QUEENSLAND

STATE HEATWAVE RISK ASSESSMENT 2019

Queensland Government

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Thank you

The Queensland State Heatwave Risk Assessment 2019 was a collaborative effort, bringing together the expertise of multiple stakeholders. Particular thanks to Queensland Health, Department of Environment and Science, and The University of the Sunshine Coast.

Foreword from Queensland Fire and Emergency Services

Natural hazards affect the lives of all Queenslanders. We are exposed to a range of hazards which can have a significant impact on our economy, our environment and may lead to significant consequences for our communities. These hazards are becoming increasingly extreme and complex, exacerbated not only by our globally interlinked economies but also the impacts of climate change.

Within the past decade we have experienced natural disasters of a size and scale that are almost unprecedented in our nation's modern history. The extreme heatwave and associated bushfires in late 2018 are a clear indication that we face new, unparalleled challenges in understanding and responding to the impacts of climate change on natural hazards which even now pose a significant risk to Queensland.

These events reinforce the need to communicate appropriate risk information across the three tiers of Queensland's Disaster Management Arrangements (QDMA): Local, District and State.

Following the release of the State Natural Hazard Risk Assessment in 2017 and through consultation with stakeholders at all levels of QDMA, the clear need for detailed and consistent information regarding the changing nature of Queensland's risk from heatwaves was identified.

Our collective ability to assess and more deeply understand the impacts of climate change on current and future natural hazard risk is the first step towards the ongoing development of resilience in the face of more and more intense natural hazards. This approach is also reflective of the international focus on understanding disaster risk as priority one of the Sendai Framework for Disaster Risk Reduction 2015–2030.

Hon. Craig Crawford MP
Minister for Fire and Emergency Services

Katarina Carroll APM
Commissioner, Queensland Fire and Emergency Services

Starting at the Local level, the communication of consistent risk information between each tier of QDMA can support communities and government, emergency services and all emergency management partners in making informed decisions.

This assessment represents a maturing capability for informing the development of current and future risk-based plans across QDMA. The inclusion of detailed climate change projections for communities in Queensland represents a first for natural hazard-based risk assessments within the emergency management sector.

Risk-based planning is one of the cornerstone enablers for the Queensland community to be better able to prevent, be prepared for, respond to and recover from natural disasters.

As the Minister for Fire and Emergency Services, and the Commissioner of Queensland Fire and Emergency Services (QFES), we thank all stakeholders for their contribution to this assessment and the continued commitment towards creating safer and more resilient communities. We would also like to specifically thank the Department of Health and the Department of Environment and Science for partnering with QFES on this initiative, and local governments for their ongoing cooperation.

We encourage all Queenslanders affected by natural hazard risk to consider the information and strategies within this valuable assessment and use it to inform the management of risks applicable to their interests and responsibilities.

Foreword from Queensland Health

Queensland is renowned for its blistering summer temperatures and snap summer storms. For Queenslanders, that's always been a part of life but climate change is intensifying these Queensland weather traits, and as summers go on for longer and heatwaves intensify, we are seeing the effects on our health.

Severe and extreme heatwaves have taken more lives than any other natural hazard in Australia.

Queensland Health plays a critical role in responding to heatwaves – our doctors, paramedics and hospital workers are seeing more people affected by heat, directly or indirectly, than ever before.

Hon. Steven Miles MP
Minister for Health and Minister for Ambulance Services

Workshops held around the state have helped inform this report and highlighted important stories. We have consulted with Queenslanders of all backgrounds, not just those in the health sector, and taken on board important lessons and advice.

Over the last few summers we have experienced record-breaking heatwaves and seen how their impacts are intensified when they coincide with another natural disaster. We only need to look to the October 2018 bushfires, or the February 2019 North Queensland flooding, to see how heatwaves can cause further distress during times of crisis.

Many of our most vulnerable Queenslanders are particularly susceptible to these health impacts, including children, the elderly, pregnant and breastfeeding women, and people with pre-existing medical conditions. In addition to the direct effects of heat illness, heatwaves, can also cause dehydration and the spread of food-and-vector borne diseases.

Queensland Health is preparing our communities for the challenges of worsening heatwaves.

This publication will make sure the Queensland Government has an informed, prepared approach for heatwaves.

Queensland Health will continue to work with QFES and DES so we can better understand how to protect all Queenslanders from the risks of heatwaves.

Foreword from Department of Environment and Science

The Department of Environment and Science (DES) is proud to have collaborated with QFES and Queensland Health to develop the State Heatwave Risk Assessment. This assessment will be an important asset for Queensland and will inform the development of health and environmental policy as well as frontline emergency services as we face more weather extremes.

Climate change is the greatest challenge facing our planet today and it is driving more severe heatwaves, fire conditions and longer bushfire seasons, here in Queensland.

Hon. Leeanne Enoch MP

Minister for Environment and the Great Barrier Reef, Minister for Science and Minister for the Arts

Queensland is unlike anywhere else in the world. We are one of the world's most naturally diverse places, home to five World Heritage Areas, more than 1300 National Parks, marine parks, state forests and other protected areas. We also have more species than any other Australian state or territory.

But we are clearly seeing the effects climate change is having on our environment. In Queensland there have already been impacts on terrestrial ecology through changing and intensifying weather patterns. In the aquatic environment, with heating oceans, and impacts from successive severe cyclones, there have been successive mass coral bleachings, and impacts from sediment.

To help Queenslanders prepare for, and recover from, climate change impacts like heatwaves and bushfires, the Queensland Government has invested in the tools and resources necessary to inform a wider understanding of climate change.

DES recently launched the Queensland Future Climate Dashboard. The dashboard features the latest climate projections data, climate change scenarios and climate initiatives; including a special section on Heatwaves and a water-security case study.

The climate projection data was incorporated into the Statewide Heatwave Risk Assessment to support accurate, effective and timely decision making to protect Queenslanders and their lifestyles, infrastructure and resources from the impacts of heatwaves.

I trust that this assessment will help Queensland to navigate the more volatile weather we are experiencing at this time and I look forward to continuing to work together with QFES and the Department of Health to equip our state for all that is to come.

Executive Summary

Although not formally classified as a disaster - as with cyclones, floods or bushfires – heatwave occurrence can result in substantial impacts to society and the environment, including impacts to human health, agriculture, the economy, fragile ecosystems, whilst also exacerbating other natural hazards that pose a risk to our communities and way of life.

Heatwaves remain Australia's most costly natural disaster in terms of human impact and are commonly referred to as "The Silent Killer". The potential for prolonged and intense heatwaves in Queensland is increasing due to the impacts of climate change and other socio-natural and anthropogenic factors. As a result, the associated consequences of these events are also increasing and are likely to have significant and protracted impacts on the community as time progresses.

Due to the extreme November heatwave and subsequent bushfires, 2018 brought in to sharp focus the need for greater consideration of severe and extreme heatwave associated risk within the broader disaster management community. It is essential that we strive to gain a better understanding of the changing nature of heatwaves, their short to long term impacts, and the opportunities at hand that may allow communities to mitigate identified vulnerabilities and consequences.

