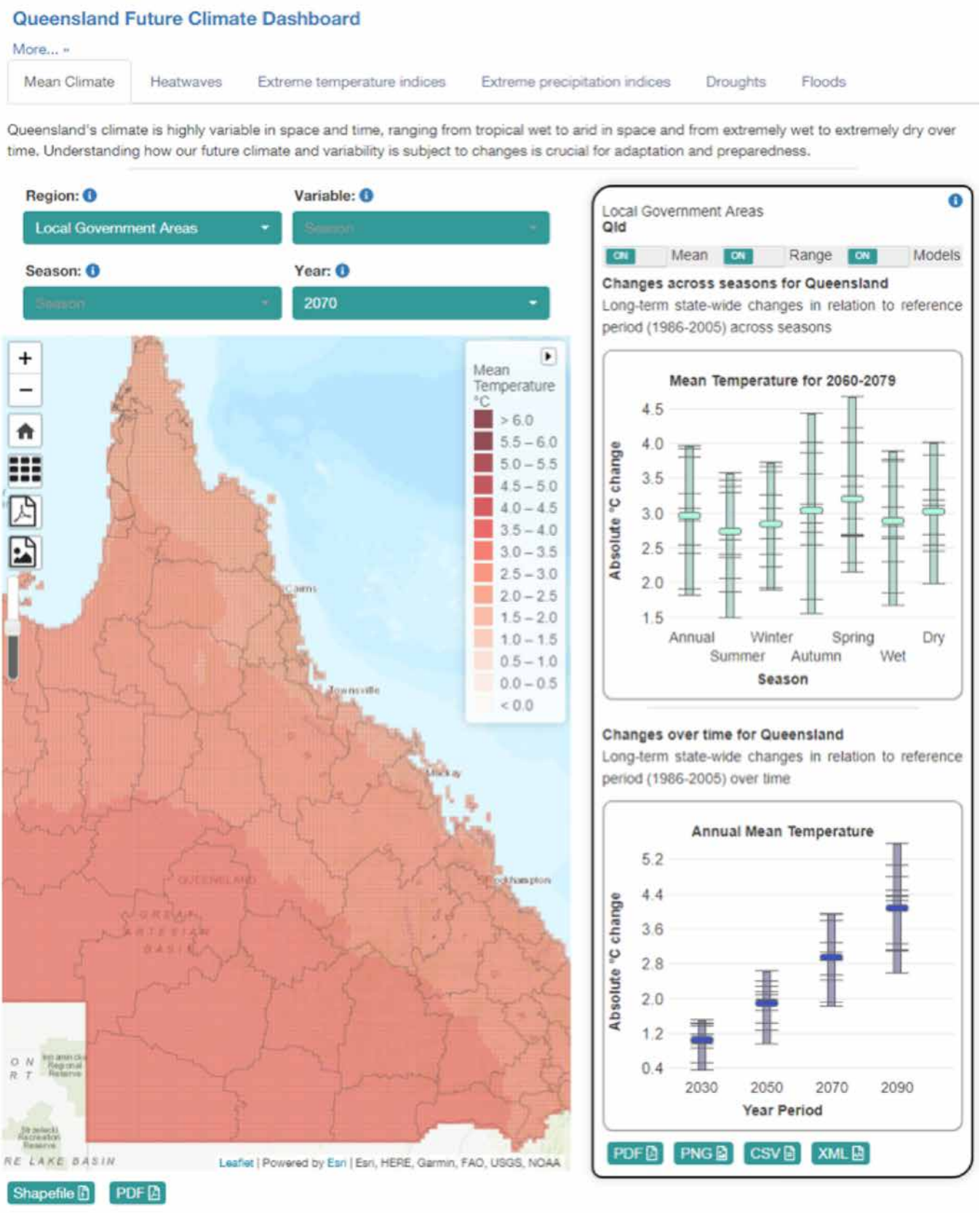

Figure 13: Queensland Future Climate Dashboard, an interactive geovisualisation platform for high resolution climate simulations.

Case study 3: State Heatwave Risk Assessment – Moving towards a collaborative understanding of Queensland's current and future risk

The State Natural Hazard Risk Assessment 2017 accorded the risks posed by severe and extreme heatwaves as the third highest priority for Queensland. They cause substantial impacts for society and the environment in several ways, including human health, agriculture, economy, natural hazards and ecosystems. Heatwaves are Australia's most costly natural disaster in terms of human impact, resulting in 4555 deaths from 1900 to 2011; greater than the sum total of all other natural hazard fatalities in the same period [32].

In January 2018, QFES began the process of undertaking a detailed macro-level risk assessment in partnership with Queensland Health and DES. The key objectives of the assessment include:

- support and inform key decision-making and disaster management planning across all levels of the QDMA with regard to current and future heatwave risk
- support Queensland Health in its role as the lead agency for heatwaves under the State Disaster Management Plan
- use the most current and accurate projections to understand Queensland's future heatwave risk potential
- analyse and report on severe and extreme heatwave risk against the six exposed elements categories used in the QERMF.

The project will be a collaborative effort across government and non-government organisations across the public and private sectors, and involve substantial engagement at state and regional level. It will culminate in the publication of the State Heatwave Risk Assessment (planned for January 2019).

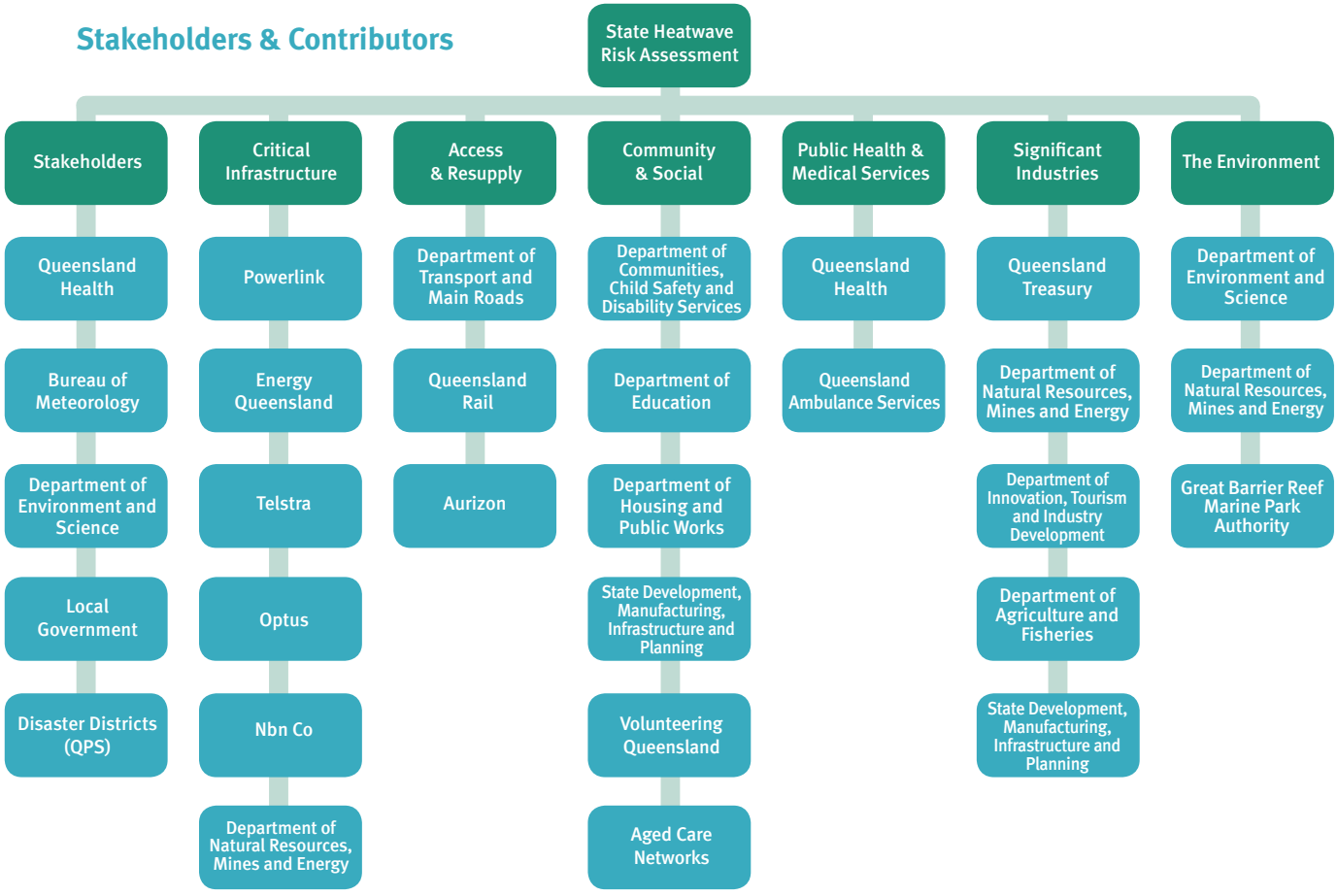

Figure 14: An overview of the stakeholders and contributors being engaged for the project.

