QUEENSLAND
2021/22 STATE DISASTER RISK REPORT

Executive Summary

2022

Queensland Government

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Additional contributions acknowledged throughout.

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https://www.disaster.qld.gov.au/qermf/Pages/Assessment-and-plans.aspx

Foreword from Queensland Fire and Emergency Services

Living in Australia's most disaster impacted state means that Queenslanders are no strangers to disaster risk. Our communities, the infrastructure on which they depend and the environment around them are exposed to a range of hazards that can result in potentially devastating impacts.

Since the publication of the 2017 State Natural Hazard Risk Assessment, 64 of Queensland's 77 local governments have been impacted by one or more declared disaster events.

Within recent years we have experienced disasters of a size and scale that are almost unparalleled in our nation's modern history and the landscape of disaster risk is continuously changing. Climate change is contributing to more extreme heatwaves, increasingly severe fire conditions, higher sea levels and worsening floods. As our society grows, so too does our exposure and the value of things that can be at risk.

Our world is more connected than ever, creating complex and wide-ranging interdependencies that are leading to more systemic vulnerability. COVID-19 has exposed many of these vulnerabilities, forcing us to think differently about the world in which we live, the way we work and the lifestyle values we cherish.

These events reinforce the need to understand and share information about disaster risk with the Commonwealth, across jurisdictions and the three tiers of Queensland's disaster management arrangements - local, district and state.

The Honourable Mark Ryan MP

Minister for Police and Corrective Services and Minister for Fire and Emergency Services

Mr Greg Leach, Commissioner

Queensland Fire and Emergency Services

This foundational report is the result of a collaborative effort between stakeholders at all levels of government and other entities working within Queensland's disaster management arrangements. Its scope builds on the 2017 Assessment by assessing a wider range of hazards and risk drivers and provides the results of assessment at a regional planning level. As with the 2017 Assessment, this report was developed using the Queensland Emergency Risk Management Framework to assess those hazards considered within.

The information contained within can help to inform more detailed, place-based local and district risk assessments and disaster management plans. These assessments and plans can guide decision making before, during and after an event to help reduce impacts of disasters on our communities, our infrastructure and environment.

All Queenslanders are affected by disaster risk in some way. We encourage all Queenslanders to consider the valuable information in this report to help them better understand and manage the disaster risks applicable to their interests and responsibilities.

We thank all stakeholders for their ongoing contributions to disaster risk management and for their contributions to this 2021/22 State Disaster Risk Report.

Table of Contents

Overview

Introduction

Under the Queensland State Disaster Management Plan, Queensland Fire and Emergency Services (QFES) has responsibility for State-wide assessment of disaster risk.[1] The 2021/22 State Disaster Risk Report (SDRR or the report) provides an assessment of State-wide risk for ten hazards, two compound or cascading events, and a range of risk drivers.

The SDRR builds on the 2017 State Natural Hazard Risk Assessment, which assessed risk for seven in-scope natural hazards, deemed the most significant to Queensland at the time of publication. This updated report has broadened its scope to provide an assessment of State-wide risk for natural (meteorological, hydrological, geohazard, and environmental), and human-induced or anthropogenic (environmental, chemical, biological and technological) hazards, through an analysis of ten hazard-based scenarios and two cascading and compounding events.

The report improves Queensland's understanding of disaster risk and provides information for all entities with disaster management responsibilities to support decision making. The development of the SDRR was an action of the IGEM 2018 Queensland Bushfire Review,[2] and its development was supported by the State Disaster Coordination Group (SDCG).

The SDRR is published in five parts across two reports:

1. This **Executive Summary**, which provides a high-level, plain English summary of the report aimed at policy officers and decision makers.
2. The **2021/22 State Disaster Risk Report**:
    a. **Section A – Disaster risk management in Queensland 2017 – 2060** details how disaster risk is assessed and managed in Queensland, major events that have occurred in the disaster management space since 2017, traditional and longstanding Indigenous applications of disaster risk management, and how climate change will change the face of disaster risk between now and the end of the century
    b. **Section B – State disaster risk assessment** contains hazard-specific risk assessments and risk analysis
    c. **Section C – Risk prioritisation** details the findings of the risk analysis that shows how hazard prioritisation has changed since the 2017 State Natural Hazard Risk Assessment, and updates the prioritisation to include the hazards that are new to this report
    d. **Section D – Technical methodologies** contains technical details of how some of the quantitative results were obtained in this report.

The intent of the SDRR is to provide a foundational level of information for risk assessments undertaken by local and district disaster management groups and other State entities. These assessments should inform the development of risk-based Local and District Disaster Management Plans. The report also provides authoritative guidance on climate change and its relation to disaster risk in Queensland.

Scope

The scope of the report contributes to the responsibilities of QFES and the Queensland Disaster Management Committee, as defined in the *Disaster Management Act 2003*.[3]

In summary, the report:

1. Provides an updated State-level disaster risk assessment for Queensland.
2. Provides a single, consolidated source of risk information, including resources, key stakeholders and plans to:
    a. Support disaster management planning across all levels of Queensland's disaster management arrangements.
    b. Help disaster management groups to assess and manage disaster hazards and associated risks (including residual risk) collaboratively across the four phases of prevention, preparedness, response and recovery (PPRR).
3. Outline the key risk priorities for Queensland and how the members, invitees and associated stakeholders work across Queensland's disaster management arrangements to collaboratively to manage these risks.
4. Enable the State Group and its members to take appropriate steps to identify and address any gaps in the management of the assessed hazards.

Key advancements made in this report since the publication of the 2017 State Natural Hazard Risk Assessment include:

- **Updating risk assessments to incorporate insights and knowledge gained from experience in the years since 2017.** In particular, the SDRR builds on the development, implementation, and improvement of the Queensland Emergency Risk Management Framework (QERMF), the production of Statewide, hazard-specific risk assessments, and the increased availability of relevant data and models.
- **Incorporating more hazards than the 2017 State Natural Hazard Risk Assessment.** The report encompasses both natural and anthropogenic hazards, including a renewed focus on pandemics and epidemics, given the emergences of the COVID-19 pandemic.
- **Including more advanced information on climate change.** Projections from 2021 to 2060 have been included, based on Representative Concentration Pathway 8.5 (see the section on climate change and disaster risk for more information) to understand how disaster risk could change across Queensland over the coming decades.
- **Reflecting the needs and expectations of numerous end-users, experts and disaster management stakeholders.** These stakeholders were consulted with during engagements across the State, undertaken since the publication of 2017 State Natural Hazard Risk Assessment.

This report is the result of engagement with lead and functional entities with disaster management responsibilities, as identified in the State Disaster Management Plan, and regional engagement with local and district disaster management groups. A list of stakeholders is included below.