It is with this aim in mind that the Queensland State Heatwave Risk Assessment (SHRA) seeks to provide the most comprehensive overview of current and future heatwave risk in Queensland. It is intended to be utilised by all levels of government in conjunction with the Queensland Emergency Risk Management Framework (QERMF) to better plan for, respond to, and recover from the likely impacts of future severe and extreme heatwave events.

By increasing our collective understanding of Queensland's heatwave risk, we can enhance our ability to deal with the impacts of events with a severity that may test our existing individual knowledge, skills, experience, and collectively, practices and preparation.

"Catastrophic events demand new thinking and approaches to meet the needs of affected communities and the expectations of a watching world. They will be events where the trust and confidence vested in us by communities will be rigorously tested and intensely monitored. Success requires leadership, imagination, creativity, innovation, initiative and compassion before, during and after these inevitable events. Delivering a practical and productive outcome requires honesty and humility in our assessments of capability; in our determination of what is possible; and in our community engagement as we collectively determine how to best deal with adversity."

(Emergency Management Australia, Australian Journal of Emergency Management 2015)

Background

In 2017 Queensland Fire and Emergency Services (QFES) completed the State Natural Hazard Risk Assessment (SNHRA) which evaluated the risks presented by seven in-scope natural hazards. The SNHRA accorded the risks posed by severe and extreme heatwaves as the third highest priority for Queensland. The risks presented by heatwaves were evaluated in broad terms highlighting several key vulnerabilities and risks requiring further analysis.

As QFES matures the QERMF by working with Local Disaster Management Groups and District Disaster Management Groups (LDMGs and DDMGs), opportunities have arisen for QFES, in collaboration with relevant Federal and State Government and industry partners, to provide support to all levels of Queensland's Disaster Management Arrangements (QDMA), through the development of in-depth risk assessments.

The QERMF, as the endorsed methodology for the assessment of disaster related risk in Queensland, is intended to:

- Provide consistent guidance for understanding disaster risk by acting as a conduit for publicly available risk information. This approach helps with collaboration and sharing of information in disaster risk management, resulting in risk-informed disaster risk reduction strategies and plans.
- Encourage jurisdictions to undertake holistic risk assessments that provide an understanding of the many different dimensions of disaster risk (hazards, exposures, vulnerabilities, capability and capacities). The assessments encompass the direct and indirect impacts of disaster, such as physical, social, economic and environmental.

Overall, the assessment and associated report seeks to complement and build upon existing Local, District and State heatwave risk assessments by providing updated and validated information relating to the changes in understanding of Queensland's heatwave potential. This assessment represents the first time the QERMF will help to inform the revision of a State level disaster management sub plan (the Heatwave Response Plan).

Context

The risk assessment was developed using the QERMF to undertake a thorough analysis of Queensland's current and future heatwave risk.

Since 1958, there has been an observable increase in the occurrence rates of all heatwave severities. Through the Bureau of Meteorology's Heatwave Service, the geographic distribution of these changes can be mapped, see Figure 1 below, demonstrating the variability of these changes across Queensland.

Globally, both historical records and future projections show that heatwaves and warm spells are becoming more frequent and intense, and lasting longer. The past four years were the four hottest years on record for global surface temperature, continuing a long-term warming trend. Figure 2 highlights the projected change in heatwave frequency across Queensland from 2030 to 2090.

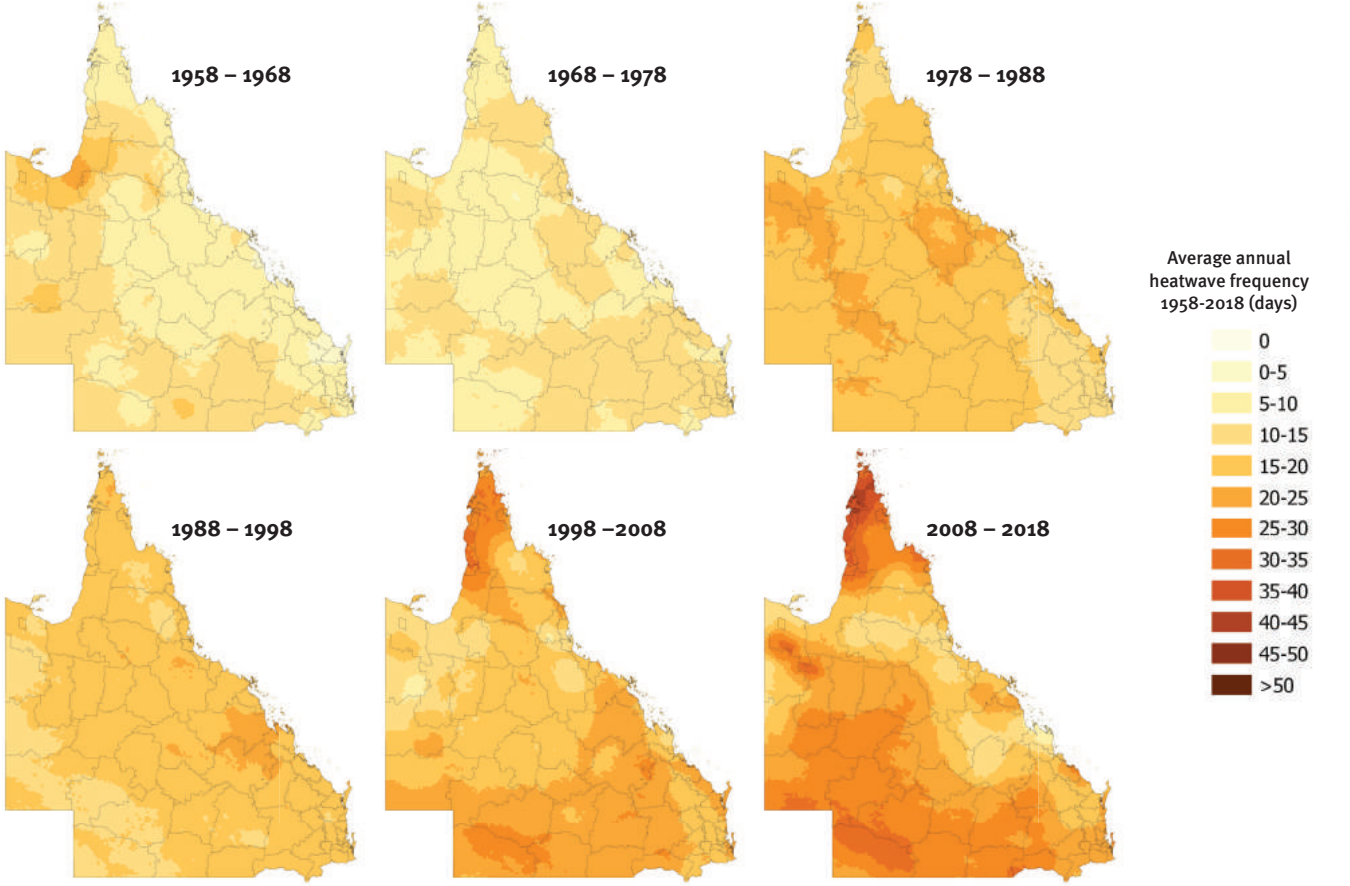


Figure 1: Historical heatwave frequency counts by decade, 1958-2018. Source: Queensland Fire and Emergency Services using data supplied under license by the Bureau of Meteorology