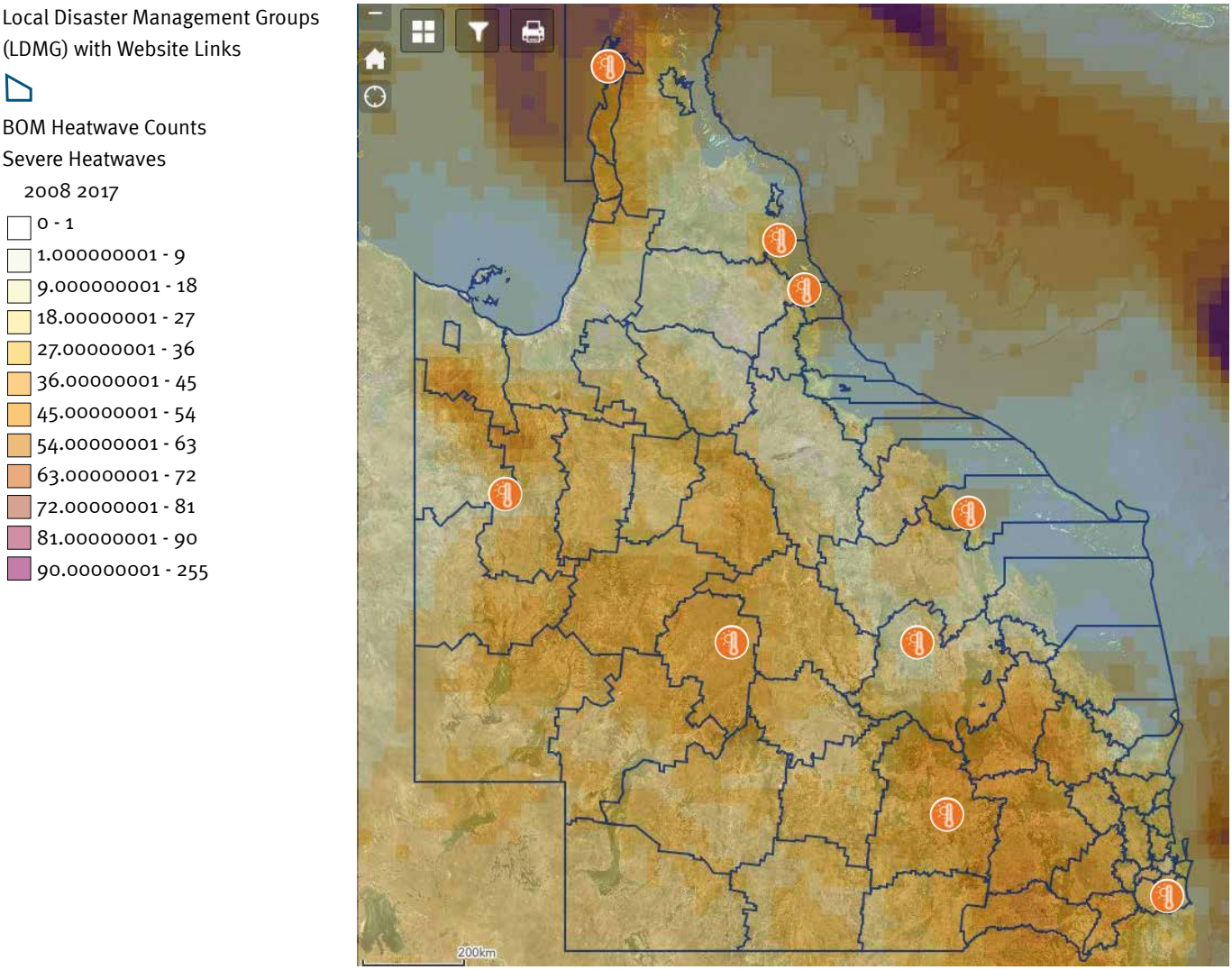

Figure 15: A visualisation of severe heatwaves between 2008–2017, overlaid with the broad locations of the communities to be examined as a part of the risk assessment.

Case study 4: The Queensland Climate Resilient Councils program

The Queensland Climate Resilient Councils program (Q CRC) is a three-year program funded by DES and delivered by the LGAQ. The program is working with 32 Queensland local governments to review and strengthen internal council decision-making processes to respond to climate change. By the end of the program, participating Queensland councils will have an increased capability to take positive actions to reduce emissions and adapt to climate change.

Phase 2 of the program was a detailed assessment of local government ability to reliably, consistently and efficiently instigate and implement decisions about responding to climate change. Councils were assessed against the 17 governance indicators (below) on a scale of 0 to 4, where 0 is none (poor practice) and 4 is advanced.

Indicators	
1. Corporate plan	10. Climate change policy
2. Financial management	11. Climate risk assessments
3. Public risk register	12. Climate legal risk
4. Asset management	13. Staff capacity and resource allocation
5. Land-use planning	14. Community/stakeholder engagement
6. Disaster management	15. Institutional/intergovernmental relationships
7. Greenhouse gas emissions	16. Climate change information
8. Climate risk management	17. Information systems
9. Adaptation planning	

To achieve a score of 4 in the area of 'disaster management':

> *The Local Disaster Management Plan (LDMP) needs to have a comprehensive inclusion of climate change. Climate change needs to be considered in all elements of the Prevention, Preparedness, Response and Recovery (PPRR). An advanced emergency management plan will identify the changing landscape of risk under a changing climate. It should link to other council activities and policies, in particular land use planning, asset management and community engagement. It should also contain rational cost/benefit and social investment decisions. A supporting climate change policy will greatly assist the implementation of an advanced emergency management plan. However, it should be noted that a basic score does not necessarily mean that the LDMP is compliant with the Queensland Local Disaster Management Guidelines (just has a high consideration of climate change in the hazard description).*

To maintain a score of 4, it is recommended that local governments 'monitor any new IPCC reports, government regulations and emerging standards which may affect adaptation actions. Furthermore, ensure that the council maintains sufficient staff capacity and resourcing to maintain this score for this indicator'.

Phase 3 of the Q CRC program commenced in January 2018, and is required to meet objectives B and D of the program:

- B. Queensland local governments have ready access to tested, accurate, appropriately targeted and fit-for-purpose information, templates and documents, that support defensible, timely and effective local climate change decision-making
- D. Development of a local government climate strategy guideline.

For further information about the LGAQ Q CRC program, go to http://qcrc.lgaq.asn.au/

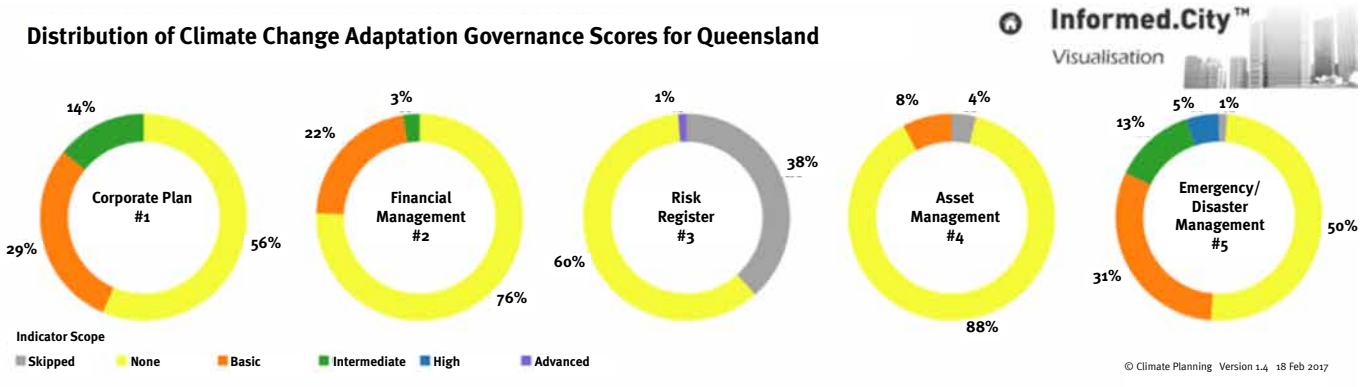

Figure 16: 2015–16 sample distribution of the baseline local government Climate Change Adaptation Governance Scores prior to the Q CRC commencing.

Case study 5: The Livingstone Shire Centre of Excellence for Disaster Management, Innovation and Community Resilience – 'The Hub'

Livingstone Shire Council has been significantly impacted by several natural disaster events since 2014, costing the community over $6.1 million. To foster resilience within the community and enhance emergency management capability in the area, the Livingstone Shire Centre of Excellence for Disaster Management, Innovation and Community Resilience was opened on 28 April 2018.

Nicknamed 'The Hub', the facility will be a focal point in building regional resilience, and will encourage climate adaptation through community workshops, training and information sessions. The location of 'The Hub' is an important part of the community engagement, being nestled in the main street of Yeppoon, fronting onto a park and giving a great inside and outside venue for education and engagement.

It is a multi-use facility that will also be activated in times of disaster, playing host to the Local Disaster Coordination Centre, and is built to stringent tropical cyclone standards. It has already hosted climate change workshops, school visits, Economic Development Plan launch and business continuity planning discussions, the Local Government Managers Australia Queensland Propeller Program, Local Disaster Management Group meetings, District Disaster Management Group meetings, and Recovery and Resilience Taskforce meetings.

Partnerships are also taking shape with tertiary institutions to take education and resilience-building to the next level, with the proposed embedding of research students, as well as short and diploma level courses to be conducted in the new facility. This proposed structure will ensure research and academia are embedded into the operational functionality of the facility.

The project received $3.35 million in funding under the Natural Disaster Resilience Program, a joint investment by the State and Federal governments, and $2.875 million from Livingstone Shire Council.

Figure 17: Livingstone Shire Centre of Excellence for Disaster Management, Innovation and Community Resilience – 'The Hub'.

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Glossary

Term/acronym	Description
Adaptation	The steps governments, businesses, communities and individuals take to deal with risks from climate change impacts.
Adaptive capacity	The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.
AFAC	Australasian Fire and Emergency Service Authorities Council
Anthropogenic climate change	Any significant change in the measures of climate lasting for several decades or longer, including changes in temperature, precipitation or wind patterns. Historically, the Earth's climate has changed over time, but there is strong scientific consensus that the recent observed changes, over the past 50 years or so, have been primarily caused by human activities.
BoM	Bureau of Meteorology
Climate	Relates to the average weather over a period of months, or over thousands or millions of years.
Climate change mitigation	Includes actions taken globally, nationally and individually to limit changes in the global climate caused by human activities. Mitigation activities are designed to reduce greenhouse emissions or increase the amount of greenhouse gases removed from the atmosphere.
Climate change projections	The simulated response of the climate system to a scenario of future emission or concentration of GHGs and aerosols, generally derived using climate models.
Climate change vulnerability	The degree to which a system or group is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a result of the type, magnitude and rate of climate variation to which a system or group is exposed, its sensitivity, and its ability to adapt.
Climate legal risk	The risk of exposure to legal action that accompanies a decision that relates to climate change impacts. It encompasses the elements of factual and legal uncertainty, and specifically concerns the risk arising from legal duties and obligations as they relate to the impacts of climate change.