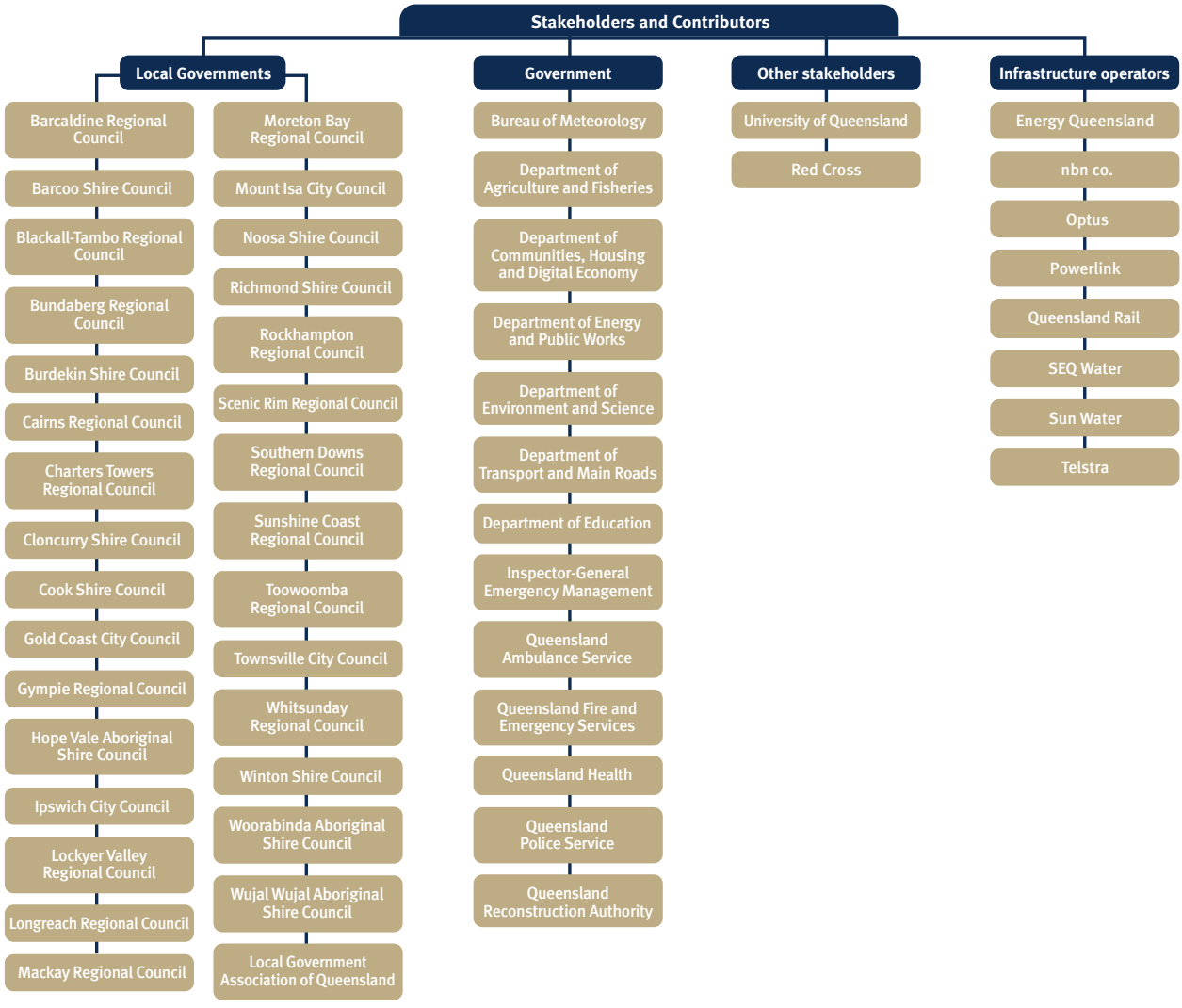


Figure 1: The stakeholders involved in consultation during compilation of the report.

Disaster risk management in Queensland

Concepts

Disaster risk arises when hazards interact with exposed and vulnerable communities, and when the impacts exceed the capacities available to manage these risks. The QERMF adopts the United Nations Office for Disaster Risk Reduction's definition of disaster risk:[4]

> *"The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity."*

Disaster risk assessment is undertaken by analysing potential hazards and evaluating existing conditions of exposure and vulnerability that, when combined, could harm people, property, services, livelihoods and the environment upon which they depend.

Disaster risk assessments include:

- identification of hazards and hazardous events (scenarios)
- a review of the technical characteristics of hazards such as their location, intensity, frequency and probability
- analysis of exposure and vulnerability to hazards, including the physical, social, health, environmental and economic dimensions
- evaluation of the effectiveness of existing and alternative coping capacities for a range of scenarios.

Disaster risk is assessed by analysing the five components of risk contained within the definition of disaster risk, adapted for the Queensland context:

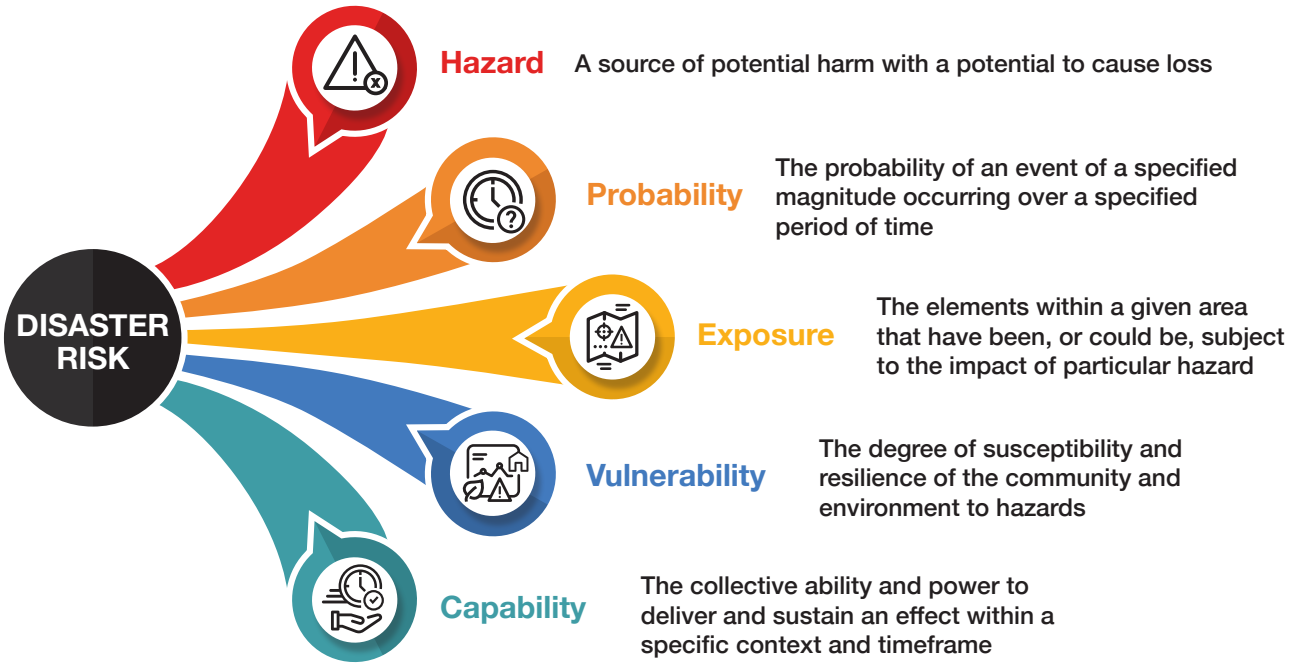


Figure 2: The five components of disaster risk.

Where risk remains, it needs to be managed. Disaster risk management is defined as:[4]

> "the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses"

This can be further broken down into three approaches for managing disaster risk:

- prevention of new disaster risks
- reduction of existing disaster risks
- management of residual risks.

Like the 2017 State Natural Hazard Risk Assessment, the 2021 report uses the QERMF to assess disaster risks. This assessment was informed by extensive engagement undertaken across all levels of government and with providers of essential services throughout 2020 and 2021.

The maturation of the QERMF has demonstrated that more guidance is needed regarding the identification, communication, and shared management of risk between all levels of Queensland's disaster management arrangements, including residual risk. Residual risk is defined as:

> *"the risk that remains even when effective disaster risk reduction measures are in place, and for which emergency response and recovery capacities must be maintained."*

The presence of residual risk implies an ongoing need to improve risk management practices, including the provision of advice, support and resources. A key objective of this report is to provide local and district disaster management groups with access to information that supports risk reduction, including avoiding the creation of new risks, reducing existing risks, and managing residual risks.

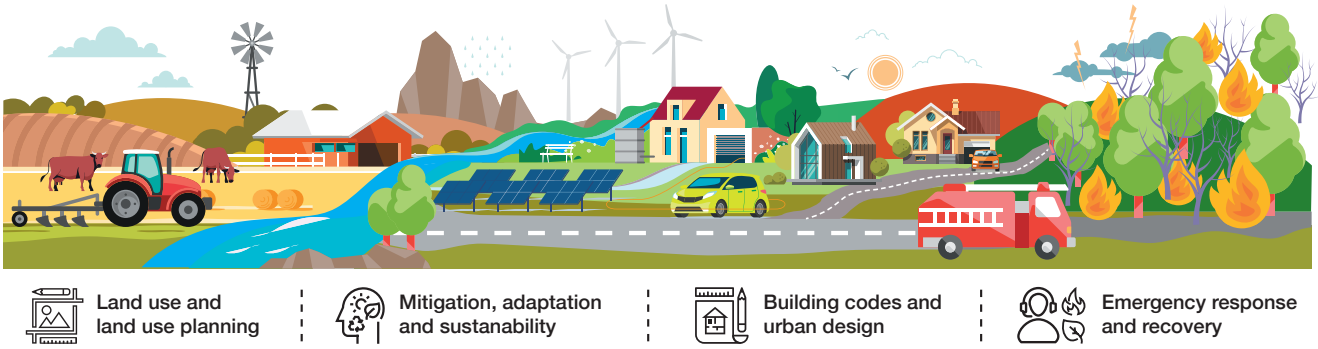


Figure 3: Overview of some risk management practices that contribute to disaster risk reduction. Source: QFES.

Context

The report contributes to the broader context of disaster risk reduction policy, guidance and activities, with an overview of these provided in figure 4.

Figure 4: Overview disaster risk reduction policy and guidance from global to household levels.

The Queensland context

Queensland is the most disaster-prone state in Australia, and the most impacted financially by disasters.[5–7] As the severity of disasters increases due to climate change, the costs of disasters will continue to rise. In the past five years Queensland has experienced a number of significant disaster events impacting 64 of Queensland's 77 local government areas (Figure 5).