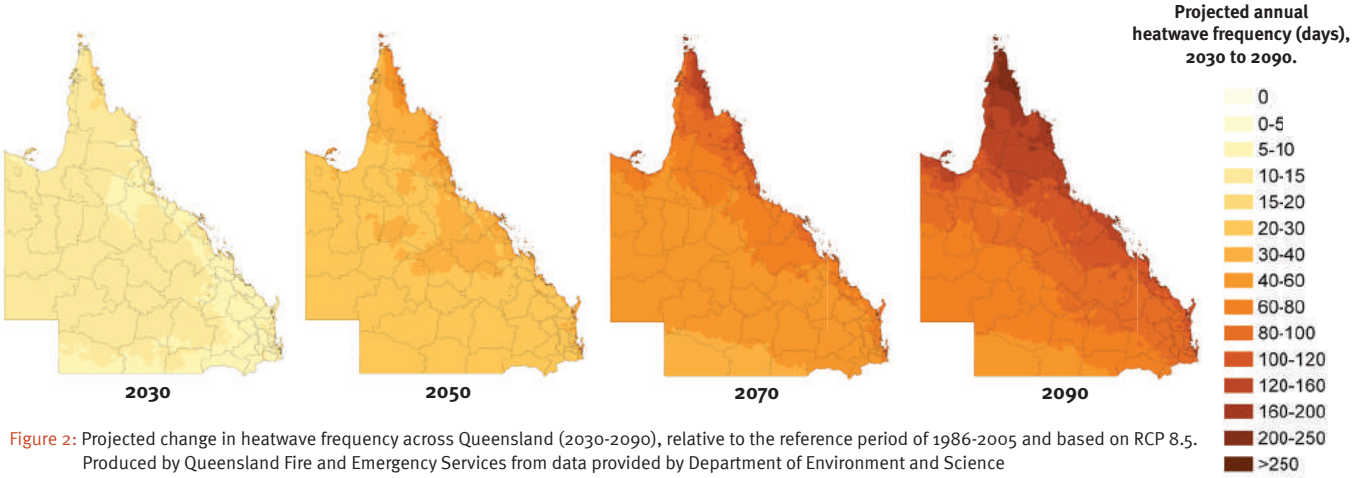


Figure 2: Projected change in heatwave frequency across Queensland (2030-2090), relative to the reference period of 1986-2005 and based on RCP 8.5. Produced by Queensland Fire and Emergency Services from data provided by Department of Environment and Science

Development and Consultation

The development of the SHRA was a collaborative effort between multiple stakeholders, coordinated through a working group led by QFES, Queensland Health (QH), and the Department of Environment and Science (DES). QH is the primary agency for heatwave, as described in the Queensland State Disaster Management Plan. The management of heatwave is currently outlined within the Heatwave Response Plan as an annex of the Queensland Health Disaster Plan.

This risk assessment process included six State level and six regional consultations (held in Longreach, Roma, Cairns, Yeppoon, Sunshine Coast, and City of Gold Coast) involving over 300 people from a diversity of subject matter expertise (see Figure 3).

The inclusion of long-term climate change projections within the assessment was made possible by the Climate Science Division, and the Climate Change and Sustainable Futures Branch, Department of Environment and Science. This collaboration represents a first for hazard specific, emergency management related risk assessments in Australia. This robust scientific basis enhances the assessment and enables State agencies and disaster management groups to inform their planning against current and future heatwave risk.

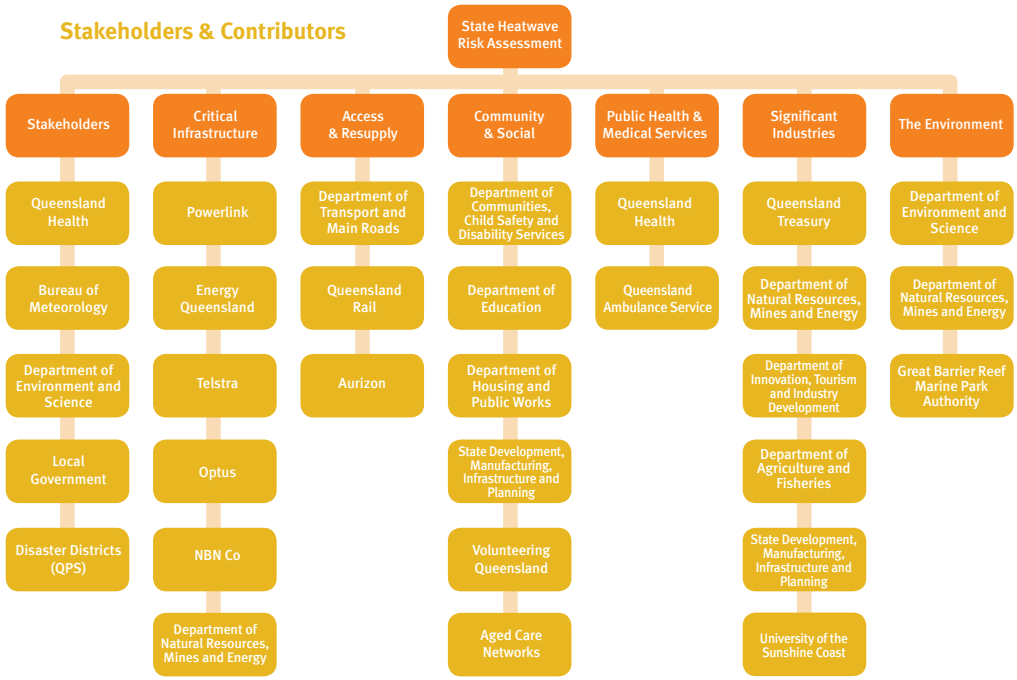


Figure 3: Stakeholders and contributors to the State Heatwave Risk Assessment process. Source: Queensland Fire and Emergency Services

Implementing the Findings of the Assessment through the QERMF Risk Assessment Process

As the potential for broad area impact from severe and extreme heatwaves increases over the 21st century, the consequences of these events may have corresponding significant and prolonged impacts on the community. Advice for the implementation of this assessment, across all levels of QDMA, is to distil the information contained within the SHRA to evaluate and understand:

1. The current probability of heatwave occurrence and increase in likelihood of heatwave occurrence (based on those figures outlined within Appendix A of the SHRA).
2. The vulnerability of the location under assessment through analysis of the local natural and built environments, and regional climatological conditions.
3. The elements of the community which may be exposed in the location under assessment (against the six QERMF categories of exposed elements) and the vulnerability of these exposed elements, noting that some elements may be exposed through broader social or economic impacts from a heatwave event (or associated hazards such as bushfire) occurring outside the region.
4. The existing controls to manage or mitigate this type of event (such as building codes, community warning strategies and specific agency disruption or continuity plans) at the respective level of QDMA to manage this type of event.

5. The existing capabilities at the respective level of QDMA to respond to this type of event.

6. The capacity of the identified capabilities.

7. The identified gaps in capability or issues of concern (residual risk) and how the management of these will be implemented through the passage of residual risk through QDMA.