Term/acronym	Description
Climate risk	The potential for adverse consequences on lives, livelihoods, health, ecosystems and species, economic, social and cultural assets, services (including environmental services) and infrastructure.
Community resilience	The ongoing and developing capacity of the community to account for its vulnerabilities and develop capabilities that aid that community in preventing, withstanding and mitigating the stress of a natural disaster event; recovering in a way that restores the community to a state of self-sufficiency and at least the same level of functioning after a natural disaster event; and using knowledge from a past response to strengthen the community's ability to withstand the next disaster event.
DDMG	District Disaster Management Group
DDMP	District Disaster Management Plan
DES	Department of Environment and Science
Disaster	A serious disruption in a community, caused by the impact of an event, that requires a significant coordinated response by the State and other entities to help the community recover from the disruption.
Disaster management	Arrangements about managing the potential adverse effects of an event, including, for example, arrangements for mitigating, preventing, preparing for, responding to and recovering from a disaster.
Disaster resilience	A system or community's ability to rapidly accommodate and recover from the impacts of hazards, restore essential structures and desired functionality, and adapt to new circumstances.
Downscaling	In relation to climate data, a strategy for generating locally or regionally (10 to 100 km) scaled data from larger global circulation models.
El Niño	The warming of the oceans in the equatorial eastern and central Pacific. Over much of Australia, El Niño brings drought. See also El Niño Southern Oscillation below.

Term/acronym	Description
El Niño-Southern Oscillation	Refers to widespread 2- to 7-year oscillations in atmospheric pressure, ocean temperatures and rainfall associated with El Niño and its opposite, La Niña. It is a basin-wide warming of the tropical Pacific Ocean east of the dateline, associated with the fluctuation of a global-scale tropical and subtropical surface pressure pattern, the Southern Oscillation.
EMAF	Emergency Management Assurance Framework
Emergency management sector	Includes any organisation (government or non-government) that contributes to emergency management activities across prevention, preparedness, response and recovery, and operates within Queensland's Disaster Management Arrangements.
EM-SAP	Emergency Management Sector Adaptation Plan
General circulation model (GCM)	A numerical model that represents physical processes in the atmosphere, ocean, cryosphere and land surface, used for simulating the response of the global climate system to increasing greenhouse gas concentrations. Also known as a global climate model.
GHG	Green House Gases
Hazard	In the context of climate change, any potential occurrence of a natural or human-induced physical event that may cause damage to property, infrastructure, livelihoods, service provision, environmental resources etc.
Heatwave	Three or more days of unusually high maximum and minimum temperatures in any area.
Ice sheet	A mass of land ice that is sufficiently deep to cover most of the underlying bedrock, so that its shape is mainly determined by the flow of the ice as it deforms internally or slides at its base.
Indian Ocean Dipole	A measure of the difference in sea surface temperature in the western and eastern equatorial Indian Ocean. When positive, there is cooler than normal water in the tropical eastern Indian Ocean and warmer than normal water in the tropical western Indian Ocean.

Term/acronym	Description
Interdecadal Pacific Oscillation	A lengthy interdecadal fluctuation in atmospheric pressure. When the IPO is low, cooler than average sea surface temperatures occur over the central North Pacific, and vice versa.
IPCC	Intergovernmental Panel on Climate Change
La Niña	La Niña is the cold phase of the El Niño-Southern Oscillation. Over much of Australia, La Niña brings above average rain.
LDMG	Local Disaster Management Group
LDMP	Local Disaster Management Plan
LGAQ	Local Government Association of Queensland
Maladaptation	Defined by the IPCC (2014) as 'an action that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future'. More precisely, maladaptation is an action taken ostensibly to avoid or reduce vulnerability to climate change that impacts adversely on, or increases the vulnerability of, other systems, sectors or social groups.
NCCARF	National Climate Change Adaptation Research Facility
NRM Regions	Natural Resource Management Regions
NSDR	National Strategy for Disaster Resilience
Ocean acidification	A reduction in the pH of the ocean over an extended period, typically decades or longer, which is caused primarily by uptake of carbon dioxide from the atmosphere, but can also be caused by other chemical additions or subtractions from the ocean.
Q-CAS	Queensland Climate Adaptation Strategy
QCOSS	Queensland Council of Social Services
QCRC	Queensland Climate Resilient Councils

Term/acronym	Description
QDMA	Queensland's Disaster Management Arrangements
QERMF	Queensland Emergency Risk Management Framework
QFES	Queensland Fire and Emergency Services
QSDR	Queensland Strategy for Disaster Resilience
Representative concentration pathways (RCPs)	The results of four separate, integrated assessment model simulations, selected and defined by their total radiative forcing (cumulative measure of human emissions of GHGs from all sources expressed in watts/square metre) pathway and level by 2100. The RCPs were chosen to represent a broad range of climate outcomes, based on a literature review, and are meant to serve as inputs for climate modelling. The RCPs are not forecasts nor are they policy recommendations.
Risk assessment	A systematic process of identifying, analysing and evaluating the potential risks that may be involved in a projected activity or undertaking.
SDGs	Sustainable Development Goals
Special report on emissions scenarios (SRES)	Emission scenarios developed by Nakicenovic and Swart (2000) and used as a basis for some of the climate projections in earlier IPCC assessment reports (up to AR4 in 2010). SRES start with socioeconomic circumstances from which emissions trajectories and climate impacts are projected into the future.
TC	Tropical Cyclone
Indian Ocean Dipole	A measure of the difference in sea surface temperature in the western and eastern equatorial Indian Ocean. When positive, there is cooler than normal water in the tropical eastern Indian Ocean and warmer than normal water in the tropical western Indian Ocean.

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Queensland Government

Appendix 1: Organisations participating in the EM-SAP development process

Australian Red Cross	Local Government Association of Queensland
Australian Volunteer Coast Guard Association	Mackay Regional Council
BMT Consulting	Metro South Hospital and Health Services
Brisbane City Council	National Broadband Network
Bureau of Meteorology	National Climate Change Adaptation Research Facility
Cairns and Hinterland Hospital and Health Services	Private building contractor
Cairns Regional Council	Queensland Ambulance Service
Cassowary Coast Regional Council	Queensland Council of Social Services
Cath Moran Ecological Consultancy	Queensland Farmers' Federation
Central Queensland Hospital and Health Service	Queensland Fire and Emergency Services
Climate and Health Alliance	Queensland Health
Commonwealth Scientific and Industrial Research Organisation (CSIRO)	Queensland Police Service
Department of Agriculture and Fisheries	Queensland Reconstruction Authority
Department of Communities, Disability Services and Seniors	Queensland Urban Utilities
Department of Environment and Science	Seqwater dam operations
Department of Natural Resources, Mines and Energy	Somerset Regional Council
Douglas Shire Council	Tablelands Regional Council
Geoscience Australia	Torres Strait Island Regional Council
Gladstone Regional Council	Torres Strait Regional Authority
Griffith University	Visionstream/Telstra
Inspector-General Emergency Management	Volunteering Queensland
Livingstone Shire Council	Wujal Wujal Aboriginal Shire Council

Appendix 2: Stakeholder consultation findings

Sector stakeholder views were collected throughout the consultation process via 80 completed responses to the online survey, 74 participants in three workshops across the state, and two phone interviews. Data collected from consultation with Queensland stakeholders during the engagement process (survey, workshops, and interviews) was analysed to identify:

- the major climate change-related impacts on emergency management sector in Queensland
- existing adaptation activities within the emergency management sector
- major barriers to successful adaptation
- gaps and opportunities related to adaptation
- priority needs to enable successful adaptation (pathways to action).

Statistical frequency analysis was conducted on the objective questions of the online survey, and thematic analysis was conducted on the open-ended questions. A text analysis was conducted on the workshop and interview data using in NVivo software. Below we discuss findings on these analyses.

Survey data collection

A discussion paper and an online survey were circulated to more than 200 relevant stakeholders across Queensland. Stakeholders were identified through the engagement process, which included assistance from existing emergency management sector networks, the steering committee and NCCARF. The survey was open for five weeks and the response was encouraging, with 80 completed responses. In the following section, we look at who responded to the survey: where they work, what type of institution, and how they categorise themselves.

Who responded to the survey?

The highest percentage of respondents (35%) work in government emergency services, with the second highest (27%) from local government. Local and district disaster management groups also had a good participation rate of about 13% and 12% respectively. Participants from non-government emergency services accounted for 9% of respondents, and infrastructure and health service providers accounted for about 6.5% and 2.6% respectively. Non-government organisations (NGOs), professional associations, research organisations and natural resource management organisations collectively accounted for about 12% of respondents (Figure 18).