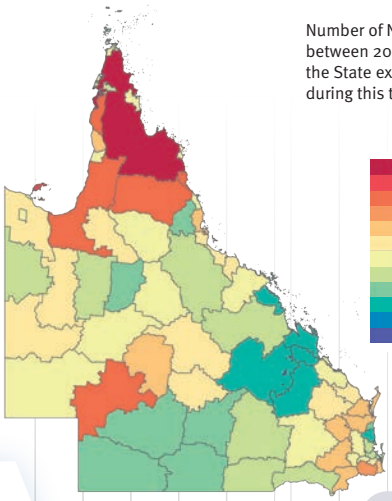
A sample of 39 disaster risk reduction studies found a cost-benefit ratio of 3.7 to 1 – this means that every dollar spent on disaster risk reduction yields 3.7 dollars in benefits.[8–12] The cost-benefit ratio for each hazard is below (Table 1):

Hazard	Cost : benefit ratio
Flood (riverine and coastal)	1:4.6
Wind (tropical and extratropical)	1:2.6
Earthquake	1:3
Drought	1:2.2
Landslide and avalanche	1: 1.5
Average	**1:3.7**

Table 1: Cost-benefit ratios, as reported by Mechler.[10]

Overall, the benefits of investing in disaster risk reduction consistently outweigh the cost of investment. Broadly, these measures may include structural or non-structural strategies, exposure and property modification, or behavioural interventions.

2017 – 2022 State Disaster Timeline



Number of NDRRA activations per LGA between 2017 and 2022. The majority of the State experienced multiple disasters during this time.

State Heatwave Risk Assessment

A comprehensive overview of current and future heatwave risk in Queensland, 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.

Severe Thunderstorm Event

A significant thunderstorm outbreak South East Queensland with the Cit hit by a 1 in 50-year storm that left s and thousands of houses without p rain falls in just over an hour, with v as floodwaters rose to a metre high

STATE HEATWAVE RISK ASSESSMENT

SEVERE THUNDERSTORM EVENT

2018-2019 Bushfire Season

- More than 4 million hectares burnt across the State
- Multiple homes lost

2019-2020 Bushfire Season

- 7.7 million hectares burnt across the State
- Multiple homes lost

2018-2019 BUSHFIRE SEASON

IGEM REVIEW: EFFICACY OF RECOVERY GOVERNANCE

2019-2020 BUSHFIRE SEASON

Heatwave

Record-breaking he the Black Summer

HEATWAVE

Tropical Cyclone Trevor

2,100 people evacuated from Borroloola, Numbulwar and Groote Eylandt.

Tropical Cyclone Nora

Widespread damage and flooding in North Queensland.

EMERGENCY MANAGEMENT SECTOR ADAPTATION PLAN FOR CLIMATE CHANGE

TC NORA

2018-2019 QLD BUSHFIRES

TC TREVOR

QUEENSLAND STATE EARTHQUAKE RISK ASSESSMENT 2019

IGEM RE BUSHF

2017

2018

2019

SNHRA17 PUBLICATION

IGEM REVIEW: CYCLONE DEBBIE

SOUTH EAST QUEENSLAND THUNDERSTORMS

SEVERE THUNDERSTORM EVENT

TC PENNY

TOWNSVILLE MONSOON & FLOODS

TSUNAMI GUIDE FOR QUEENSLAND

IGEM REVIEW: PARADISE DAM PREPAREDNESS

STATE NATURAL HAZARD RISK ASSESSMENT 2017

A report on 7 natural hazards that formed the basis of State-wide hazard prioritisation in the Queensland State Disaster Management Plan.

South East Queensland Thunderstorms

Over 130,000 homes lose power for >24hours after destructive winds gusting to over 109km/h brings trees and powerlines down across the South East. Energex records 265,000 lightning strikes in 24 hours. Worst affected areas are Kingston, Jimboomba, Crestmead, North Maclean and Beenleigh.

Severe Thunderstorm Event

- Widespread storms, destructive winds, flash flooding and large hail from the South Burnett to the Sunshine Coast
- A powerful tornado hit Tansey, north-west of Murgon
- 3 injured

Townsville Monsoon & Floods

- 2 fatalities
- $1.2 billion insurance cost
- 300,000 cattle perished

HEATWAVE

Heatwave

Much of the State experienced multiple days with daytime temperatures in excess of 40 degrees and nighttime temperatures above 25 degrees.

IGEM REVIEW: 2019 MONSOON TROUGH RAINFALL AND FLOOD REVIEW

2019 GOLD COAST STORM

2019 Gold Coast Storm

Large hail impacted areas in the Coast, Logan and the northern G

IGEM REVIEW: 2018 QUEENSLAND BUSHFIRES REVIEW

DOCUMENT

ROYAL COMMISSION

COVID-19 PANDEMIC

TROPICAL CYCLONE

RIVERINE FLOODING

HEATWAVE

BUSHFIRE

SEVERE THUNDERSTORM EVENT

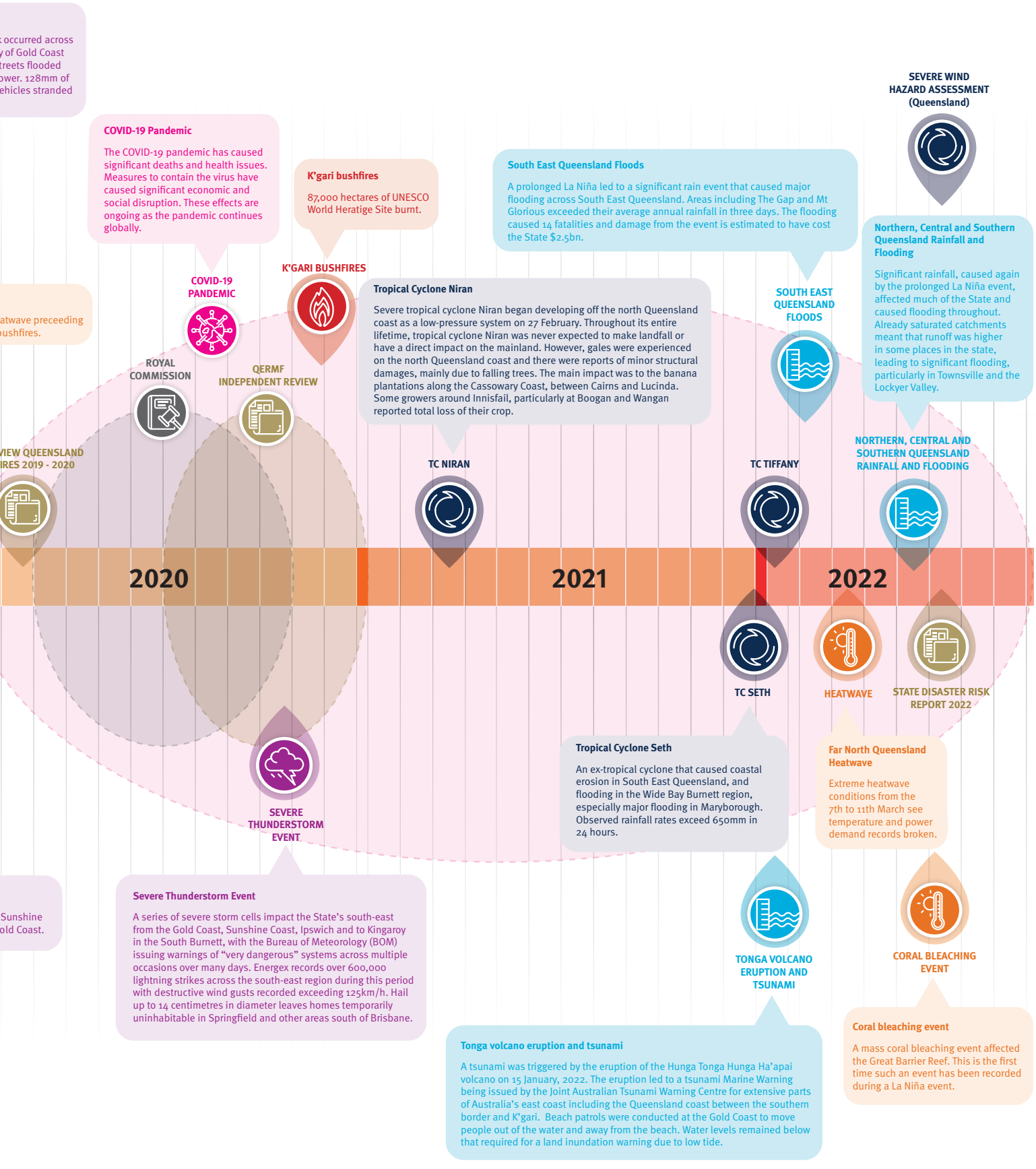


Figure 1: Queensland's disaster timeline since 2017 showing the number, frequency, type and locations of events.