Once steps 1 through 7 have been completed, this assessment can then be tabled for acceptance by a disaster management group or agency for incorporation in to their respective disaster management or business continuity plan.

If, through the implementation of this assessment, further advice or evaluation is required, assistance in accessing relevant expertise can be sought through the contact details provided within the report.

The Assessment

Regional assessment of future heatwave occurrence

To better communicate the projected changes in heatwaves across the different climate regions within Queensland, the assessment has selected nine community typologies that are representative of the differences in:

- climatology
- demographics
- social vulnerability (using the Australian Bureau of Statistics' Socio-Economic Indexes for Areas (SEIFA) as a baseline)
- regional economic profiles.

The boundaries selected for this analysis generally follow local government areas (LGAs). However, where LGAs were too small to represent regional climatic processes, they were grouped with adjacent LGAs with similar climate profiles (see Figure 4 below). The Gold Coast is an exception to this rule as the State Heatwave Risk Assessment (SHRA) aims to represent a community indicative of a complex urban environment.

The results of this analysis are shown within the infographic on pages 10 and 11 and have been used to inform the conclusions drawn from this assessment as outlined in the Summary on page 16.

	REGION NAME	LOCAL GOVERNMENT AREAS
1	Eastern Gulf of Carpentaria	Mapoon Aboriginal Shire Council, Napranum Aboriginal Shire Council, Pormpuraaw Aboriginal Shire Council, Kowanyama Aboriginal Shire Council
2	Mount Isa	Mount Isa City Council
3	Etheridge	Etheridge Shire Council
4	Wet Tropics Coast	Douglas Shire Council, Cairns Regional Council, Cassowary Coast Regional Council
5	Longreach	Longreach Regional Council
6	Mackay	Mackay Regional Council
7	Central Highlands	Central Highland Regional Council
8	Maranoa	Maranoa Regional Council
9	City of Gold Coast	City of Gold Coast

Figure 4: Selected community typologies to present regionalised high-resolution heatwave projections.
Source: Queensland Fire and Emergency Services and Department of Environment and Science

Heatwave projections for selected locations in Queensland (1986 to 2090)

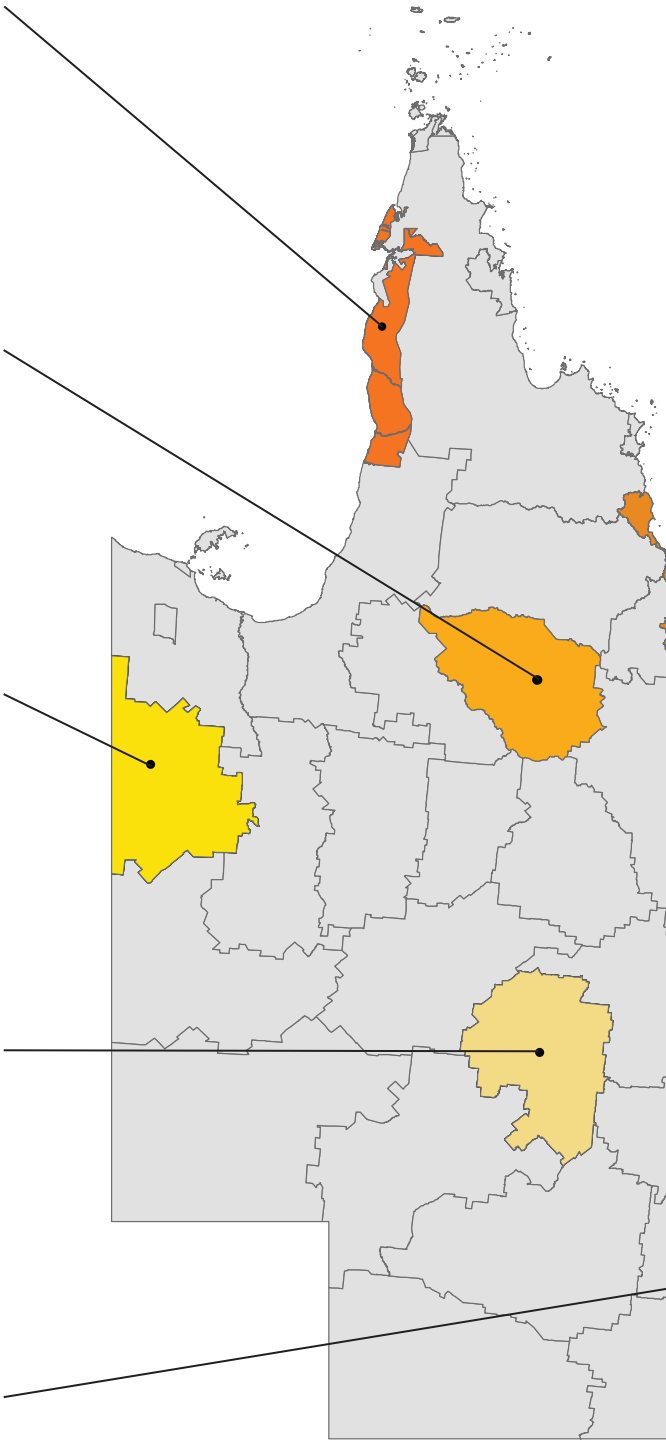
EASTERN GULF OF CARPENTARIA						
Index	Heatwave Index	Reference	2030	2050	2070	2090
HWF	Heatwave frequency (%)	0.4%	3.5%	8.8%	23.4%	44.4%
HWD	Heatwave duration (days)	2	6	14	35	62
HWMt	Temperature of heatwave magnitude (°C)	31.6	32.0	32.4	32.9	33.4
HWAt	Temperature of heatwave amplitude (°C)	31.8	32.4	33.1	34.2	35.3
Hot Days	Days >35°C	65	81	99	134	189
Hot Nights	Nights >20°C	253	288	320	347	358

ETHERIDGE						
Index	Heatwave Index	Reference	2030	2050	2070	2090
HWF	Heatwave frequency (%)	1.7%	2.9%	8.2%	19.5%	33.0%
HWD	Heatwave duration (days)	4	4	9	23	48
HWMt	Temperature of heatwave magnitude (°C)	31.4	31.8	32.1	32.6	33.0
HWAt	Temperature of heatwave amplitude (°C)	31.8	32.4	33.0	34.0	35.0
Hot Days	Days >35°C	91	112	152	185	213
Hot Nights	Nights >20°C	159	192	224	259	295

MOUNT ISA						
Index	Heatwave Index	Reference	2030	2050	2070	2090
HWF	Heatwave frequency (%)	1.6%	3.1%	7.2%	14.7%	22.8%
HWD	Heatwave duration (days)	4	3	7	15	29
HWMt	Temperature of heatwave magnitude (°C)	34.3	34.6	35.0	35.5	36.1
HWAt	Temperature of heatwave amplitude (°C)	34.8	35.3	36.0	37.0	38.2
Hot Days	Days >35°C	148	168	203	223	267
Hot Nights	Nights >20°C	177	203	228	254	284