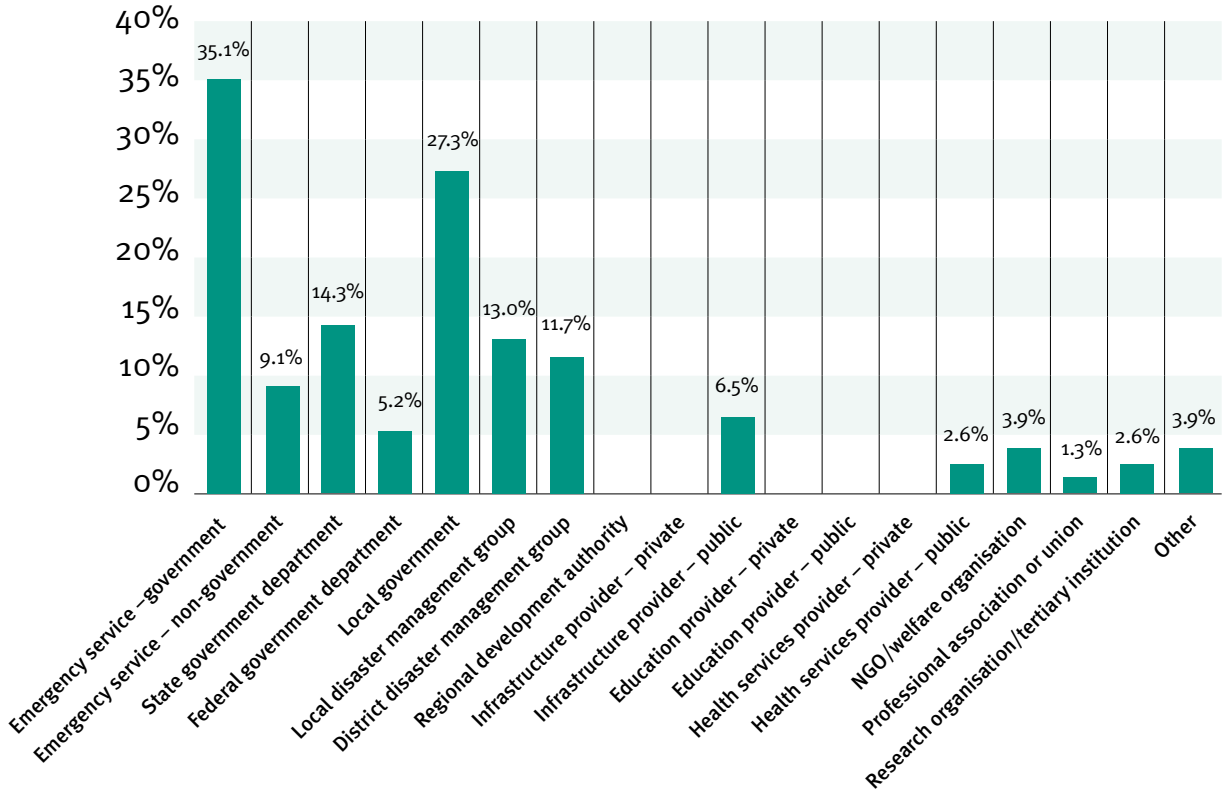

Figure 18: Distribution of organisations that participated in the survey. Sum of all categories will not add to 100% as respondents were allowed to categorise themselves into more than one.

When we asked people whether they were responding on behalf of their organisation or as individuals, 77% stated individual and the remaining 23% on behalf of an organisation.

Notably, 80% of respondents held a mid to senior level management position within their organisation, while more than 11% were advisors to the organisation. This suggests that survey responses captured viewpoints of relatively higher management within organisations.

Figure 19 shows the geographic distribution of the areas covered by the respondents.

A discussion paper was circulated along with the survey, and 51% of respondents reported reading the discussion paper before completing the survey. Out of those who read the paper, 73% read the full paper while others read parts of it. This indicates a good rate of readership of the paper among survey respondents.

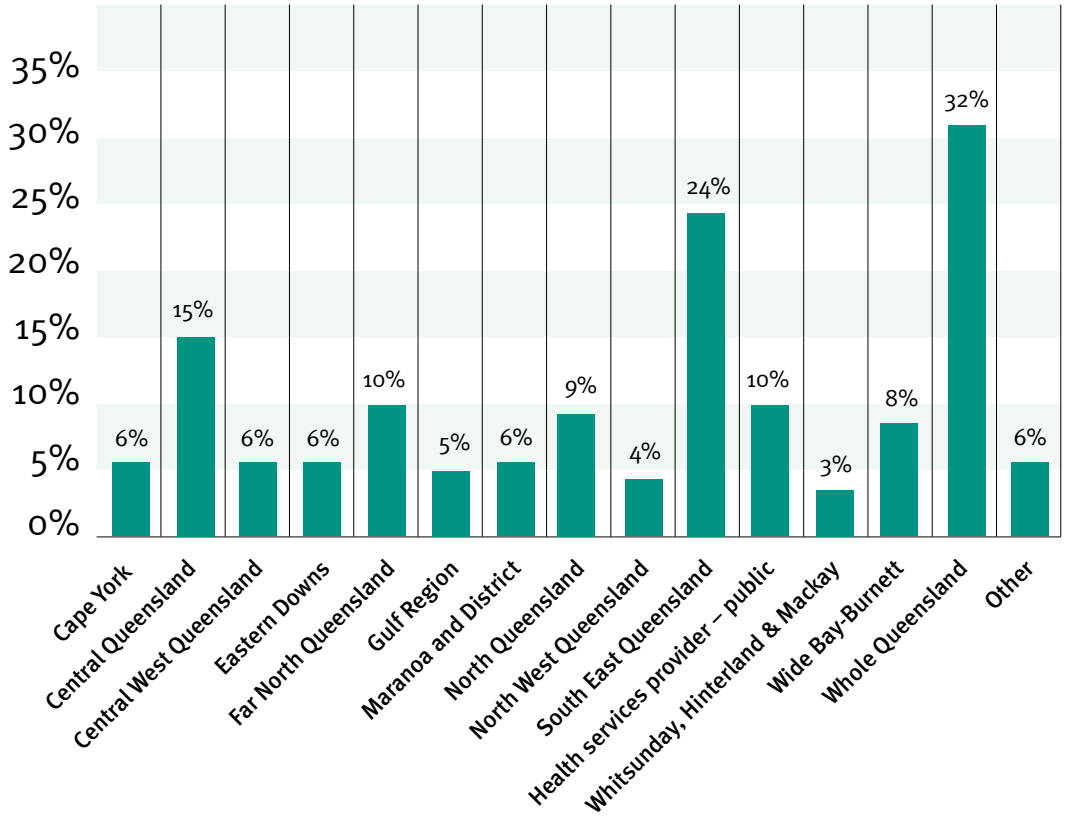

Figure 19: Geographic distribution of the respondents.

Workshop data collection

Who attended the workshops?

74 participants attended three workshops. Attendees were from a range of organisations from within and outside the sector, as reflected in Appendix 1.

How the workshops were structured

The six-hour long workshops included a brief session on the project background and current knowledge on the topic, followed by five breakout sessions where participants were asked to discuss key questions. These included:

- What are the impacts of climate change on the emergency management sector?
- What are the existing adaptation initiatives within the sector?
- What are the barriers to acting on climate change in the emergency management sector?
- What are main gaps and what are the opportunities when acting on climate change, e.g. for improving health and wellbeing, economic, or other community outcomes?
- What is required to move adaptation forward? Strategies, policies, plans, actions? What about possible funding mechanisms?

Notes were taken at each breakout group for further analysis and reporting. Group facilitator notes and other written feedback from each breakout group were coded in NVivo software to extract the major themes of the discussions. The major themes of discussion in relation to each of the five workshop focus topics has been discussed in the main body of the report.

Interview data collection

Two telephone interviews with local government representatives from the Remote Area Planning and Development Board in Longreach. The workshop structure and questions were used to guide the interview process, and the interviewees were encouraged to read the EM-SAP discussion paper prior to interview. Questions included:

- What programs does your local government currently have underway
- that are directly or indirectly contributing to climate adaptation for the emergency management sector?
- Further, if you are aware of any other programs not run by your local government that achieve the same outcome, please describe them. Do any of these provide a case study of best practice?
- What barriers and challenges does your local government and other organisations face in trying to implement emergency management climate adaptation initiatives?
- Further, what gaps and opportunities have you experienced or foresee for the same group of stakeholders?
- Finally, if you were to nominate three key priorities to feature in the emergency management sector adaptation plan, what would they be?

Summary of stakeholder views

Theme 1: Likely impacts of climate change on the sector

Awareness among stakeholders about climate change impact on the sector

91.5% of respondents reported having at least some level of awareness about climate change science. Interestingly, this falls to 81% when asked about their awareness of the impacts of climate change on the emergency management (EM) sector. 19% of respondents suggested that they are 'not aware at all' of climate change impacts on the EM sector. This suggests that there is room for improvement among EM stakeholders in understanding climate change impacts. Table 2 shows the source of climate change-related information within this 'climate change aware' group of respondents, which suggests that, apart from accessing national, international and government scientific sources, a number of respondents also use media and internet articles to obtain climate change-related information.

Table 2: Source of climate change information

Source of climate change related information	%*
Queensland state government sources (e.g. DES)	58.73%
CSIRO and Bureau of Meteorology (e.g. Climate Change in Australia website)	88.89%
NCCARF resources	28.57%
Other (e.g. scientific journal papers, media reporting, internet articles, documentaries)	26.98%

** Sum of all categories will not add to 100% as respondents could select more than one source.*

Figure 20 shows the distribution of natural hazards that respondents and their organisations cover under their portfolio. Severe weather events, heatwaves and tropical cyclones are the top three in the list. Apart from these listed hazards, respondents also mentioned flash flooding and landslip under the 'other' category. These hazards have the potential to increase in frequency and intensity due to climate change, and place greater demand on the EM sector.