Two pillars of Queensland's approach to disaster risk management are Queensland's disaster management arrangements, and the QERMF. Central to both is the communication and escalation of disaster risk for management between each level of the arrangements (local, district, State and Federal). This passage of risk information can occur during any phase of disaster, however the communication of risk well before an event occurs will help to ensure that appropriate measures are developed and implemented to prevent, mitigate, prepare for, respond to and recover from a disaster event.

The relationship between the QERMF and Queensland's disaster management arrangements is depicted in Figure 6.

Indigenous perspectives

Current disaster management practices in use in Queensland have evolved in the context of two centuries of European colonisation. Meanwhile, the presence of Aboriginal and Torres Strait Islander peoples in Queensland extends back over 60,000 years.[34] The emergence of disaster management practices over these millennia – given a much longer and more varied experience of natural hazards – can help to highlight how these risks have been mitigated in the past.

Many First Nation groups' vocabularies did not have a phrase or word for now what is widely called 'disaster management' or 'disaster risk reduction'. This term has only been associated with First Nations practices recently because of the bearing of traditional knowledge on contemporary practices such as land management, coverage of natural hazard disaster events via digital media and the increasing role that Indigenous local governments play in disaster risk management in collaboration with other local and State authorities.

Traditional Lore in Queensland included complex land management skills which were attuned to an in-depth knowledge of weather patterns and cycles dating back to and linked with previous natural occurring events like volcanic activity and major sea level rise tens to hundreds of thousands of years ago. This understanding of all biota enabled Indigenous peoples' practices to overlap and complement Queensland plant and animal species' reproduction, movement and migration. These practices promoted food security for both Indigenous populations and endemic wildlife.

Disaster risk management has been an important aspect of life for the First Nations peoples in Queensland for many millennia and continues to be today.

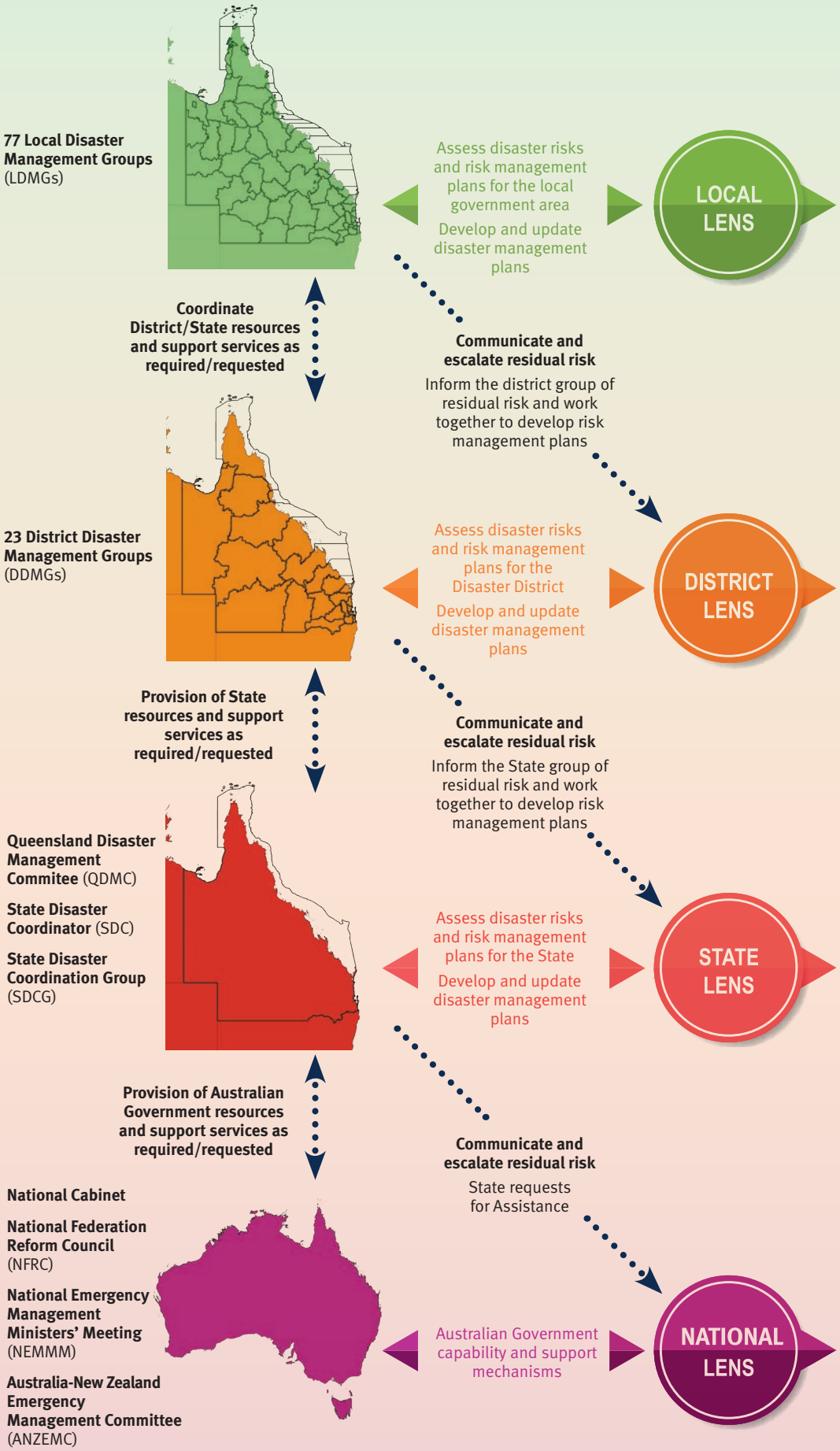
Projections

In the report, disaster risk and climate risk are treated equivalently, instead of climate change being treated as a driver of increased disaster risk. Climate change refers to any significant change in climate variables lasting for several decades or longer (such as temperature, rainfall or wind patterns). It is different from weather, which is short-term and variable. Climate change is attributed to several natural and human-induced factors.[14–16]

Climate modelling work indicates that climate change is likely to have transformative impacts across Queensland's disaster management arrangements, with impacts relevant across varied industries, demographics and ecosystems. The Queensland climate is highly variable and climate change is already impacting the economy, environment, and society. Average temperatures across the State are 1.4°C higher than they were 100 years ago,[17] with shifts beyond natural variability resulting in exposure to increased disaster risks.

The Queensland high-resolution climate projection data have been modelled using both Representative Concentration Pathway 4.5 and Representative Concentration Pathway 8.5 as these are considered realistic upper and lower emissions trajectories that are useful for estimating future climate risks. It has been found that the trend in global emissions has followed Representative Concentration Pathway 8.5 most closely for the past decade, and this appears to be the most likely scenario until 2050, even with recent efforts at mitigation.[18]

The report finds that long-term changes in Queensland's climate will change the number and severity of hazard events towards the end of the century. These projections are important for disaster risk management both in coming years, but also for disaster risk reduction today. Some significant impacts for each of the regions in the report are summarised in Table 2.



DISASTER MANAGEMENT ACT 2003

4A Guiding principles

Local governments are primarily responsible for managing events in their area

29 Establishment

A local government must establish a local group

30 Functions

Functions of local groups includes:

(a) ensure disaster management and operations are consistent with the State

(b) regularly review and assess disaster management

(d) identify services required and provide advice to the district group

(g) provide reports and recommendations to the district group

DISASTER MANAGEMENT ACT 2003

4A Guiding principles

District groups and the State group should provide local governments with appropriate resources and support to help them carry out disaster operations

23 Functions

Functions of a district group includes:

(a) ensure disaster management and operations are consistent with the State

(b) egularly review and assess disaster management

(c) provide reports and recommendations to the State group about disaster management

(d) review and assess (i) disaster management of local groups and (ii) local disaster management plans

DISASTER MANAGEMENT ACT 2003

4A Guiding principles

District groups and the State group should provide local governments with appropriate resources and support to help them carry out disaster operations

18 Functions

Functions of the State group includes:

(a) develop strategic framework for disaster management for the State

(c) establish and maintain arrangements between State and Commonwealth

(e) provide reports and make recommendations about disaster management and disaster operations

(g) coordinate State and Commonwealth assistance

Australian Strategy for Disaster Resilience

National Framework for Disaster Risk Reduction

Australian Disaster Preparedness Framework

Figure 6: Relationship between Queensland's disaster management arrangements and the Queensland Emergency Risk Management Framework (QERMF)