LONGREACH						
Index	Heatwave Index	Reference	2030	2050	2070	2090
HWF	Heatwave frequency (%)	2.3%	3.3%	8.1%	14.5%	21.5%
HWD	Heatwave duration (days)	5	3	8	14	26
HWMt	Temperature of heatwave magnitude (°C)	34.1	34.3	34.8	35.2	35.7
HWAt	Temperature of heatwave amplitude (°C)	34.9	35.4	36.1	37.0	38.2
Hot Days	Days >35°C	123	145	171	192	217
Hot Nights	Nights >20°C	133	163	189	217	240

MARANOA						
Index	Heatwave Index	Reference	2030	2050	2070	2090
HWF	Heatwave frequency (%)	2.5%	2.8%	7.6%	14.0%	22.3%
HWD	Heatwave duration (days)	5	3	7	12	23
HWMt	Temperature of heatwave magnitude (°C)	31.0	31.3	31.7	32.1	32.5
HWAt	Temperature of heatwave amplitude (°C)	31.9	32.4	33.1	34.0	34.8
Hot Days	Days >35°C	46	54	76	81	98
Hot Nights	Nights >20°C	60	93	122	154	182



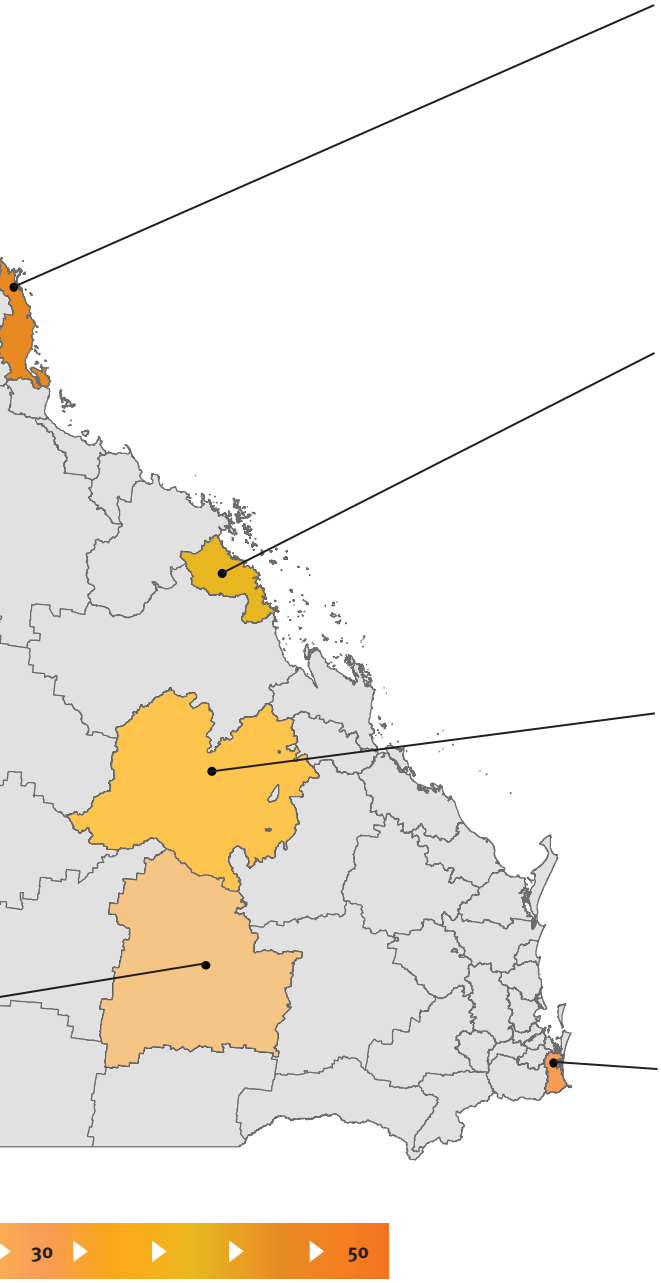
HEATWAVE FREQUENCY BY 2090 (% OF YEAR)

20

UNDERSTANDING THE DATA

Index	Heatwave Index	Definition
HWF	Heatwave frequency	Number of heatwave days relative to number of days in a year - i.e. [number of heatwave days/365] x 100 (%)
HWD	Heatwave duration	Number of days of the longest heatwave of the year (days)
HWMt	Temperature of heatwave magnitude	Average mean temperature (in ˚C) of all heatwave days across the year
HWAt	Temperature of heatwave amplitude	Average mean temperature (in ˚C) of the hottest heatwave days of the year
Hot Days	Days >35˚C	Annual count of days with maximum temperature >35ºC
Hot Nights	Nights >20˚C	Annual count of nights with minimum temperature >20ºC

Note: All figures represent an absolute change from the reference period (1986 to 2005) unless expressed in negative terms, based on RCP 8.5. Further information and guidance on the data represented within this infographic can be found at Appendix F.



Infographic created by Queensland Fire and Emergency Services. Data supplied by the Climate Science Division, Department of Environment and Science

WET TROPICS COAST						
Index	Heatwave Index	Reference	2030	2050	2070	2090
HWF	Heatwave frequency (%)	1.4%	3.1%	12.5%	29.5%	41.6%
HWD	Heatwave duration (days)	3	4	15	44	80
HWMt	Temperature of heatwave magnitude (˚C)	29.2	29.4	29.7	30.3	30.9
HWAt	Temperature of heatwave amplitude (˚C)	29.6	29.9	30.6	31.6	32.8
Hot Days	Days >35˚C	3	4	17	35	72
Hot Nights	Nights >20˚C	179	217	253	289	321

MACKAY						
Index	Heatwave Index	Reference	2030	2050	2070	2090
HWF	Heatwave frequency (%)	2.1%	3.2%	10.6%	24.3%	35.8%
HWD	Heatwave duration (days)	4	4	11	34	72
HWMt	Temperature of heatwave magnitude (˚C)	29.0	29.3	29.7	30.2	30.7
HWAt	Temperature of heatwave amplitude (˚C)	29.5	30.0	30.6	31.6	32.8
Hot Days	Days >35˚C	4	9	20	33	67
Hot Nights	Nights >20˚C	128	157	186	217	255

CENTRAL HIGHLANDS						
Index	Heatwave Index	Reference	2030	2050	2070	2090
HWF	Heatwave frequency (%)	2.7%	3.0%	8.1%	16.3%	26.5%
HWD	Heatwave duration (days)	5	3	7	16	33
HWMt	Temperature of heatwave magnitude (˚C)	30.9	31.3	31.7	32.2	32.7
HWAt	Temperature of heatwave amplitude (˚C)	31.8	32.4	33.2	34.2	35.3
Hot Days	Days >35˚C	50	62	85	95	117
Hot Nights	Nights >20˚C	86	117	146	178	206

CITY OF GOLD COAST						
Index	Heatwave Index	Reference	2030	2050	2070	2090
HWF	Heatwave frequency (%)	2.1%	3.1%	8.9%	18.4%	28.4%
HWD	Heatwave duration (days)	4	4	9	22	45
HWMt	Temperature of heatwave magnitude (˚C)	27.4	27.7	28.1	28.7	29.1
HWAt	Temperature of heatwave amplitude (˚C)	28.4	28.9	29.7	30.7	31.6
Hot Days	Days >35˚C	1	3	6	13	34
Hot Nights	Nights >20˚C	50	76	106	141	175

Key Observations from the Assessment

While heatwaves of all intensities have direct impacts on mortality and morbidity, they also cause numerous indirect impacts to communities. These include stress on electricity networks, emergency services, hospitals and infrastructure, such as road damage and transport delays when railway lines buckle.