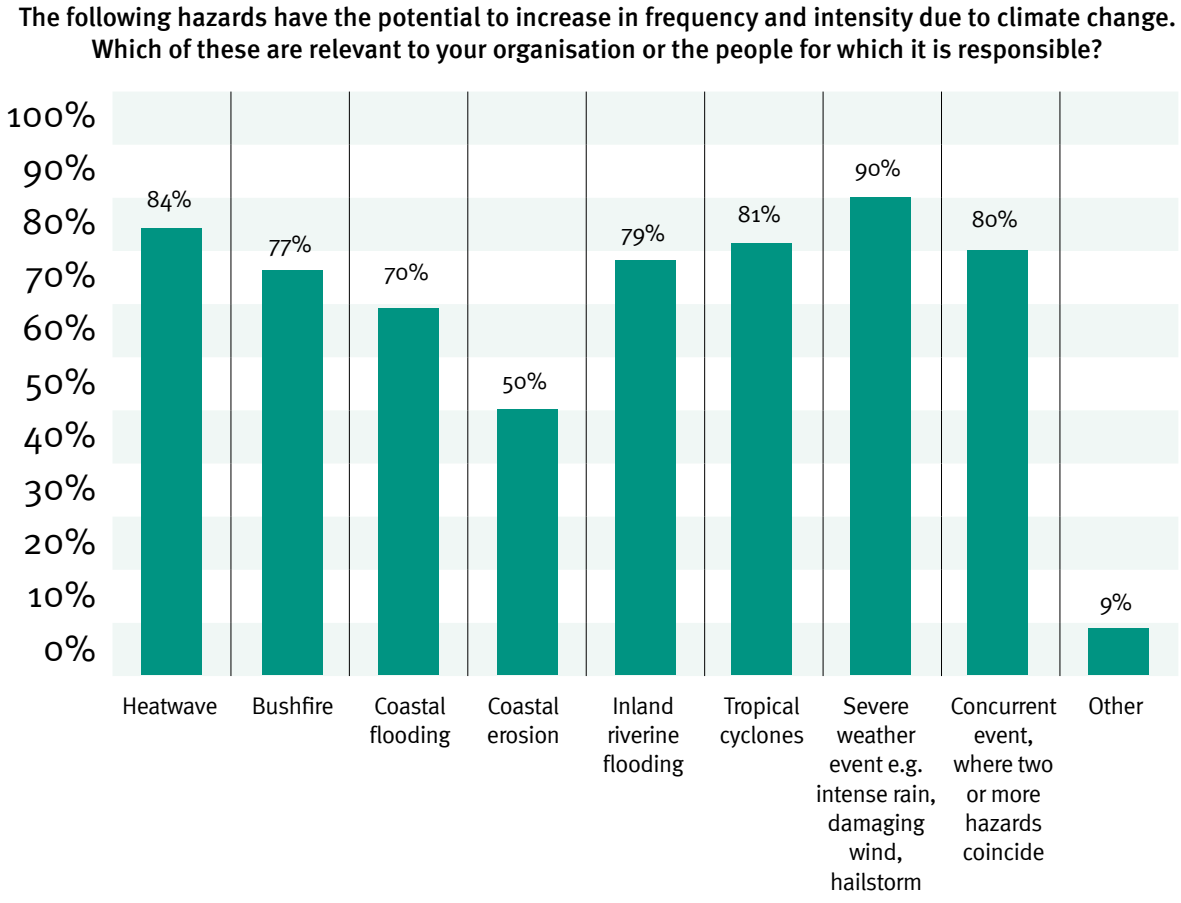

Figure 20: Distribution of natural hazards that respondents and their organisation cover under their portfolio.

Climate change impacts of greatest concern to the EM sector

The following are the major climate change impacts the EM sector is concerned about. Figure 21 shows a word cloud generated form a text analysis of workshop responses around impacts of climate change on the EM sector in Queensland.

Increased demand on services

Demand for service will increase for the EM sector as frequency, intensity and duration of events increases with climate change, and will be a major impact on the sector (32% of survey respondents). Participants suggested that co-occurrence of events such as bushfires and heatwaves, coastal cyclones and upper catchment extreme rainfall, drought and bushfire can increase the complexity and uncertainty of future hazard events, which will stretch the service demand, potentially leading to resourcing issues (47% of survey respondents). The potential complexity associated with future climatic conditions, such as an extended dry periods followed by excessive rainfall, can cause landslips, which can increase the challenge for emergency management and rescue. Workshop participants noted that managing current demand is prioritised over increasing future resilience, creating additional challenges for the sector.

Health and wellbeing of staff, volunteers and emergency responders

Working in extreme conditions such as heatwaves and bushfires can have negative health effects on EM staff and volunteers. Heat stress is likely to affect volunteers in the EM sector more and more into the future. Workshop participants suggested a continual need to support permanent and volunteer staff with appropriate clothing and PPE that is designed for the conditions that are faced, and activity management to reduce exposure. Increased frequency of natural disaster events in future in Queensland will provide less time for EM staff, emergency responders and volunteers to recover from stress, and can also increase the chances of workplace injuries, and create fatigue that will impact on the mental health and overall wellbeing of staff and volunteers (36% of survey respondents). Such increased demand for services can also put pressure on personal and family relationships of staff and volunteers (25% of survey respondents).

Figure 21: Word cloud on impacts of climate change on the EM sector.

Impact on infrastructure that supports the EM sector

Disaster and emergency services need interagency engagement and surge capacity to prepare for any pending response, and to recover following a response. Workshop participants highlighted the importance of making critical infrastructure climate-resilient, so that during emergencies, critical facilities can remain accessible and operational (e.g. prevent loss of telecommunications, electricity supply, water supply and road access). Complexity of emergency management and coordination can further increase as a result of a breakdown in critical infrastructure or services and their supply chains as a result of an extreme event (48% of survey respondents). Understanding the connectivity of different services and the risk to many services as a result of a weakness in one service was considered important.

Increased risk of damage to EM organisations' own assets from extreme weather events is also critical (36% of survey respondents). As an example, disaster coordination centres that are located in floodplains can become inaccessible during cyclones and flood emergencies. In particular, remote communities of Queensland can be at higher risk, as these remote regions can become inaccessible after a natural disaster as a result of flooded roads, damaged telecommunications systems, etc.

Workforce management, volunteer recruitment and retention

Increased demand for, and complexity of, EM services are likely to place higher stress and cognitive demand on crews, emergency management teams and leaders. Reduction in capacity of government and other agencies that have historically supplied resources can further stress the sector. This has resulted from workforce rationalisation, economic restraints and restructuring. Workshop participants suggested that sometimes there are not enough staff and equipment to support affected communities during extreme events, which can undermine the safety and quality of services (33% of survey respondents).

The aging population of Queensland will lead to an aging volunteer workforce. This will affect emergency management volunteers, as younger and less experienced personnel will need to be recruited to step up and manage emergency events sooner than typical career progression pathways. Therefore, the mix of volunteer and permanent workforce that is used currently may not be optimal in the future. Retention of a skilled workforce and attracting volunteers is likely to become more difficult, particularly in regions where the climate is not conducive to sustaining an established population.

Community expectations, preparedness and resilience

While impacts on the wider population from increased frequency or magnitude of extreme climate events is likely to increase, there is often inadequate community awareness of the increased threat of natural disasters, leading to them being unprepared and resulting in increased demand for services from the EM sector. Increased complexity in EM may arise as extreme events become larger, occur simultaneously and impact on places that have not experienced events of such intensity in the past, potentially exposing an underprepared community. The potential for impacts from unfamiliar hazards on underprepared communities is a significant challenge facing disaster managers, as many community members may be unable to foresee how situations can deteriorate quickly and turn into a disaster. A further layer of complexity may arise as the underlying vulnerability of communities increases as a result of the gradual effects of climate change such as droughts. In such cases, an extreme event can represent a threshold beyond which a community cannot recover, and further challenge emergency management. As an example, a general decline in health and wellbeing of the population as a result of climate change and associated impacts (e.g. reduced quality of the built environment including housing, water and food security) can gradually decrease community resilience and increase EM service demand in Queensland.

Financial impacts

The complexity and uncertainty of future hazard events are likely to increase costs to disaster management organisations (45% of survey respondents). Financial impacts on communities from slow onset impacts of climate change and from extreme events were also noted by workshop participants. These impacts related to loss of income and difficulty associated with access to finance. It was noted that, in regional areas, shrinking populations do not have the economic capacity to cover capital investments required for adaptation and mitigation measures. Impacts on climate vulnerable industries such as tourism and agriculture affect local and regional employment opportunities, which can compound levels of disadvantage, reducing community resilience. Therefore, workshop participants highlighted the importance of increasing community resilience so that communities can be self-reliant, which will ultimately help in reducing service demand on the EM sector.

Wider cross-cutting impacts

In order to realise community resilience outcomes and reduce service demand, understanding and consideration of cross-sectoral impacts in the planning process is critical. While asking about respondent understanding of these cross-sectoral links, the following were highlighted:

- critical infrastructure and supporting services such as communications, electricity, transport, water and sewage
- land-use planning (e.g. limit development in at-risk areas)
- local governments manage a number of critical infrastructure facilities (e.g. roads, water supply, sewerage) that are critical for EM services to be able to operate effectively, making them a critical element in managing climate risks to the sector
- social and community services (e.g. vulnerable communities are more at risk during disasters)
- biodiversity and ecosystems (e.g. use of natural environment as a shield to hazards)
- health services and related infrastructure (e.g. health services and facilities need to be operational for effective management of a disaster)
- insurance sector (e.g. can provide incentive to communities and businesses to take actions that can increase their disaster resilience)
- private sector business and industry (e.g. tourism, agriculture, fisheries)—tourists are often unfamiliar with the region, and any local emergency procedures, and have limited resilience. This makes them more likely to be impacted by natural disasters, leading to increased demands on the EM sector.

Theme 2: Current climate-related plans, strategies and frameworks relevant to the EM sector in Queensland

Stakeholder awareness of existing adaptation initiatives within the EM sector

To address the impacts from climate-related hazards under current and future climate, a range of plans, strategies and frameworks are in place in Queensland. While they may not have been developed in response to climate change, they contribute towards increasing the resilience of the EM sector. When asked about their awareness of such relevant plans, strategies and frameworks, 57% of respondents suggested that they had some level of awareness, while 43% of respondents suggested that they were not aware at all. Those who are aware of these strategies were asked to provide a list, which is summarised in Table 3.