Region	Significant impacts
Cape York	• Significant decrease in summer rainfall for 2020-40 and 2040-60, and in autumn for 2040-60 • Increases in temperatures are below State averages for both periods (2020-40 and 2040-60) • Significantly lower than State average Forest Fire Danger Index (FFDI) through to 2056-66, though rising relative to earlier decades • Some impacts of sea level rise on coastal areas
Central Queensland	• Significantly higher than average autumn rainfall in 2040-60 • Lower than average increases in annual temperatures in 2040-60, and higher than average summer maximum temperature increases in 2020-40
Central West	• Significantly higher than average annual temperature increases in both periods (2020-40 and 2040-60) • Significantly higher number of spring hot days for both periods (2020-40 and 2040-60) • Substantial increase in decadal FFDI towards 2056-66, greatly above the State average
Darling Downs	• Lower than average increase in hot days for both periods (2020-40 and 2040-60) • Significantly lower than average increases in summer and autumn temperature, but significantly higher than average temperature increases in winter and spring • Substantial increase in decadal FFDI towards 2056-66, though still slightly below the State average
Far North Queensland	• Significantly lower summer rainfall for both periods (2020-40 and 2040-60) • Lower maximum, minimum, and mean temperature increases than the State average for both periods (2020-40 and 2040-60) • Significant impacts of sea level rise on coastal areas
Gulf of Carpentaria	• Large increase in hot days than average for both periods (2020-40 and 2040-60) • Significantly higher spring rainfall in 2020-40 and 2040-60 and autumn rainfall in 2040-60 • Significantly higher than average spring temperature increases in 2020-40, and significantly lower than average increases in spring and summer temperatures in 2040-60 • Substantial increase in decadal FFDI towards 2056-66, greatly above the State average
Mackay, Isaac and Whitsunday	• Larger decrease than average in spring rainfall for 2040-60 • Lower than average spring and autumn temperature increase for both periods (2020-40 and 2040-60) • Significant impacts of sea level rise on coastal areas
Maranoa-Balonne	• Significantly lower than average autumn and summer temperature increase in 2020-40 • Significantly higher than average winter and spring temperature increases in both periods (2020-40 and 2040-60) • Substantial increase in decadal FFDI towards 2056-66, though still not greatly above the State average
North Queensland	• Highly significant increase in summer and autumn maximum temperatures in 2040-60 • Lower than average increase in winter and spring temperatures for both periods (2020-40 and 2040-60)
North West	• Significantly higher than average increases in average summer and autumn temperatures in 2040-60 • Significant increase in spring rainfall for both periods (2020-40 and 2040-60), and for summer and autumn in 2040-60
South East	• Significant increase in number of hot days for all seasons for both periods (2020-40 and 2040-60) • Lower than average temperature increases for 2020-40 • Significantly lower spring and autumn rainfall for both periods (2020-40 and 2040-60) but significantly higher summer and winter rainfall for both periods (2020-40 and 2040-60) • Significantly lower than average FFDI through to 2056-66 though rising relative to earlier decades • Significant impacts of sea level rise on coastal areas
South West	• Significantly higher increases for temperatures and hot days for all seasons for both periods (2020-40 and 2040-60) • Lower winter rainfall for both periods (2020-40 and 2040-60) • Significantly higher decadal FFDI than the State average, increasing towards 2056-66
Wide Bay Burnett	• Significantly fewer hot days for all seasons and all periods (2020-40 and 2040-60) • Lower than average temperature increases for 2020-40 • Significantly lower than average FFDI through to 2056-66, though rising relative to earlier decades • Significant impacts of sea level rise on coastal areas

Table 2: Regional overview of projected impacts to Queensland to 2060, assuming RCP8.5.

Responding to a changing climate requires action to reduce the negative impacts of climate change, and to take advantage of emerging opportunities. Climate adaptation involves going above and beyond traditional preparedness for climate variation, natural hazards and disaster events. It requires developing a comprehensive understanding of how a changing climate will affect Queensland, our regions and our communities, and actively working to reduce our exposure to climate risks while capturing new opportunities. Successful adaptation to climate change is a proactive and long-term process.

Hazard prioritisation is an important aspect in climate change-related disaster risk reduction. As climate change alters normal weather patterns, the risk posed by each hazard to a given area will change. This change is unlikely to be significant year-on-year, or across each five-year period, but over the decades and towards the end of this century, the likelihood of a given hazard is likely to substantially change. Sustainable development reduces both the risk posed by disasters and the impacts of climate change. It is important therefore to consider mitigation activities in a broader and future-focused context.

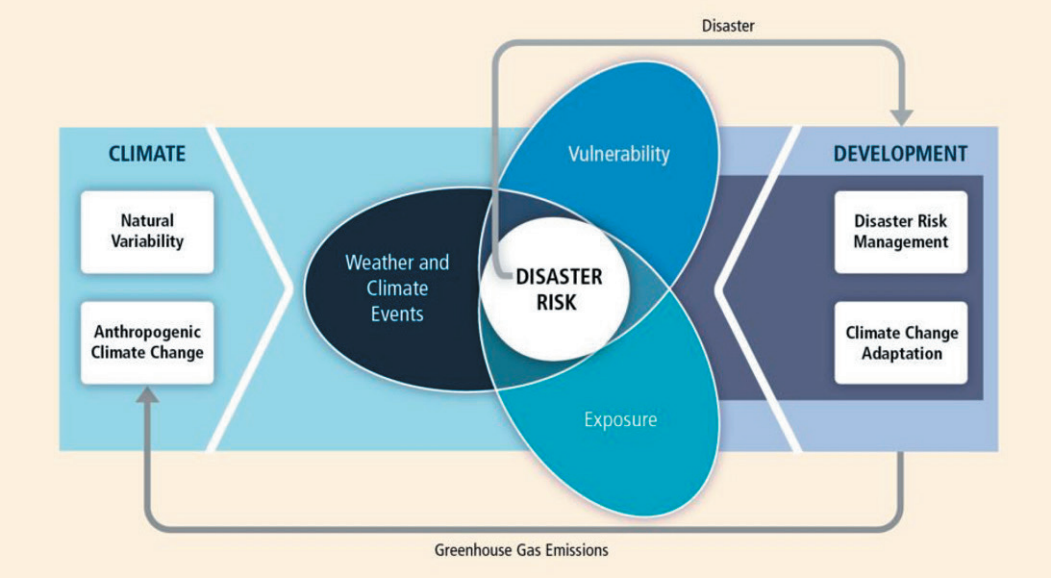


Figure 7: The relation of disaster risk, development, and climate change. Source: IPCC.

Approach

Scope

Section B of the SDRR includes hazard-specific risk assessments and risk analysis. These assessments are intended to support entities with responsibilities for disaster risk management under Queensland's disaster management arrangements. They include a high level of technical detail for each of the hazards and outline potential impacts of the hazards with reference to experiences of historical impacts in Queensland, other states and territories, and overseas.

This report expands on the 2017 State Natural Hazard Risk Assessment and builds on the comprehensive hazard assessments undertaken since, including the 2019 State Heatwave Risk Assessment, 2019 State Earthquake Risk Assessment and the 2021 Severe Wind Hazard Assessment for Queensland.

The scope for these assessments has been expanded to include a broader range of natural and human-induced hazards, along with a range of risk drivers. While prioritisation of these hazards is provided as part of the risk evaluation, all hazards assessed have the potential to result in severe or catastrophic impacts and should be given appropriate consideration.

The hazards assessed within this report are not exhaustive - the updated hazard list to support monitoring and reviewing the implementation of the Sendai Framework for Disaster Risk Reduction identifies 302 hazards in total, although not all are relevant to Queensland.[19] Alignment of assessments in this report with the revised Sendai hazard list is outlined in Figure 8.

Assessment

Each hazard assessment has a consistent format, to maximise its usefulness in preparing risk assessments at the local and district levels. Each assessment has been designed to link to the development of appropriate scenarios and calculation of risk under the QERMF. The structure of each risk assessment, as well as some guidance about how to interpret their contents, is outlined below.

1. Understanding the hazard

This section provides a general overview of the hazard and scope of the assessment, contextualising both the history and projections or future occurrence of the hazard.

The **definition** of the hazard used for the assessment draws on definitions used by other Queensland and Commonwealth government agencies. **Hazard ratings** provide guidance on the scale and severity of hazards to support scenario-based risk assessments. Hazard ratings are provided for the ten hazards (tropical cyclones, riverine flooding, thunderstorm, heatwave, bushfire, earthquake, tsunami, pandemic, biosecurity, and chemical, biological and radiological event) and not the cascading and compounding events (infrastructure failure and mass casualty incident). Cascading and compounding events generally have a broader scope and more varied causes than the other hazards identified here. They arise from systems of interrelated parts, which makes them difficult to assign hazard ratings to reliably.