For the purposes of this report, the impact has been assessed against the occurrence of severe and extreme intensity heatwaves. This is because people, infrastructure and the environment typically have the capacity to cope during more common, low intensity heatwaves.

The impacts of severe and extreme heatwaves are likely to affect all sectors of Queensland's communities, from the public to government organisations and industries, health, utilities, commerce, agriculture, and infrastructure (as shown in Figure 5 below). The impacts that may be currently expected, and which may intensify with the projected increase in frequency, intensity and duration of heatwaves, are explored in greater detail within this section.

Assessing hazard interaction and the impact of hazard characteristics on exposed elements provides a clear understanding of a region's or community's vulnerabilities. This risk assessment highlights those elements susceptible to the characteristics of the hazard under the current and the projected future climate.

The key observations for communities across Queensland are presented below according to the six exposed element categories outlined within the Queensland Emergency Risk Management Framework (QERMF).

This list is not exhaustive, and all the elements highlighted will not be applicable to every local government area (LGA) within Queensland.

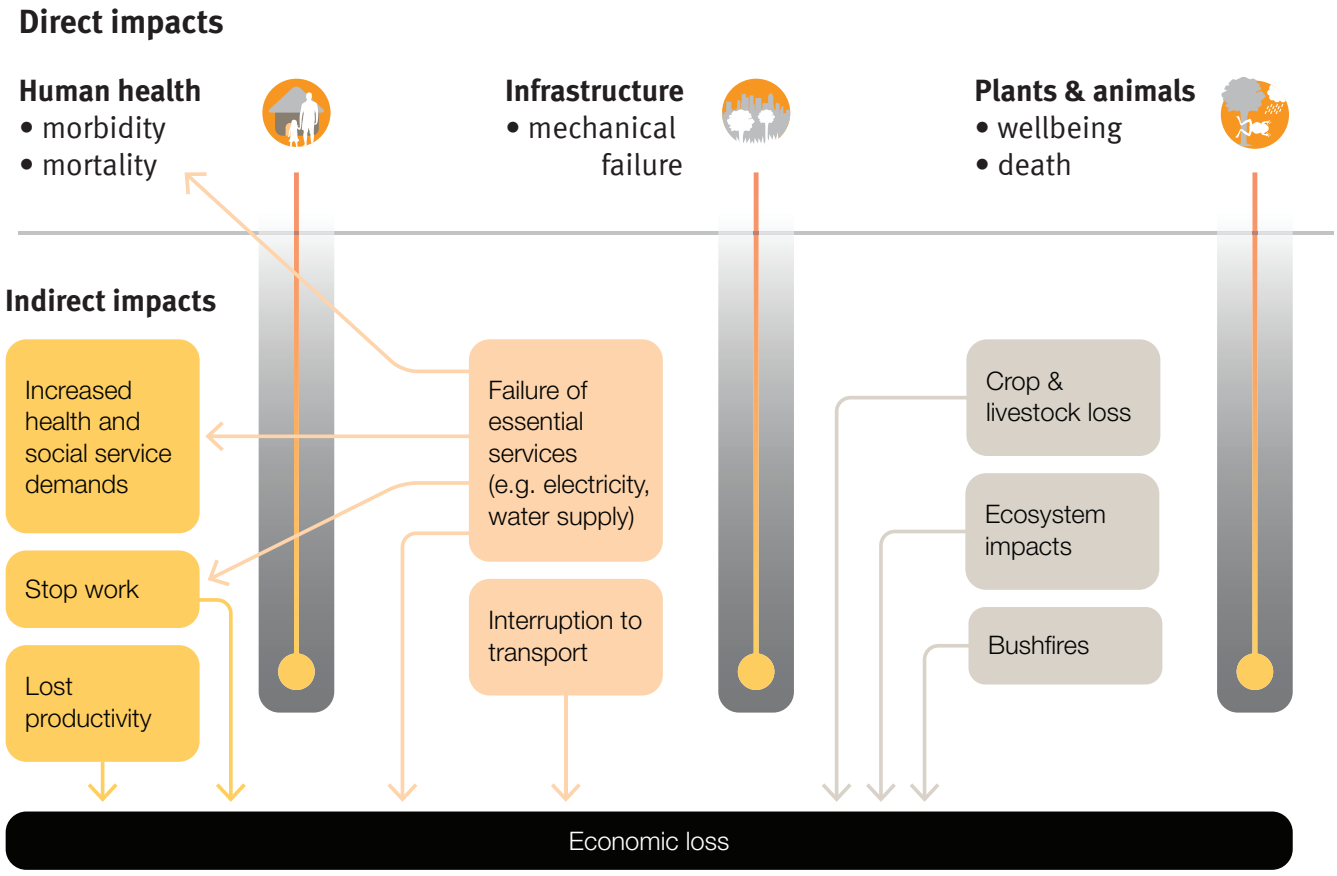


Figure 5: Schematic diagram showing the direct and indirect impacts of extreme heat. Source: NCCARF

Essential Infrastructure: Key points

- Higher demand will increase strain on the power network, especially during hot nights. Projected changes in heatwave frequency, duration, and intensity are likely to contribute to further increased demand
- Exposure and vulnerability of the power network may be compounded by heatwave-associated hazards such as cyclone and bushfire
- Higher operating temperatures reduce the efficiency of backup power generation and battery storage, further compounding vulnerability of the power network
- There is a higher risk of bacterial contamination within water infrastructure such as reservoirs and bores
- Passengers at surface transport stations and stops may be at higher risk of heat related illness due to a general lack of mechanical cooling and ventilation at these facilities.

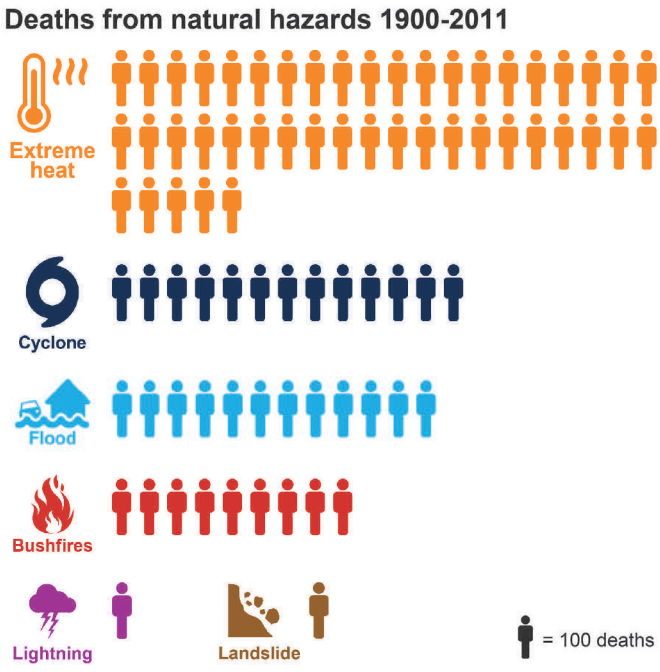


Figure 6: Infographic highlighting the mortality rate of heatwaves against other significant natural hazards within Australia. Source: Department of Environment and Science adapted from McMichael et al., 2003

Access and Resupply: Key points

- Road and rail networks are vulnerable to damage during periods of intense heat. This may result in road closures and affect heavy haulage, and result in service cancellations or speed reductions for rail transport and freight services
- Some bridges may be vulnerable to extreme heat, causing premature deterioration of the structure due to stress from thermal expansion and movement
- Active transport modes are likely to be underutilised, possibly increasing reliance and strain on the road and rail network
- People walking and using active transport are more likely to be exposed, and more vulnerable to heat related illness
- Extreme temperatures may affect aircraft movements and reduce the capacity of air transport.