When asked if organisations had assessed climate change risks to their organisation, its staff and the people it provides services to, about half (48%) responded positively and a fifth (20%) negatively. A third of the respondents were 'unsure' about this. When asked to provide details about the risk assessments that they have conducted, responses included consideration of climate change and sea-level rise in flood and coastal hazard studies (storm surge, cyclone, erosion modelling), Queensland State Natural Hazard Risk Assessment 2017 and the QERMF. On the other hand, when asked if they had implemented initiatives to reduce identified risks (i.e. adaptation action), only a third said 'yes' and a quarter said 'no'. This suggests that adaptation action is lagging behind risk identification.

Table 3: Current plans, strategies, frameworks that are relevant to addressing climate change related impacts on the EM sector in Queensland.

Plan / strategy / framework	% of respondents aware
Disaster management plans (local, district and state)	9%
Qcoast2100	11%
Queensland Climate Adaptation Strategy	24%
Sector Adaptation Plans	8%
Disaster management Acts and Regulations in Queensland	1%
Queensland Climate Transition Strategy	13%
Queensland Climate Resilient Councils Program	5%
Queensland State Natural Hazard Risk Assessment	4%
Queensland Strategy for Disaster Resilience	5%
Queensland Emergency Risk Management Framework	6%
Individual local council adaptation strategies	6%
National Disaster Risk Reduction Policy	1%
National Climate Resilience & Adaptation Strategy	1%
National Strategy for Disaster Resilience	3%
Paris Climate Change Agreement	5%
Sendai Framework Disaster Risk Reduction (2015–30)	6%
Powering North Queensland Plan	1%

Existing adaptation initiatives

Below we highlight major existing initiatives that emerged from stakeholder consultation.

Sector-led initiatives

Participants highlighted the State Natural Hazard Risk Assessment conducted by QFES in 2017 as an important step in assessing statewide current and future natural disaster risks. Participants also noted the QERMF, which provides a risk assessment methodology that can be used within disaster management planning at all levels of the QDMA. QFES's strategic and operational planning for service amalgamation and integration with meteorological services was also discussed as a good initiative.

Some ongoing initiatives were also noted such as 'Operation Cool Burn', which is a program under which QFES conducts bushfire mitigation activities such as hazard reduction burning to reduce fuel loads, improvement of strategic fire breaks by landowners, and targeted community education. It was also noted that Queensland Ambulance Service has increased its capacity so that it can better manage surge in demand during future extreme events.

Local government hazard mapping and mitigation programs

The Qcoast2100 program provides funds to coastal local governments to conduct their Coastal Hazard Assessment Studies, which aim to identify areas and assets that are likely to be affected by sea-level rise and its associated processes such as erosion and inundation (e.g. coastal hazard maps). Local government flood studies also consider climate change impacts on local flood probability and extents, and produce hazard maps that also inform local government planning schemes. These studies inform land-use planning by local governments and provide the opportunity to restrict development in hazard-prone areas.

Increasing community resilience programs

Community engagement and education programs such as 'Get ready' by the Queensland Reconstruction Authority and 'Pillow case' by the Red Cross provide opportunity to engage with the community and educate them about disaster risks and their potential increase in the future. Red Cross conducts a project which engages with migrants from cultural and linguistic diverse backgrounds to educate them about disaster risks. Although these programs are not directly associated with climate change, they support engagement with communities and provide them with information and education about future risks. Workshop participants also noted the importance of better early warning systems (e.g. 'opt-in' messaging services for severe weather alerts) in increasing community preparedness.

Increasing resilience of critical infrastructure and services

The EM sector is reliant on critical infrastructure such as telecommunications, electricity, transport facilities and hospitals, and workshop participants discussed examples where efforts have been made to increase the resilience of this infrastructure and the services that it provides. Examples highlighted by participants included Seqwater developing strategies to ensure its business continuity under future extreme conditions; the hospital in the Livingstone Shire Council being relocated from a flood-prone area to a higher ground; a remote indigenous community Wujal Wujal that developed a backup communications system by (see Case study 1).

Volunteer education and capacity-building programs

QFES runs volunteer capacity-building and education programs. These programs aim to enrich support to QFES volunteers so that their time can be used effectively and strategically, and a more rewarding experience can be delivered to them. It is important to build a sustainable model for attracting, recruiting and retaining volunteers that is applicable to local community needs and risk. Some of these works are already underway.

Use of technology

Use of new and advanced technology in the EM sector is on the rise. Geospatial information systems are used frequently to better analyse risk-prone areas and their characteristics. This allows overlaying hazard maps, including climate change projections and sea-level rise inundation maps, with existing assets and community settlements to identify the ones which are at risk. There has been adoption of improved frontline personal protective equipment for firefighters and improved firefighting techniques such as compressed air foam systems. A number of councils (e.g. Logan, Cairns, Gold Coast) have developed disaster dashboards, which provide disaster-related local and relevant information such as early warnings, information about evacuation centres, flood water levels and maps, and live camera feed of flood-prone roads.

Theme 3: Barriers and challenges for climate adaptation in the EM sector

Figure 22 shows a word cloud of major barriers and challenges for climate adaptation in the EM sector. These barriers and challenges are also described below.

Increasing cost of adaptation and lack of funding

Dealing with conflicting priorities, for example, balancing demands of current challenges against planning for potential future issues, is a major barrier for climate adaptation (58% of survey respondents). Therefore, like most other sectors, the EM sector struggles to fund adaptation projects. Higher initial costs of adaptation are also seen as a major barrier, since many benefits are deferred (longer term). Climate change risks are often seen as one of many risks faced by an organisation, but one which is seen as more distant. Capacity and resourcing of adaptation projects are more challenging in rural and regional areas of Queensland than in urban centres. Participants noted that there are often funds available to rebuild and recover after a disaster event, but a shortage of funding in between disaster events to build overall resilience.

Lack of guidance, proactive and preventive approach

Lack of guidance to act on adaptation within government is seen as one of the major barriers by the participants (36% of survey respondents). Leadership for managing climate change risks is often reactive. Participants noted that 'reinventing the wheel" happens over and over, resulting in programs losing momentum. Political leadership and the absence of bipartisan support provide inconsistent messages to the community, hindering progress of societal action on climate change. Although local governments are leading on climate adaptation, they often lack the capacity and ability to influence beyond their jurisdiction. They also suggested that legislative structure and arrangements are not supporting good decision-making, and often promote taking long-term decisions with a short-term vision. Participants suggested that such a lack of clear direction and guidance from governments delays actions against climate change risks and place greater burden on the EM sector.

Figure 22: Word cloud for major barriers to adaptation by the EM sector.

Lack of community education, awareness and understanding of climate change risks

There is a lack of awareness about climate change risks among governments, practitioners in the sector and the wider community. Limited coverage of risks in the media, public resistance to change and the complexity of the problem are contributing to this. Participants noted that there is scope for improvement in communication of climate change science to communities and practitioners. As a result of such lack of awareness, many EM sector agencies have not assessed climate change risks to their own assets and operation.

Broader engagement around climate adaptation through community participation and collaboration with other sectors is required at the local level. Lack of awareness of the legal liability of not managing climate change risks is also seen as an issue for this sector. There is a lack of information in relation to the psychological impacts on EM staff, volunteers and communities as a result of potential increased future service.

Climate change risks vary spatially and temporally, and workshop participants suggested that often they do not understand local scale risks. This limits their ability to communicate those risks effectively and trigger any necessary action. Although regional scale climate change projections and local scale sea-level rise and catchment flood maps are available, often translating scientific information into consequences for the EM sector and services is challenging. The lack of knowledge on how climate change will affect EM organisations' assets and operation at a local level is a barrier to adaptation of the sector (41% of survey respondents).

Lack of mainstreaming of climate change risks

Workshop participants suggested that climate change risks are seen as a problem in the future, and are therefore often pushed back in favour of addressing current risks. As a result, they are often not considered or integrated into the core business processes of organisations. This leads to not allocating enough resources for managing climate change risks, which limits the EM sector's ability to plan for adaptation.

Lack of cross-agency and cross-sectoral collaboration

There is a lack of connectedness between layers of government and essential services in terms of managing climate change risks. Silos in portfolio policy-making prevent coordinated approaches. Creating a framework for cross-sectoral planning and response is vital for effective adaptation in the EM sector. Participants noted that there is confusion over accountability for action, related to the roles and responsibilities of the Commonwealth and state governments.

Participants also noted that interagency communication within the EM sector and cross-sectoral collaboration (with agencies external to the EM sector) on managing future climate change risks are not as prevalent or frequent as they should be.

Critical infrastructure resilience is important for EM operations during disasters. Critical infrastructure is highly interdependent (e.g. high reliance of all infrastructure on electricity and communications technologies), and it is important for relevant agencies to communicate and share information to build overall resilience of these systems. In this regard, understanding the resilience of each other's businesses is critical, but workshop participants suggested that often this information is considered confidential, and is therefore not shared.

Social vulnerability and lack of community capacity

Socially vulnerable and remote communities can be less resilient and have limited capacity to adapt to future increased disaster risks. Existing inequality in those communities can affect the ability of individuals and communities to recover from disaster. Participants suggested there is a need to support vulnerable community groups and civil society.

Lack of coordinated funding

The costs of increasing resilience are often borne by one sector organisation, but the benefits are enjoyed by others (e.g. increasing the height of a hospital access road beyond a certain flood level will cost the transport department, but the benefits are widespread). There is a need to better coordinate funding across different government departments to enhance effective adaptation within the sector.

Inadequate urban / infrastructure planning

Inadequate urban planning often increases exposure to climate change risks as it allows development in hazard-prone areas, which increases future disaster risks and makes any future adaptation in those areas more expensive. Workshop participants also suggested that disaster coordination centres are sometimes located in old buildings and not in safe parts of town.