Where feasible, the **Projections** section in each assessment provides guidance on **probability** for each hazard at the regional planning level. Probabilities are provided on a scale of 1 to 5, as follows:

Variable	5	4	3	2	1
	Almost certain	Frequent	Likely	Infrequent	Rare and Very Rare
Annual Exceedance Probability (AEP)	63% per year or more	20% to <63% per year	5% to <20% per year	0.5% to >5% per year	Less than 0.5% per year
Average Recurrence Interval (ARI)	1 year	4.5 years to 1 year	20 to 4.5 years	200 to 20 years	More than 200 years
Description	Could happen at least once a year	Could happen several times per decade	Could happen about once a decade	Could happen one or more times within my lifetime, or within the lifetime of my home	Could happen in my lifetime, or in the lifetime of my children or grandchildren

Table 3: Probability variables used within the assessments.

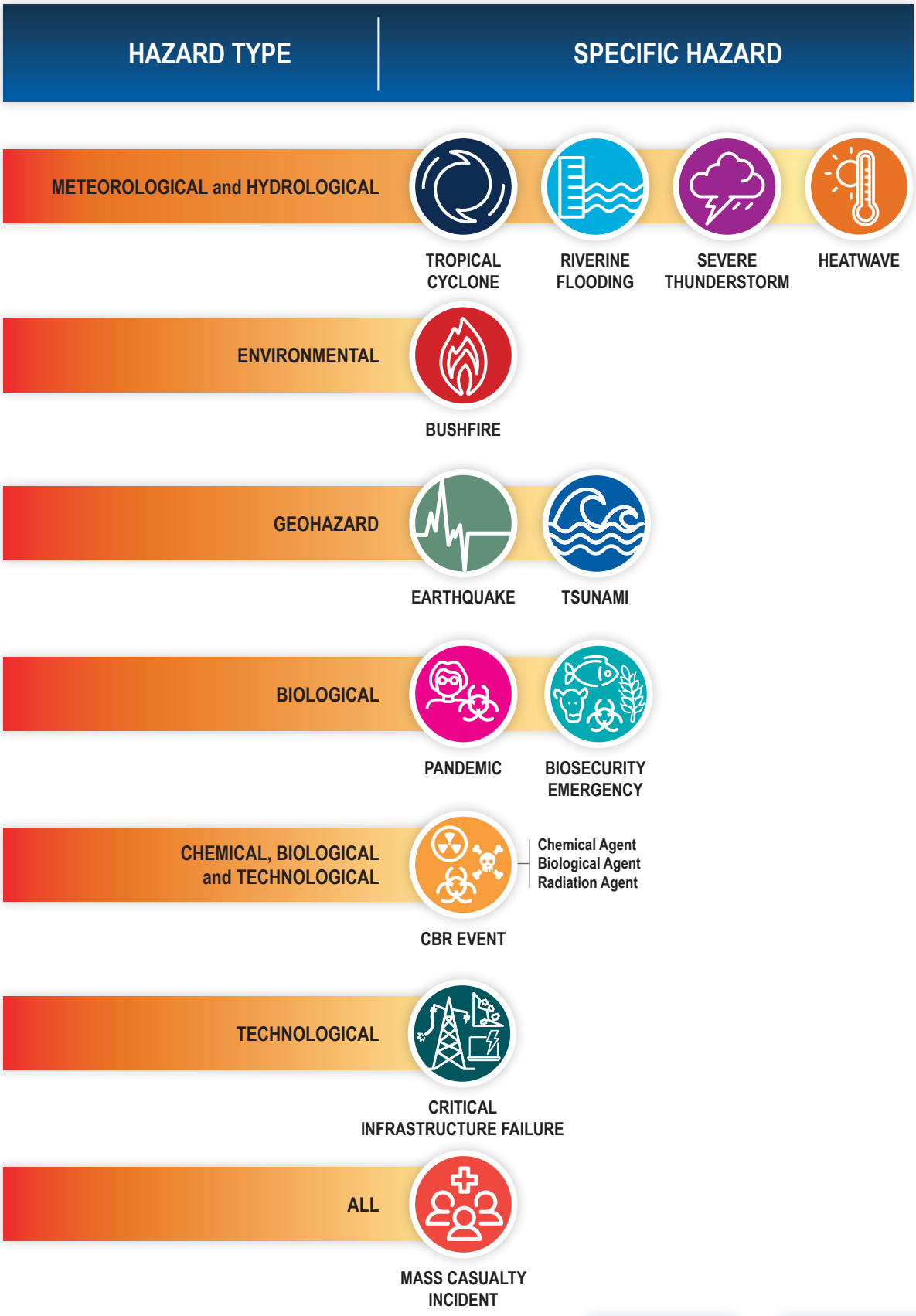


Figure 8: Twelve hazard assessments are included in the scope of the report. Source QFES.

There are a range of ways to express probability. Table 4 provides additional guidance on how to consider the likelihood of an event over a range of time frames. This can help to communicate the risk and potential danger to the community and relevant decision makers, helping them make informed and long-term decisions about risk.

Chance of an event of a given intensity being exceeding in any one year	Probability of experiencing an event in timeframe		
	30 years (mortgage)	70 years (lifetime)	100 years (infrastructure)
10% (1 in 10 odds)	95.76%	99.93%	99.99%
5% (1 in 20 odds)	78.53%	97.24%	99.40%
2% (1 in 50 odds)	45.45%	75.68%	86.73%
1% (1 in 100 odds)	26.03%	50.51%	63.39%
0.5% (1 in 200 odds)	13.96%	29.59%	39.42%

Table 4: Guidance on how to understand and communicate probabilities across different timeframes. Adapted from: Queensland Chief Scientist.[20]

We do not provide probability variables for all hazards, due to inherent difficulties in calculating probabilities for some hazards.

2. Management of the hazard

This section provides an overview of key hazard management functions and entities. Potential Triggers for the activation of response arrangements are identified where practical for each hazard. Identifying these triggers, and linking these to relevant preparation and response activities within disaster management plans can help to ensure timely activation of support and resources across all levels of Queensland's disaster management arrangements, as outlined in the Queensland Disaster Management Guideline.

Considerations for disaster management groups

These breakout boxes are provided to prompt discussion within disaster management groups and to help identify considerations for appropriate risk-based planning.

3. Scenario

Each risk assessment contains example **scenarios** that can be tailored for use in hazard assessments at the local and district levels. These scenarios can also provide a basis for an exercise to validate the assessment of risk and local capability. They have been produced in consultation with subject matter experts.

4. Impacts

Each risk assessment contains an overview of potential **impacts** for each hazard across a range of exposed elements. Impact descriptions are clustered into the following categories, representing aspects of the built, social, economic and natural environments:

- Essential infrastructure
- Transport
- Community
- Health and wellbeing
- Business and economy
- Natural environment.

These are high-level and reflect the experience of disaster management groups, the guidance of subject matter experts, and findings of academic research. They are designed to act as a prompt for assessing local and district level exposure and vulnerability. Impacts can also be spatially mapped for communities across Queensland to provide a more explicit overview of hazard exposure and vulnerability.

5. Supporting information

Additional information and links are provided for each hazard. This includes the relevant state and Commonwealth plans and procedures for each hazard, as well as technical guidance.

6. Risk summary

A **summary** of the risks associated with the hazard, including:

- impact, likelihood and forward projections of the risk
- mitigating factors
- potential impacts across the areas of essential infrastructure, transport, community, health, economy and the natural environment.

The technical methodologies that were used as part of the risk assessments and risk analysis are detailed in Section D of the report.

Figure 9: Representation of disaster impacts. Source: QFES.

Findings

Hazard prioritisation

The risk assessments provided in the report are used as a basis for analysing the risks, and in particular in identifying how salient certain hazards are for Queensland. Those hazards first assessed in the 2017 State Natural Hazard Risk Assessment have shifted subsequently in their prioritisation. During the subsequent four years, new hazards have also emerged.

The prioritisation resulted from a mixed methods approach that used quantitative and qualitative understandings of disaster risk across the State to rank them in their importance to each of the Queensland planning regions, and then to the State as a whole.

It was appropriate to use both qualitative and quantitative analysis in risk prioritisation for two reasons:

1. Successful disaster risk management relies on both a technical understanding of hazards and practice-based knowledge that arises from past experience and shared learnings. It is not sufficient to rely on either of these kinds of knowledge, but it is instead vitally important that both kinds of knowledge are used. Hazard prioritisation, then, should use both kinds of knowledge.
2. Data was available for some hazards and not others. This is particularly problematic, with common hazards such as severe thunderstorm not having reliable quantitative data to inform hazard prioritisation.