Medical: Key points

- Significantly increased mortality rates are likely among older populations and medically dependent people with pre-existing conditions
- Vulnerable populations include the elderly, the very young, Aboriginal and Torres Strait Islander communities, people outdoors, people working in hot and/or humid environments, and those with compromised physical and mental wellbeing
- Urban populations are at higher risk of exposure due to Urban Heat Island Effect (UHIE)
- Risk of food-borne and vector-borne diseases may increase
- Increased prevalence of mental, behavioural, and cognitive disorders is likely.

Community and Social: Key points

- There may be an increased demand for social support and mental health services
- Cultural and linguistic barriers may increase vulnerability due to social isolation, limited understanding of heatwave risk, and limited comprehension of key messaging.
- Exposure of urban populations is compounded by lack of green space, buildings blocking air flow, and the prevalence of heat-absorbing surfaces that release heat slower at night, which expose people to elevated temperatures for longer
- Tourists may have a lower ability to cope with heatwave effects compared to local, acclimatised populations
- Heatwaves are likely to contribute to more people visiting beaches, public pools and inland swimming areas, which may increase the risk of drowning and injury, and place further strain on associated services.

Significant Industry: Key points

- Transport and logistics may be impacted by damage to the road and rail network, and limitations to aircraft operations
- Sustained high temperatures may reduce crop yield and quality, and affect the productivity, health and wellbeing of livestock
- Associated increases to bushfire risk may result in death of or injury to people and livestock, and loss or damage to crops, plantations, buildings, assets and equipment
- Vulnerability of ecosystems and impacts to biodiversity may affect tourism. Visitation and enjoyment of attractions and experiences may decline
- Some businesses may experience reduced revenue and/or increased operating costs because of higher temperatures.

Environment: Key points

- Mass bleaching of the Great Barrier Reef may occur, significantly impacting ecology and biodiversity
- Higher temperatures may result in increased occurrence of algal blooms and fish kill incidents in freshwater ecosystems
- Mass deaths of heat sensitive species such as flying foxes and birds may occur, and the risk of extinction for some species may increase
- Bushfire risk is often higher during heatwave events, increasing the vulnerability of native species and the natural environment.

Figure 7: The collection of flying foxes which succumbed to the effects of the extreme heatwave forced some residents to be evacuated from their homes due to potential human health impacts. Source: Cairns Local Disaster Management Group

Risk Management Considerations

Consideration of climate change within the assessment shows that the magnitude of and exposure to heatwave is projected to increase, and that associated risks may extend across all sectors. There are numerous governance challenges relating to future heatwave risk, including taking appropriate actions to reduce negative impacts to human health and wellbeing, the environment, and the economy.

Noted below are considerations that may help to address issues arising from the examination of heatwave risk using this assessment. These considerations were derived from the extensive consultation process undertaken during the development of the assessment. They are not prescriptive nor exhaustive, and it is expected that other strategies may be identified to reduce risk.

"Time is perhaps the most mind-bending feature [of climate change], the worst outcomes arriving so long from now that we reflexively discount their reality"

David Wallace-Wells
The Uninhabitable Earth: Life After Warming

Consideration 1: Government policy and initiatives should seek to enable all sectors to prepare for projected increases in heatwave risk in a collaborative manner. Some considerations that extend across sectors include:

- Exposure and vulnerability of our aging population
- Sustainability and adaptation of food production and supply
- Adaptation and sustainability of urban areas through improved urban design and increased urban forestry and canopy coverage
- Adaptation and sustainability of the agricultural and rural economic sectors in areas such as business, innovative sector transition initiatives and regionally focused investment
- Other pathways and actions such as those outlined in the Queensland Climate Transition Strategy and the Queensland Climate Adaptation Strategy.

Consideration 2: Building design, urban design, and urban planning can both exacerbate and alleviate the effects of heatwave. Some sector-specific considerations that can be taken in anticipation of, or response to the increasing risks associated with heatwave include:

- Engaging climatologists in planning and development stages
- Introduce specific heat reduction and resistance measures, including passive design features
- Improve resilience and adaptation of buildings and occupants to climate variability, and reduce exposure to people especially vulnerable to heatwave (for example, the elderly, children, and medically dependent persons)
- Improve industry and consumer education regarding the heat risks associated with building design and material selection
- Implement planning controls that specifically target heatwave, similar to existing controls for flood, cyclone, fire, and earthquake.

Consideration 3: Across Australia, heat-related deaths exceed those from all other natural hazards combined. The formal classification of 'extreme' heatwave as a disaster would likely improve the visibility of associated risks, and streamline funding options for disaster response, recovery and risk reduction.

Consideration 4: Community messaging that is informed by Queensland Health guidelines can be shared through formal and informal networks. Further works should be undertaken to improve the consistency and dissemination of key messaging through partnerships, such as with Local, District and State disaster management groups, non-government organisations, and businesses.

Summary

Within the State Natural Hazard Risk Assessment 2017, the risks associated with heatwaves were accorded the third highest priority from the seven natural hazards assessed. Heatwaves, it was acknowledged at the time, were likely to have been underestimated in terms of impact and consequences across all sectors of the community due to their less violent, slower onset and less publicised nature.

This subsequent assessment has proven that hypotheses correct – with some exceptions, there is a broad underestimation of the risks associated with heatwaves and heat events within disaster management, business continuity and climate adaptation planning across Queensland. This is consistent with heatwave's growing reputation as a 'silent killer'.

The aim of this assessment is to increase the understanding and awareness of the current and future risks and impacts of heat events, heatwaves, and associated hazards. The challenges outlined below reflect the key findings of this assessment, and should be considered as a guide for further study, discussion and future planning against heatwave related risk.