Theme 4: Gaps and opportunities for adaptation

Figure 23 below summarises the key themes that emerged from discussions on gaps in current adaptation activities, and opportunities for adaption in the future. These are also described below.

Figure 23: Word cloud for gaps and opportunities for adaptation in the EM sector.

Increase community resilience and take adaptation action

Participants felt that taking action and managing climate change risks will provide a great opportunity to increase resilience of the EM sector. This will bring communities together and promote collaboration within and across sectors to use resources efficiently for solving a common problem. The EM sector generates significant levels of trust within the community, which can unify people on climate action to achieve bipartisan support from policy-makers. Initiatives to build capacity in the community, EM workforce and volunteers in regional areas are needed, so that when they are cut off by disasters, they can continue to serve the community before outside help arrives. Relying more on local capacity for transport, energy, food and water can build local resilience.

Rebuilding critical infrastructure better after a disaster, with increased capacity to withstand future hazards, will reduce future costs. Increasing the resilience of critical infrastructure is essential for maintaining services that are required to support the EM sector. Planning for a resilient food system to ensure supply both during disasters and in relation to longer term climate stressors would provide food security.

Awareness raising and engagement about climate change

Participants suggested that there are certain gaps in education and awareness among EM staff, volunteers and the community about climate change risks. Strategically designed education and awareness programs can enhance preparedness and adaptive capacity and help build resilience. Using social media to disseminate information and alerts can be effective. A positive message about the benefits of climate action is needed. Better communication of climate science and local climate change risks can also trigger actions within the community to build its resilience. Inclusion of climate-related education in all levels of the education curriculum is important.

Work with insurance and business sectors to drive adaptation action

It is important to increase disaster resilience of the supply chain of the business sector so that impacts on local economies can be minimised. As an example, critical assets of businesses needs to be made more disaster-resilient (e.g. relocating assets to higher ground in flood-prone areas). The insurance sector can drive change towards community resilience via price signals (e.g. higher cost of insurance in the hazard-prone areas). The EM sector needs to work collaboratively with the business and insurance sectors to promote increasing community resilience and reduce reliance on emergency services.

Co-benefits of climate mitigation and adaptation

Participants suggested that there is a gap in efforts to reduce carbon emissions by the EM sector. Mitigating carbon emissions by the EM sector, including investment in renewable energy generation, can lead to more efficient use of resources and reduced costs. Use of renewable energy such as solar with battery capacity can increase resilience of EM facilities under extreme events and make them less reliant on a centralised electricity supply.

Better policy and urban design

There are gaps in coordinated policy-making across governments and sectors. Climate adaptation actions can provide opportunities to improve urban design and policy for improving the general wellbeing of the Queensland community. Improving early warning systems for natural hazards (e.g. heatwave, flood) will contribute towards making communities more resilient. A review and update of approaches at all levels of government to build on existing knowledge and fill in gaps (e.g. taking a research approach) would be beneficial. Bringing stakeholders together in a cross-sectoral approach can improve engagement through co-production of policies. Policy can be improved by inclusion of monitoring and evaluation strategies to ensure recommendations are implemented and followed up. Participants suggested the need to review building codes to investigate whether they need to be updated, as cyclones may move further south in the future. Often there are discrepancies in the resilience of different components of a building that need to be addressed (e.g. roofs are resilient to cyclone, but walls are not).

Participants noted that there are opportunities for better coordination between organisations and peak bodies across sectors (e.g. COAG, AFAC, Engineers Australia) to promote system-wide climate change risk management.

Making climate change risks – 'business as usual'

Often climate change risks are not integrated within core business processes of agencies. Including climate change risks within core business processes will ensure close monitoring of these risks with time, and allow agencies to make long-term plans to gather necessary resources to implement adaptation actions and reduce future risks on agencies' assets and operations.

Volunteer management and recruitment approaches

There are gaps in sharing resources across the EM sector for training and capacity building of volunteers. Participants noted that there are opportunities to develop combined training programs for EM staff and volunteers for activities that are common across agencies. This will allow sharing volunteers across EM agencies, and can also free up additional resources for further resilience-building of agencies.

Interagency collaboration and integration

Participants noted that there is a gap in terms of leading and coordinating climate change initiatives of the EM sector in Queensland, as it is not clear what the roles of LDMGs or DDMGs are. There needs to be a greater collaboration across these groups in terms of climate change initiatives and action.

Participants highlighted gaps in coordination of data and information sharing across different agencies within the EM sector. Increasingly more data and information are available, but sharing across EM agencies and other organisations (e.g. councils, hospitals, infrastructure managers) is limited. There are opportunities to develop data sharing arrangements so that information can be fed into the decision-making of multiple agencies across the EM sector. Such capacity and decision support tools can enhance the sector's capacity to meet future demands.

Use of advanced technologies to manage risks

The EM sector in Queensland is adopting new technologies for managing risks, and there are more opportunities to use smart technologies for future risk management. For example, participants noted that drones are already in use for initial damage assessments after a disaster event. There are opportunities to use smart technologies such as sensors, the Internet of Things and analysis of remotely sensed images to get real-time information in disaster coordination centres to assist decision-making under future extreme conditions.

Filling knowledge gaps through research

The top three knowledge gaps identified by stakeholders were:

- understanding risks at a local scale
- behaviour and processes that can promote community preparedness
- understanding impacts on the EM sector as a result of cascading failure of infrastructure and services.

See Figure 24 for the full list of knowledge gaps. Participants recommended coordinated efforts to fund practical research projects to address some of these knowledge gaps.

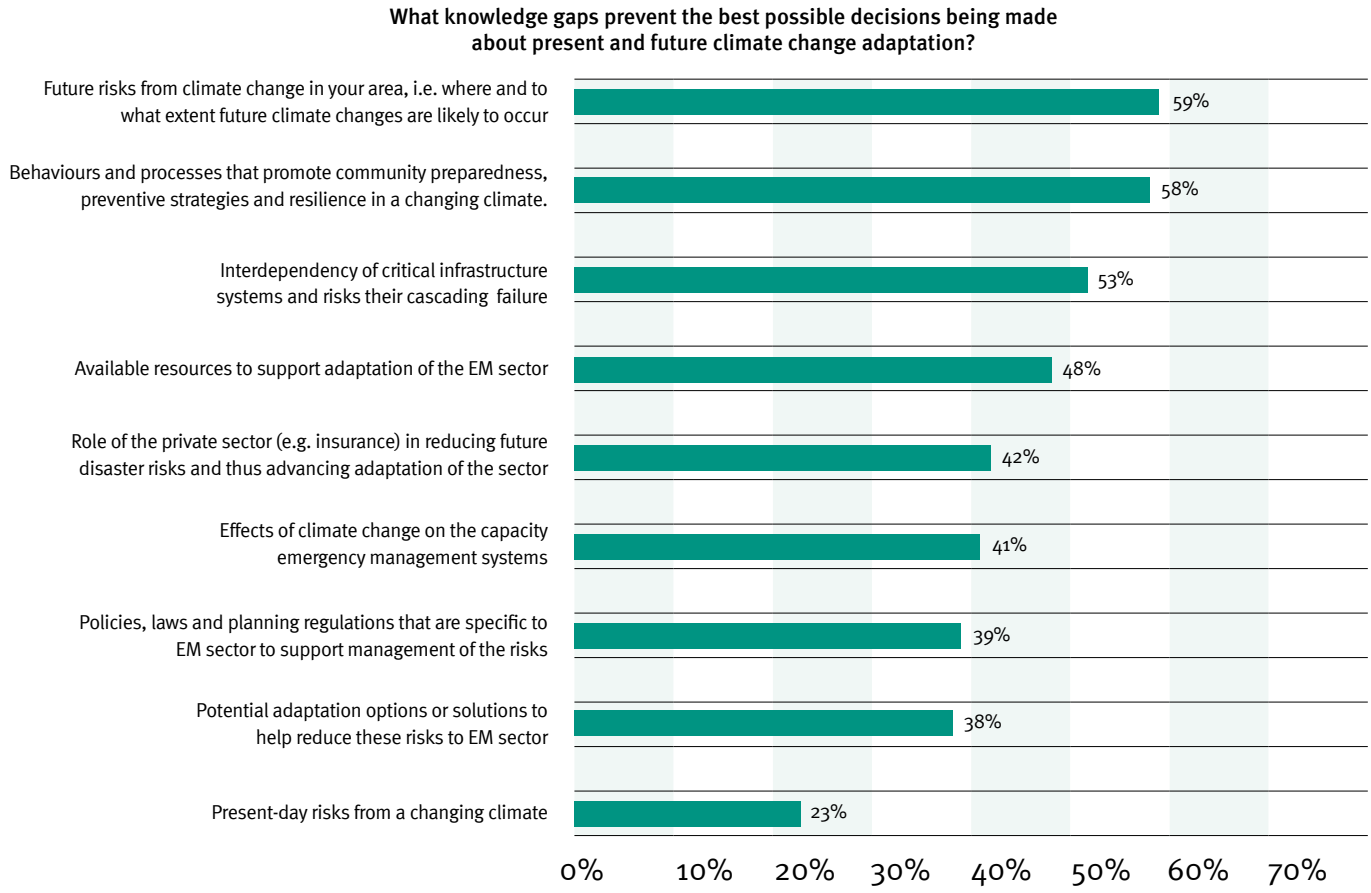

Figure 24: Knowledge gaps preventing future adaptation of the EM sector.

Theme 5: Priority needs to enable successful adaptation (pathways to action)

Figure 25 broadly portrays the major adaptation pathways, which are further discussed below.