The resulting method had a two-staged approach. Hazard prioritisation per planning regions were derived, and then were aggregated to the State level. This means that the State priorities are based on local priorities, reflecting local leadership in Queensland's disaster management arrangements.

It is important to note that, while these priorities represent relative importance of hazards for each region, the prioritisations do not imply that any hazard is unimportant. The hazards detailed in the SDRR are all extremely important to disaster risk management in Queensland, representing the most salient hazards to the Queensland context. More broadly, in 2020, the United Nations Office for Disaster Risk Reduction has compiled a globally representative list of potential hazards that contains 302 hazards, while we focus in this report on ten.[19] So, even hazards that are relatively low in this prioritisation are extremely important to the Queensland context, and the risks that they pose should be assessed and managed.

Regional hazard prioritisation

The following tables provide the rankings per hazard for each of the planning regions.

Regional ranking	Hazard									
	Tropical cyclone	Riverine Flooding	Severe thunderstorm	Bushfire	Heatwave	Earthquake	Tsunami	Pandemic	Biosecurity	Chemical, biological, radiological
Cape York	1	3	6	2	4	9	8	7	5	10
Central Queensland	4	1	3	2	5	8	10	7	6	9
Central West	9	1	5	2	3	8	10	7	6	4
Darling Downs	9	1	3	2	4	8	10	5	6	7
Far North Queensland	1	2	3	4	7	10	9	5	6	8
Gulf of Carpentaria	1	2	4	3	6	9	10	8	7	5
Mackay, Isaac and Whitsunday	1	3	4	2	5	8	10	6	7	9
Maranoa-Balonne	8	1	3	2	4	7	10	5	6	9
North Queensland	1	2	4	3	5	10	9	7	6	8
North West	5	2	3	1	4	8	10	7	6	9
South East	6	1	2	3	4	9	10	5	7	8
South West	8	1	3	2	4	9	10	6	5	7
Wide Bay Burnett	6	1	2	3	4	9	10	5	7	8

Table 5: Prioritisation of hazard according to Queensland's planning regions.

From these region-level prioritisations, the following LGA-level risk prioritisations have been derived for use in local disaster manage planning.

LGA name	Hazard									
	Tropical cyclone	Riverine Flooding	Severe thunderstorm	Bushfire	Heatwave	Earthquake	Tsunami	Pandemic	Biosecurity	Chemical, biological, radiological
Aurukun	1	3	6	2	4	8	7	9	5	10
Balonne	9	1	3	2	4	8	10	5	7	6
Banana	4	1	3	2	5	7	10	9	6	8
Barcaldine	8	1	5	2	3	7	10	9	6	4
Barcoo	8	1	5	2	3	7	10	9	6	4
Blackall Tambo	8	1	5	2	3	7	10	9	6	4
Boulia	8	2	5	1	3	7	10	9	6	4
Brisbane	6	1	2	3	4	8	10	5	9	7
Bundaberg	4	1	2	3	5	8	10	6	9	7
Burdekin	1	3	4	2	5	10	8	9	6	7
Burke	1	3	4	2	6	7	9	10	8	5
Cairns	1	2	3	4	6	10	9	5	7	8
Carpentaria	1	3	4	2	6	7	9	10	8	5
Cassowary Coast	1	2	3	4	6	10	9	5	7	8
Central Highlands	4	1	3	2	5	7	10	9	6	8
Charters Towers	1	2	4	3	5	9	10	8	6	7
Cherbourg	6	1	2	3	4	8	10	5	9	7
Cloncurry	5	2	3	1	4	7	10	9	6	8
Cook	1	3	6	2	4	8	7	9	5	10
Croydon	1	2	4	3	6	7	10	9	8	5
Diamantina	8	2	5	1	3	7	10	9	6	4
Doomadgee	1	3	4	2	6	7	9	10	8	5
Douglas	1	2	3	4	6	10	9	5	7	8
Etheridge	1	2	4	3	6	7	10	9	8	5
Flinders	5	2	3	1	4	7	10	9	6	8
Fraser Coast	4	1	2	3	5	8	10	6	9	7
Gladstone	4	1	2	3	5	7	10	9	6	8
Gold Coast	6	1	2	3	4	8	10	5	9	7
Goondiwindi	9	1	2	3	4	8	10	5	7	6
Gympie	6	1	2	3	4	8	10	5	9	7
Hinchinbrook	1	2	4	3	5	10	8	9	6	7
Hope Vale	1	2	6	3	4	8	7	9	5	10
Ipswich	6	1	2	3	4	8	10	5	9	7
Isaac	1	3	4	2	5	7	10	6	9	8
Kowanyama	1	3	4	2	6	7	9	10	8	5
Livingstone	3	1	4	2	5	7	10	9	6	8

LGA name	Hazard									
	Tropical cyclone	Riverine Flooding	Severe thunderstorm	Bushfire	Heatwave	Earthquake	Tsunami	Pandemic	Biosecurity	Chemical, biological, radiological
Lockhart River	1	2	6	3	4	8	7	9	5	10
Lockyer Valley	6	1	2	3	4	8	10	5	9	7
Logan	6	1	2	3	4	8	10	5	9	7
Longreach	8	1	5	2	3	7	10	9	6	4
Mackay	1	3	4	2	5	7	10	6	9	8
Mapoon	1	3	6	2	4	8	7	9	5	10
Maranoa	9	1	3	2	4	8	10	5	7	6
Mareeba	1	2	3	4	6	9	10	5	7	8
McKinlay	5	2	3	1	4	7	10	9	6	8
Moreton Bay	6	1	2	3	4	8	10	5	9	7
Mornington	1	3	4	2	6	7	9	10	8	5
Mount Isa	5	2	3	1	4	7	10	9	6	8
Murweh	8	1	3	2	4	9	10	7	5	6
Napranum	1	3	6	2	4	8	7	9	5	10
Noosa	6	1	2	3	4	8	10	5	9	7
North Burnett	6	1	2	3	4	8	10	5	9	7
Northern Peninsula	1	3	6	2	4	8	7	9	5	10
Palm Island	1	2	5	3	4	10	8	9	6	7
Paroo	8	1	3	2	4	9	10	7	5	6
Pormpuraaw	1	3	6	2	4	8	7	9	5	10
Quilpie	8	1	3	2	4	9	10	7	5	6
Redland	6	1	2	3	4	8	10	5	9	7
Richmond	5	2	3	1	4	7	10	9	6	8
Rockhampton	4	1	2	3	5	7	10	9	6	8
Scenic Rim	6	1	2	3	4	8	10	5	9	7
Somerset	6	1	2	3	4	8	10	5	9	7
South Burnett	6	1	2	3	4	8	10	5	9	7
Southern Downs	9	1	2	3	4	8	10	5	7	6
Sunshine Coast	6	1	2	3	4	8	10	5	9	7
Tablelands	1	2	3	4	6	9	10	5	7	8
Toowoomba	9	1	2	3	4	8	10	5	7	6
Torres	1	2	6	3	4	8	7	9	5	10
Torres Strait Island	1	2	6	3	4	8	7	9	5	10
Townsville	1	2	4	3	5	10	8	9	6	7
Weipa	1	3	6	2	4	8	7	9	5	10
Western Downs	9	1	3	2	4	8	10	5	7	6
Whitsunday	1	3	4	2	5	7	10	6	9	8
Winton	8	1	5	2	3	7	10	9	6	4
Woorabinda	4	1	3	2	5	7	10	9	6	8
Wujal Wujal	1	2	3	4	6	9	10	5	7	8
Yarrabah	1	2	3	4	6	10	9	5	7	8

Table 6: Local Government Area hazard prioritisations.

State hazard prioritisation

These local priorities aggregate up to the following State-level ranks:

Hazard	Overall Rank (State)	Previous ranking (2017)
Riverine flooding	1	= 1
Tropical cyclone	2	= 1
Bushfire	3	4
Severe thunderstorm	4	2
Heatwave	5	= 3
Pandemic	6	n/a
Biosecurity	7	n/a
Chemical, biological, radiological	8	n/a
Earthquake	9	5
Tsunami	10	n/a

Table 7: State-level prioritisation of hazards in this report and the 2017 State Natural Hazard Risk Assessment.

Overall risk

Risk manifests itself differently in different areas across the State. Some areas have greater exposure to hazards, while others have communities that are vulnerable to acute and longer-term impacts of hazards. The SDRR provides some guidance on how exposure, vulnerability, and overall probability (disaster risk proneness) differ across the State.

These findings are expressed as scores, to allow for comparison across the State. The method for calculating these scores is based on two analytic products developed by QFES: the Risk Exposure Index and the Risk Vulnerability Index. These products allow for an analysis of the geographic distribution of exposure and vulnerability by using spatial data of physical assets, and regional economics and demographics. The inclusion of probability – based on the probability information provided in the risk assessments in this report – allows for an overall risk score to be provided for each of the planning regions.