Six main challenges that can be addressed to help manage our increasing heatwave risk in Queensland were identified:

1. Increasing urbanisation, an absence of climate-based building codes for local contexts, and a lack of urban designs that can adequately manage the increasing exposure of urban populations to urban heat island effect (UHIE).
2. This is further exacerbated by increasing loss of urban canopy cover, green spaces and lack of support for using 'green infrastructure' components of urban planning and design to improve the management of heatwaves and UHIE within Queensland.
3. Community education of the current and future risks posed by heatwaves continues to lag behind education initiatives and campaigns for events that are less frequent but more visible, such as cyclones, floods and bushfires.
4. Aging populations in areas projected to experience higher rates of heatwave occurrence are expected to increase pressure on health, aged care and community services. This is likely to be acute within regional communities projected to experience the highest increases in heatwave occurrence.
5. Increasing heatwave occurrence in regions already experiencing water stress and/or prolonged drought conditions will exacerbate issues currently facing many rural Queensland communities. Agricultural losses during heatwave events are projected to increase markedly unless robust government policy initiatives that enable the sector to transition sustainably can be rapidly implemented.
6. Adaptation strategies for individuals and communities against increasing climate related risks such as heatwaves are currently not widely accessible. This is compounded by a lack of understanding within at-risk communities of suitable adaptation strategies and their benefits. Increasing access to cost effective solutions that increase community and household resilience to heatwaves is a key challenge facing many local governments throughout Queensland and, indeed, Australia.

Considering the above challenges, the assessment of current and future risk potential, and additional information outlined in this assessment, the following areas of Queensland are considered be at highest risk from future heatwave and heat events:

1. *Regional communities located within the tropical region of Far North Queensland including those of Cairns, Etheridge, Mareeba, Douglas, Wujal Wujal and Cooktown. This assessment reflects the current heatwave potential within the region and the projected increase in heatwave frequency to the end of the 21st century.*

   It also acknowledges the changing nature of the communities within Far North Queensland which are growing in both age and population. As an example, Cairns has the fourth fastest growing population of those aged over 65 in Queensland behind the Wide Bay, Sunshine Coast and Darling Downs regions.

   This assessment also accounts for the challenges presented to the environment and ecosystems within Far North Queensland, which links to the regional economy. These sectors are at significant risk from increasing bushfire potential, increasing occurrences of mass-deaths of native wildlife populations and exacerbation of the risk to the survival of the Great Barrier Reef.

   Of note, Aboriginal communities located within Far North Queensland are projected to experience the highest rate of increase in heatwave frequency per local government area (LGA); with communities such as Napranum and Torres Shire experiencing over 250 days per year in heatwave conditions by 2090.

2. *Communities within the Central and Western regions of Queensland such as those within Central Highlands and Longreach.*

   This analysis identifies potential impacts to communities located within this region from some of the highest rates of increase in both heatwave frequency per LGA and average temperatures; days above 35˚C are projected to double across the region by 2090.

   This expected increase also coincides with projected increases in drought occurrence and general water stress, and a declining population base across many western regional communities.

   Given that many of these communities are involved in or support the agricultural sector, subsequent impacts to this sector from increasing temperatures and heatwave occurrence will likely compound impacts to the communities in the future.

3. *Communities within and surrounding the Greater Brisbane region such as Moreton Bay, Ipswich, Logan, Lockyer Valley and Scenic Rim.*

   This analysis reflects the challenges posed by the significant increase in projected population growth, associated urbanisation, inadequate building designs, and UHIE potential within the region. Many of these areas have some of the lowest levels of urban canopy coverage within Queensland and loss rates are increasing as further areas are cleared for development.

Importantly, the assessment also found a low level of awareness among the public on how to manage the risks posed by heatwaves due to an increasing reliance on active cooling methods such as air conditioning within homes, offices and social infrastructure.

Despite according these areas highest priority in terms of heatwave risk potential, the increasing risk to other areas within Queensland should not be discounted.

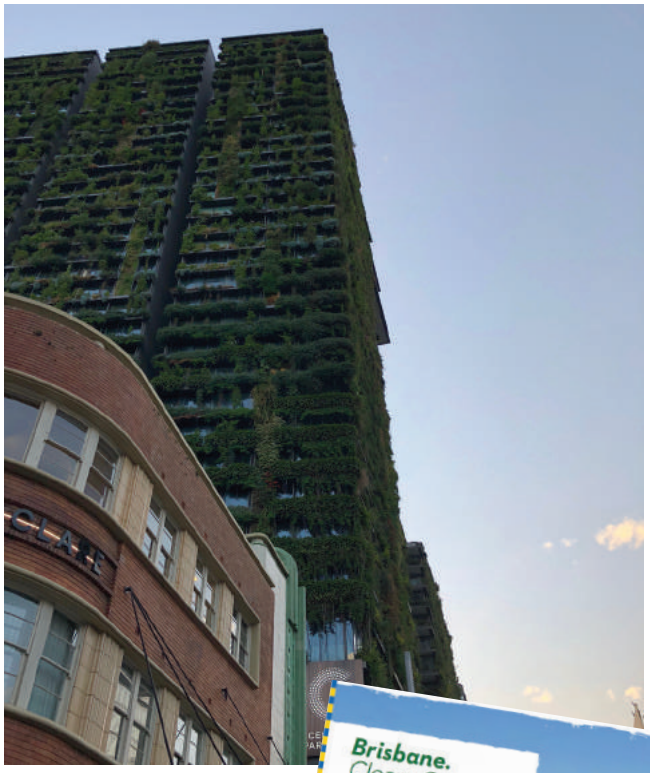
It is important to reflect that whilst prevention, preparedness and response to heatwaves as a hazard will primarily focus on human health, there is an immediate and growing need for a coordinated multi-agency approach at all levels of Queensland's disaster management arrangements. This reflects the findings of the assessment, which has highlighted cross sectoral impacts from heatwaves, and therefore the need for a coordinated approach to address the changing nature of heat events and heatwaves under the influence of climate change.

Future iterations of the assessment and other associated studies will continue to explore this risk in greater detail and, as a result, better define Queensland's risk from heatwaves and associated hazards.

If further research, analysis or assessment is required after reviewing this document to understand the heatwave risk for a particular area, a collaborative approach with the stakeholders listed below is recommended to ensure consistency in evaluating the hazard in line with State and national assessments.

Key agencies:

- Queensland Fire and Emergency Services (Hazard and Risk Unit)
- Queensland Health
- Department of Environment and Science
- Bureau of Meteorology.



The above images highlight examples of strategies that aim to deal with the increasing risks associated with heatwaves and urban heat island effect (UHIE) using 'green infrastructure'. Clockwise from bottom left:

- Image of the extensive canopy cover present at the Eumundi Markets, Queensland. This canopy is maintained to provide respite and protection from the heat for the thousands of visitors to this popular tourist destination. Source: Queensland Fire and Emergency Services
- Artist rendering of Melbourne as a 'green city'. Under the Melbourne Urban Forest Strategy, Melbourne City Council seeks to increase public realm canopy cover from 22% at present to 40% by 2040. Source: Melbourne City Council
- Image of the vertical hanging gardens at One Central Park in Sydney's CBD. This vertical garden is designed to improve the air quality and thermal efficiency of the building. It uses only recycled water to care for the 85,000 plants that make up the vertical garden. Source: Queensland Fire and Emergency Services
- Brisbane. Clean, Green, Sustainable 2017-2031. This strategy highlights how Brisbane City Council will deal with climate related risks through a multi-sector approach. Chapter 8 details the use of 'Urban Forestry' to improve air quality and reduce the risks associated with UHIE. Source: Brisbane City Council

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