Leadership and policy-making across governments and within sector organisations

Pragmatic action and coherent government policies are required for effective adaptation by the EM sector. Adaptation activities should be accommodated within the existing business practice of EM agencies and other related organisations. It is important to promote innovation in managing climate risks within the sector. Policies need to be developed that can allow EM sector agencies to move from ad hoc strategy to a more systematic approach, and allow integration of climate change risks within organisations' core business processes.

Procurement policies within the sector need to be reviewed to ensure that they consider climate change risks. Climate change risks and their management options should be included in disaster management guidelines. It is also important to consider that increasing resilience of our communities and infrastructure today will save future damage costs, which will provide an opportunity to free up disaster rebuilding funds. However, appropriate leadership and policies are required within the sector to invest in resilience building. Policy-makers and leaders should be lobbied to support climate adaptation across communities and sectors, as the benefits are widespread and enable disaster mitigation and preparedness.

Education and awareness of climate change risks for EM staff, volunteers and the community

Participants suggested that awareness training within EM sector organisations, volunteers and the community in general is a priority action. Specifically, the EM sector's credibility needs to be leveraged to influence education and awareness within community. There should be investment in community education and awareness, including shared responsibilities and the importance of being resilient.

Allocation of resources to support adaptation by EM sector organisations

Funding and support for EM sector organisations to undertake mitigation and adaptation activities is critical. Specifically, resources are required for understanding climate change risks to organisational assets and operations. Participants noted that it is important to leverage on existing funds and grant opportunities (e.g. National Disaster Relief and Recovery Arrangements) to support these activities. A pathways approach should be adopted by EM agencies so that funding required for adaptation activities can be spent over many years, based on identified priorities that can reduce initial high cost of adaptation.

It was also suggested to promote innovation across the EM sector and provide funds to support development of innovative solutions to future EM sector challenges (e.g. start-up innovation grants). It is important to provide necessary data, tools and information to LDMGs and DDMGs about climate change risks, and clearly define their roles and responsibilities.

Participants suggested that treasury departments (federal and state) should be engaged in the adaptation process so that appropriate funds are allocated for adaptation by the sector. It was suggested that the financial and legal drivers need to be made more prominent to encourage decision-makers to allocate funds to address adaptation and climate risk management.

Increase resilience and adaptive capacity of EM sector organisations

Initiatives that build capacity of EM sector organisations to climate change risks should be promoted. Specifically, increasing the capacity of EM sector organisations in regional areas is critical. It was suggested in the workshops that the focus should be on increasing resilience of the sector, not just adapting to climate change. Proper training should be provided to staff who are initiating and managing ongoing cross-sector collaborative projects on climate change. It was also suggested that best practice guidelines on climate adaptation be developed for the EM sector.

Understand climate change risks to assets and operations of EM sector organisations

EM sector organisations, including volunteer organisations, should conduct climate change risk assessments to understand risks to their own assets and operations. Participants suggested audits to identify the extent to which agencies have already conducted such assessments, and areas for further action. Where resources are not available for immediate risk assessments, agencies could plan to conduct this every two to three years.

Collaboration and resource sharing

Stakeholders highlighted the need to collaborate with the insurance industry (e.g. Insurance Council of Australia). Participants noted that there needs to be collaboration within the EM sector to share volunteers and training facilities to enable combined training programs for tasks and activities which are common across agencies and low in risk.

It is important to develop greater levels of trust between agencies within and outside the EM sector to promote information sharing and collaboration.

There is a need to establish formal data-sharing arrangements within the EM sector and across sectors for enhanced decision-making. Frameworks for cross-sectoral planning and response are vital for effective adaptation by the EM sector.

Promote community resilience building and self-reliance

It is important to build community self-reliance and resilience to manage demand on the EM sector in future. Such awareness can be raised through campaigns focusing on climate change and community resilience (e.g. on-ground campaign, social media or traditional media), climate change awards, and recognition of community climate change champions. There can also be a distinct disjunction between what the community 'wants' and what the community 'needs'. Effective engagement with the community can drive change and build resilience. Participants suggested that resilience-enhancing behaviours should be promoted as part of community engagement.

Volunteer and workforce management

Increased demand for volunteers in the future needs to be addressed. There should be programs to attract youth into volunteering, potentially starting from schools. Notably, some of these programs are already underway. There also needs to be increased collaboration between EM agencies to train and broaden the pool of volunteers.

Increase resilience of critical infrastructure

Planning is a tool that can be used to great effectiveness in building resilience to climate impacts in both hard (physical) and soft (community and social assets) infrastructure. Urban planning that accounts for climate change can help address coastal hazards such as flooding, but should also protect against heatwaves through building design, public transport and infrastructure. Future urban planning decisions need to account for potential risks from climate change (e.g. sites for key infrastructure like hospitals, roads, water storage, and sewerage plants).

Investing in better communications infrastructure is considered vital to improve access to regional and remote communities to help prevent disconnection following extreme weather events.

Research and development of new knowledge and supporting tools

Better data (e.g. climate change and sea-level rise projections, finer scale asset information, real-time information of hazards) to understand local scale risks would help support better decision-making. Research and development of data-driven decision support tools that can use new technologies (e.g. drones, Internet of Things, sensors), along with sophisticated models and advanced analytics, will enhance the EM sector's capacity to meet future increased and complex demands.

Figure 25: Word cloud for ways to support effective adaptation by the sector.

Appendix 3: EM-SAP priorities categorised by EM phases

Allocation of priority adaptation measures across four distinct phases of emergency management (prevention, preparedness, response and recovery).

Priority	Identified actions	Prevention	Preparedness	Response	Recovery
Sector-led awareness and engagement about climate change	Build on existing community education and engagement programs within and outside the sector to include climate change science and associated impacts, and create engagement and awareness where they don't exist.		X		
	Incorporate or provide access to climate change education and training for the emergency management workforce.		X		
	Partner with schools, tertiary institutions and professional peak bodies to incorporate climate adaptation and emergency management as a consistent theme in curriculum and professional development training and education programs.		X		
Integration of climate change into sector governance and policy	Implement clear and long-term policy on climate adaptation within sector organisations.	X	X	X	X
	Facilitate integrated planning across the sector and within government for the management of climate change and adaptation activities.	X	X	X	X
	Influence legislative reform that supports a consistent approach to climate change at all levels of government.	X	X	X	X
	Examine sector procurement policy to understand future sustainability and adaptability to climate change, and where possible, to drive appropriate change in supply chains.		X		
Enhancing the sector's understanding of climate change risk and its ability to adapt	Incorporate climate change consideration into organisational resilience practices, including enterprise risk management, business continuity planning, crisis management, emergency management and security management.	X	X		
	Develop an approach consistent with the 'State Government pathway' that enables a consistent evaluation of climate risk across sector organisations.	X	X	X	X

Priority	Identified actions	Prevention	Preparedness	Response	Recovery
Enhancing the sector's understanding of climate change risk and its ability to adapt	Work with local governments, disaster management groups and natural resource management groups to manage 'natural infrastructure' to reduce harm from natural disaster events.	X	X		
	Deliver the necessary data, tools and information to disaster management groups about climate change.	X	X		
	Examine the feasibility of a review that conducts an assessment of existing and planned sector facilities and their interdependencies against future climate change projections, with the aim of reducing future climate risk	X	X		
Research and development of new knowledge and supporting tools	Provide support and partnerships for research projects that inform sector climate adaptation, such as those that explore climate change science, application-ready data for activities such as risk assessment, and development of innovative adaptation solutions.	X	X		
	Provide access to data and decision support tools for understanding local-scale climate change risks.	X	X		
	Use advanced technology to support sector activities and decision-making in climate change applications, such as enhancement of personal protective equipment to cater for anticipated climate change, use of remote sensing and imagery, and evolving mitigation options.	X	X	X	X
	Develop a dynamic suite of guidelines and tools that foster information sharing and provides examples of sector approaches or case studies of better practice for climate adaptation.		X		
Allocation of resources to support sector adaptation	Influence funding stream alignment within and beyond the sector where possible to allow for climate adaptation initiatives.		X		
	Encourage sector organisations to allocate resources for research and development, risk assessment and planning and, capacity and capability enhancement for the purposes of climate adaptation.	X	X		

Priority	Identified actions	Prevention	Preparedness	Response	Recovery
Allocation of resources to support sector adaptation	Forge partnerships that foster investment in climate adaptation between and beyond sector stakeholders, particularly those that support cost-sharing or sharing of other resources.	X	X		
	Identify opportunities across all levels of government to enhance the coordination of resources targeting climate adaptation.	X	X	X	X
Increasing the resilience of infrastructure critical to the sector and community	Understand infrastructure interdependencies and vulnerability of the sector, and plan and implement adaptation solutions.	X	X	X	
	Influence the incorporation of climate scenarios into land-use planning for essential infrastructure and communities.	X	X		
	Foster partnerships and joint planning between the sector and infrastructure operators and owners.	X	X		
	Where possible, ensure sector organisations are involved in land-use and infrastructure planning processes and are resourced to effectively contribute.	X	X		
Promoting and enabling community resilience-building and self-reliance	Continue to advocate for and facilitate activities that foster community resilience.	X	X	X	X
	Influence land-use and urban planning through incorporation of climate change scenarios and risk information.	X	X		
	Undertake engagement activities that incorporate community self-reliance and resilience-building activities in preparation for, and use during, times of disaster.	X	X	X	X
	Work closely with other government and non-government organisations to increase the resilience of the community to climate change.	X	X		
Volunteerism, volunteering and workforce management	Evaluate the impact of climate change on the availability of volunteers across the sector to continue to deliver goods and services across the state.		X		

Priority	Identified actions	Prevention	Preparedness	Response	Recovery
Volunteerism, volunteering and workforce management	Incorporate climate change risks into volunteering and workforce strategies and planning across sector organisations, and in emergency management planning.		X		
	Foster partnerships between sector organisations, the community and beyond to enhance collaboration and cross-utilisation of the existing and future volunteer and paid workforce.		X		

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