Technical details of this approach are presented in Section D of the main report.

Region	Overall exposure	Vulnerability			Probability	Risk
		Social	Economic	Overall		
Cape York	1	1	5	3	1.83	2
Central Queensland	3	4	3	4	1.66	3
Central West	3	3	4	4	1.83	3
Darling Downs	4	4	4	4	1.83	3
Far North Queensland	1	3	3	4	1.99	2
Gulf of Carpentaria	1	2	1	1	1.66	1
Mackay, Isaac and Whitsunday	3	1	3	2	1.66	2
Maranoa-Balonne	5	5	3	5	1.83	4
North Queensland	2	5	4	5	1.83	3
North West	2	2	4	3	1.66	2
South East	3	1	3	3	1.66	2
South West	4	4	5	5	1.67	3
Wide Bay Burnett	2	3	5	4	1.66	2

Table 8: Overall risk score for each planning region.

Summary

Riverine flooding

The 2021/22 State Disaster Risk Report has identified managing the risks associated with riverine flooding as the highest priority for Queensland, particularly over the coming decade. Climate projections present a varied picture for the State for flood risk. However, given the proximity of population centres to rivers or creeks, riverine flooding poses a serious risk to Queensland. The river basins and catchments of Queensland cover very large geographic areas and pose many challenges with regards to logistics, access/resupply and evacuation if required.

Significant work has been and continues to be undertaken in the identification and management of flood risk by both the Queensland and Federal Government. Previous risk assessments have nominated riverine flooding as the most destructive natural hazard in Queensland with very significant disruption to business and damage to property and the environment, such as the recorded impacts during the flooding events of 2010/11 and 2022.

Tropical cyclone

This report has identified managing the risks associated with tropical cyclone as Queensland's second highest priority. This is a relative reduction from equal first in the 2017 State Natural Hazard Risk Assessment, due to a reduction in the frequency of tropical cyclone events. While tropical cyclone is the most disruptive and damaging natural hazard within Queensland with the potential to pose the most risk to life due to limitations to disaster operations during impact. Further, after heatwaves, tropical cyclones have claimed the most lives in Queensland, although not in recent years.

While Queensland is very well placed with regard to mitigation efforts, including the capability to prepare for, respond to and recover from tropical cyclones, the reasonably rapid onset and destructive nature of tropical cyclones – over broad scale geography involving numerous local government areas and multiple disaster districts – can render the management of disaster operations challenging. This is particularly the case with large severe tropical cyclones such as Tropical Cyclone Yasi in 2011 and Tropical Cyclone Debbie in 2017. Little can be done to mitigate tropical cyclone hazard, meaning that efforts to prevent and reduce exposure and vulnerability to the hazard become more important. The impacts to Queensland's and indeed the national economy can be very significant, with long term recovery efforts required.

Bushfire

Bushfire is a frequently occurring event in Queensland however is generally very well managed and often occurs in less densely populated areas. While this can reduce the risk to life there is still the potential for a range of significant economic impacts to Queensland agriculture, industry and tourism. Bushfire Prone Area mapping is used within land use planning and mitigation operations along with predictive analytics and fire weather forecasts to proactively manage this hazard before risks manifest. **This report identifies managing bushfire risk as Queensland's third priority.** This is an increase from the 2017 State Natural Hazard Risk Assessment, which assessed bushfire as the fourth priority. This is due to a projected overall increase in fire weather conditions throughout the State.

Severe thunderstorm event

Severe thunderstorm events have historically been one of Queensland's most damaging natural hazards. When conditions are conducive to severe weather events, rapid onset can pose risk to life such as the creation of hazardous road conditions. Further, significant economic impacts have been recorded by severe weather events destroying agriculture and or damaging built up areas. Like tropical cyclone risk, efforts to reduce exposure and vulnerability will be more effective than mitigating the hazard. **This report identifies managing the risks associated with severe thunderstorm events as the fourth highest priority for Queensland.**

Heatwave

Heatwaves, arguably due to their less violent, slower onset and less publicised nature, have only more recently begun to be recognised at a true level of risk. Heatwaves can lead to a broad range of potential health effects impacting mortality rates for vulnerable persons as well as potential impacts on essential services. Heatwaves are also one contributing factor, from a multi-hazard perspective, in the increased hazard of bushfire. **This report identifies managing the risks associated with heatwaves as the fifth highest priority for Queensland.**

Pandemic

Until the emergence of the COVID-19 pandemic, epidemic and pandemic diseases were not viewed as a high priority across Queensland. The severe impacts of COVID-19, which extends beyond the immediate human health impacts, have illustrated that pandemic preparedness is an important aspect of disaster risk reduction in Queensland. At the time of publication, COVID-19 is an ongoing health emergency, and continues to have significant impacts on the Queensland economy – especially the tourism and tertiary education industries. With greater global interconnectedness, and the importance of globally connected industries to Queensland's economy, future pandemics will pose a significant risk for Queensland, and lessons from the present pandemic will help to ensure that Queensland is prepared. **Managing the risks associated with pandemics and epidemics is Queensland's sixth priority.**

Biosecurity emergency

Infectious plant or animal disease can have significant economic impacts, especially for parts of the State that have important and potentially susceptible industries like agriculture, horticulture and aquaculture. Like pandemics, the risk of biosecurity incursions increases as Queensland becomes more connected to global markets, which sees greater movement of products and people. **Managing the risks associated with infectious plant or animal diseases is Queensland's seventh priority.**

CBR incident

Chemical, biological and radiological events can have potentially catastrophic consequences, but the risk in general of these events is uniformly low across Queensland. Strong regulations and obligations of companies to manage their own risk with respect to materials that can lead to CBR events mean that the risk of an event is not considered overly significant. However, given that CBR materials are found throughout the State – particularly hazardous materials in urban areas – this poses a greater risk than rare natural hazards. Therefore, **managing the risks associated with CBR incidents is Queensland's eighth priority.**

Earthquake

Earthquakes are a commonly occurring phenomenon in Queensland with some geographic areas registering the strongest events to occur on the eastern seaboard in the past 150 years, most notably the Great Queensland Quake of 1918 near Gladstone at a magnitude of 6.05. However, the magnitude of most events is often less than 3.5 with the effects seldom felt. While not relevant to all of Queensland, some areas regularly experience onshore and near shore earthquakes with a magnitude greater than 5. An earthquake of this magnitude occurring within the vicinity of a built environment is likely to cause significant damage to structures, underground services and piping, with potential risk to life due to the collapse of structures. The accurate assessment of earthquake susceptibility is a highly specialised discipline with this assessment team referring areas with potential susceptibility to Geoscience Australia. **Managing the risks associated with earthquakes is Queensland's ninth priority.**

Tsunami

Due to the low likelihood of tsunamigenic earthquakes around the Solomon Islands and New Zealand, the likelihood of a tsunami impacting Queensland is correspondingly low. However, because the coast is more densely populated than the State's interior – thereby exposing some larger population centres to risks posed by tsunami – the consequences of impact would be significant. There remains substantial uncertainty regarding submarine landslide tsunami potential in Queensland, with recent studies demonstrating a number of potential areas of concern in South East Queensland. **Managing the risks associated with tsunami is Queensland's tenth priority.**

Next steps

The findings of the SDRR have relevance for the everyday business of everyone engaged in disaster risk reduction within Queensland's disaster management arrangements. Queensland Fire and Emergency Services will continue work with disaster management groups, State entities and non-government stakeholders to help put the findings of the report into practice. This includes using the information within to assess capability requirements, and to inform the revision of disaster management plans.

The report has been developed in a way that allows for iterative updates that can include future refinement of the data products used in this report, and can incorporate lessons learned from disaster management experiences in coming years. Further, it is expected that the technical methodologies that have been developed for the report will be subjected to peer review, enabling the continuous refinement of the approach and the products that support disaster risk reduction.

The effects of climate change on natural hazard activity is a prominent area of climate research given the consequences of these events and is advancing rapidly. Future generations of global circulation models and regional climate models will help to refine our understanding of the projected changes of natural hazard frequency, severity and intensity, and therefore the likelihood of extreme disaster events across Queensland.

The report has benefited from a large amount of combined experience of disaster management stakeholders across Queensland, and it is intended that this engagement be continued into the future.

If further research, analysis, assessment or advice is required after reviewing the State Disaster Risk Report to understand natural hazard risk for a particular area, a collaborative approach with the stakeholders listed below is recommended to ensure consistency in evaluating hazards in line with state and national frameworks.

Key agencies:

- Queensland Fire and Emergency Services
- Department of Environment and Science
- Australian Climate Service

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